NATIONAL CONFERENCE ON EDUCATION AND NEW LEARNING TECHNOLOGIES 2025 (NCENT2025)



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NCENT 2025

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Welcoming Address by Chief Executive Officer

Assalamualaikum Warahmatullahi Wabarakatuh ,
Proceedings of the National Conference on Education and New Learning Technologies (NCENT2025)

It is with great pride and appreciation that I extend my warmest congratulations on the successful publication of the proceedings of the National Conference on Education and New Learning Technologies (NCENT2025), hosted by Kolej Poly-Tech MARA Ipoh.

NCENT2025 was conceived as a platform to bring together scholars, researchers, and practitioners to exchange insights and innovations that respond to the conference theme: “Challenges and Innovations in the 4th Industrial Revolution (4IR) Era: Strive Towards Educational Excellence.” In alignment with this vision, the papers published in this volume represent a diverse array of research findings, practical applications, and theoretical discussions across multiple educational sub-themes.

These proceedings reflect not only the intellectual rigour of the contributors but also the dedication of our academic community in advancing knowledge and practice in education and learning technologies. Each paper included has undergone a review process to ensure relevance, academic value, and alignment with the goals of the conference. While the scope of publication remains within the proceedings format and not a peer-reviewed journal, the standards maintained are still commendable and appropriate for scholarly referencing.

I wish to take this opportunity to express my heartfelt appreciation to all presenters, paper contributors, reviewers, editors, and organizing committee members who have worked diligently to make this publication possible. Special thanks also go to our participants and partners who have shown unwavering support for NCENT2025.

May this proceeding serve not only as a documentation of ideas presented but also as a catalyst for further dialogue, research, and collaboration in pursuit of educational excellence in the digital era.
Thank you and congratulations once again.



Warm Regards

EN. RADZUAN BIN RAZALI (HAJI)

Welcoming Address by Director Of Kolej Poly-Tech MARA Ipoh

ٱلسَّلَامُ عَلَيْكُمْ وَرَحْمَةُ ٱللَّهِ وَبَرَكَاتُهُ

It is with great honour and heartfelt appreciation that I welcome you to the official proceedings of the National Conference on Education and New Learning Technologies (NCENT2025), proudly organised by Kolej Poly-Tech MARA (KPTM) Ipoh. This event was successfully held on 17 th July 2025 at our very own campus in Ipoh, Perak.

Guided by the main theme, “Challenges and Innovations in the 4th Industrial Revolution (4IR) Era: Strive Towards Educational Excellence,” this conference aimed to create a meaningful platform for educators, researchers, and practitioners to exchange insights and discuss transformative strategies in education, particularly in response to the evolving demands of the 4IR era.

We are immensely proud to have received 118 research papers from highly committed scholars and academics representing various public and private institutions of higher learning (IPTA and IPTS) across Malaysia. Each submission underwent a thorough screening and review process to ensure that only high-quality, relevant, and impactful papers were selected for presentation and publication. Our deepest gratitude goes to our dedicated team of reviewers, many of whom are experienced academicians from different universities, who diligently assessed each paper with utmost professionalism and care.

We also wish to express our appreciation to all participants, especially those who attended not as presenters but as enthusiastic learners and supporters of academic excellence. Your presence contributed significantly to the vibrant exchange of knowledge that took place throughout the event.
On behalf of the organising committee, I would also like to convey our sincere thanks to all sponsors, partners, and contributors who made this conference and the publication of this proceeding possible.

May this proceedings volume serve as a valuable academic resource, inspiring continued dialogue, research, and innovation in the field of education and learning technologies.
We hope it will be widely referred to by educators, students, and policymakers in Malaysia and beyond.
Thank you and congratulations once again to everyone involved.



Warmest regards,
PN. ANISA BT MOHD YUSOFF

Welcoming Address Of Organization Committee

ٱلسَّلَامُ عَلَيْكُمْ وَرَحْمَةُ ٱللَّهِ وَبَرَكَاتُهُ

It gives me great pleasure to pen this message for the official proceedings of the National Conference on Education and New Learning Technologies (NCENT2025), hosted by Kolej Poly-Tech MARA Ipoh on 17th July 2025. Themed “Challenges and Innovations in the 4th Industrial Revolution (4IR) Era: Strive Towards Educational Excellence,” this conference successfully brought together passionate educators, committed researchers, and forward-thinking practitioners from all corners of Malaysia.

This proceeding serves as more than just a record of the conference; it is a living repository of knowledge, capturing a wealth of scholarly efforts and innovative ideas that reflect the dynamism of today’s educational landscape. In an era defined by rapid technological changes, such publications play a vital role in bridging research and practice, providing educators with access to current findings, novel methodologies, and practical approaches that can be implemented in their own classrooms and institutions.

A total of 118 papers were submitted and carefully reviewed, resulting in a rich compilation of academic work covering a diverse range of sub-themes from digital learning technologies and curriculum innovation to assessment, language teaching, and student development. The rigorous selection and peer-review process ensured that each paper included in this proceeding contributes meaningfully to the body of educational knowledge.

I am deeply grateful to all the authors, whose dedication and intellectual contributions have shaped the content of this proceeding. My heartfelt thanks also go to the reviewers who devoted their time and expertise to ensuring academic integrity and quality. To the many participants, especially those who joined to listen and learn, thank you for affirming the value of shared knowledge and lifelong learning.

Importantly, this proceeding is not just a documentation of what transpired during the conference it is a platform of ongoing relevance, a resource for future reference, and a catalyst for future research. I strongly encourage fellow academics, students, and educators to make full use of the insights and evidence-based practices shared within these pages, not only to enrich their own teaching and learning, but also to inspire continuous progress in the field of education.

Let us continue to support one another in our academic endeavours, and may this proceeding stand as a testimony of our collective commitment towards educational excellence.

Wabillahi taufik wal hidayah. Wassalamualaikum warahmatullahi wabarakatuh.



With warmest regards,

PN. NOR AZIZAN BT. MOHD DAUD



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CONFERENCES PAPER



National Conference on Education and New Learning Technologies 2025 (NCENT 2025)
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Utilizing Web Technology for Land Development Procedures towards a User-Friendly and Efficient Approach

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ABSTRACT

Land development in Malaysia is a process that involves various procedures that need to be followed to ensure that the planned development is in line with the laws and guidelines set by the local authorities. Lack of knowledge about the process and legal requirements often leads to delays or non-compliance, which can ultimately result in conflict or inappropriate development. The objective of this study is to determine the public's knowledge of land development procedures and to propose a web-based solution for more effective information dissemination. The research adopts a quantitative approach, utilizing a questionnaire as the primary data collection tool. A total of 300 respondents, selected through purposive sampling, participated in the study, comprising residents from the Kota Setar district, Kedah. Relevant literatures were consulted also. The findings reveal that limited access to procedural information and insufficient public involvement contribute to inefficiencies and conflicts in the land development process. Respondents emphasized the importance of stricter compliance with planning procedures and greater community engagement to enhance transparency and efficiency. Additionally, the results indicate that providing clear, accessible information can improve understanding and reduce potential disputes. Based on these findings, the study recommends the development of an interactive website as a practical solution to bridge the information gap. The need for innovative approaches such as proposed website would serve as a centralized platform, offering comprehensive guidelines, and tools to help users navigate the land development process more effectively. Such a platform would not only streamline information delivery but also promote public participation and awareness. In conclusion, transparent and well-organized management of land development can enhance planning quality and ensure environmental sustainability.

KEYWORDS: Land development, public participation, website development, planning procedures, environmental sustainability.

1 INTRODUCTION

Land development is a cornerstone of urban growth, economic development, and environmental sustainability. In Malaysia, the procedures governing land development are multifaceted, involving zoning, permitting, environmental assessments, and community consultations. These processes are regulated by various legal frameworks, including the Town and Country Planning Act 1976 (Act 172) and the Federal Territory (Planning) Act 1982 (Act 267).

Despite the significance of these procedures, public awareness remains limited. A study in the Petaling district revealed that local community familiarity with land conversion processes stood at only 40%,

underscoring a substantial knowledge gap. This lack of understanding can lead to public confusion, resistance to development projects, and missed opportunities for civic engagement.

With the advent of digital technologies, there is an opportunity to bridge this gap. The e-Tanah system, an electronic land administration platform, has been instrumental in enhancing service delivery efficiency in land administration. Expanding such digital platforms can facilitate better public access to information and foster greater transparency in land development procedures.

This study aims to assess the current level of public knowledge regarding land development procedures and propose a web-based solution to enhance information dissemination and public engagement. The complexity of land development procedures, coupled with insufficient public awareness, poses significant challenges to effective urban planning and community participation. While public participation is a statutory requirement under the Town and Country Planning Act 1976, the actual engagement often falls short due to limited public understanding of the processes involved.

Traditional methods of information dissemination, such as physical notices and public hearings, have proven inadequate in reaching a broad audience. The COVID-19 pandemic further highlighted the limitations of these conventional approaches, emphasizing the need for digital solutions that can provide timely and accessible information to the public.

Without a more effective means of communication, public trust in land development processes may erode, leading to increased resistance and delays in project implementation. Therefore, there is an urgent need to develop and implement a web-based platform that can provide clear, accessible, and timely information on land development procedures to the public.

2 LITERATURE REVIEW

This study based on several relevant major theories. First, the Technology Acceptance Model (TAM) is used to support the assessment tools variable. TAM explain how users come to accept and use technology and it is influenced by two main factors, namely perceived usefulness and perceived ease of use. Land development is inherently complex, involving multiple stakeholders, intersecting legal and regulatory frameworks, and a range of environmental, social, and economic considerations (Enemark, 2005; Williamson et al., 2010). This literature review will include previous studies and related theories to provide a comprehensive picture of the processes and challenges in land development.

2.1 Malaysia Development plan

The statutory development plans required under the Act are national physical plan, state structure plan, local plan and special area plan. Refer to Ahmad Sarkawi (2006), the administration of this Act is carried out at three different governmental levels which are the Federal, the State and the Local Government. Thus Abdullah et.al., (2010) Planning authorities are established at each level of the government to undertake planning of different scale and function.

The One Stop Centre (OSC), established in 2007 by the Ministry of Housing and Local Government (KPKT), plays a crucial role in facilitating the implementation of development plans across Malaysia. Its primary function is to streamline the process of planning permission and technical approvals for development proposals submitted to local authorities (KPKT, 2007). The connection between the OSC and the development plan is rooted in the operationalisation of spatial and land use policies outlined in statutory documents such as the *Rancangan Struktur Negeri* (State Structure Plan), *Rancangan Tempatan* (Local Plan), and *Rancangan Kawasan Khas* (Special Area Plan) (Federal Department of Town and Country Planning [JPBD], 2012).

Development plans serve as guiding instruments for land use, infrastructure provision, environmental protection, and socio-economic growth. However, without an efficient administrative mechanism, these plans may remain theoretical. The OSC acts as the administrative gateway through which all development proposals are assessed and approved in accordance with the provisions of these statutory plans. Specifically, Ismail & Said (2015) when a development application is submitted to the OSC, it is evaluated based on its compliance with the existing land use zoning, planning standards, plot ratios, building density, and environmental considerations as stipulated in the development plan. This ensures that all approved developments are aligned with the long-term vision and planning goals of the local authority. The respondents for e-submission at the planning stage under OSC.

Furthermore, Kamaruddin et al., (2020) the respondents for e-submission at the planning stage under OSC Online 3.0 System consisted of the professional people, the owners, and the representatives of the project owners. OSC Online 3.0 System consisted of the professional people, the owners, and the representatives of the project owners.

Local authorities in Malaysia, also known as Pihak Berkuasa Tempatan (PBT), play a crucial role in the administration and management of urban and rural development within their jurisdictions. Among their core responsibilities is the management and approval of planning and building applications, ensuring that all proposed developments comply with existing regulations and zoning requirements (PLANMalaysia, 2020). They are also tasked with the implementation of statutory development plans, including Structure Plans (Rancangan Struktur Negeri) and Local Plans (Rancangan Tempatan), which guide land use and physical development strategies at both the state and local levels (Ministry of Housing and Local Government, 2019).

Furthermore, local authorities operate the One Stop Centre (OSC), a centralized digital system introduced to streamline and coordinate the development approval process by integrating technical feedback from various departments (KPKT, 2021). In addition to regulatory functions, PBTs are responsible for delivering essential public services such as waste management, road maintenance, drainage systems, and the provision of community facilities. Importantly, they also facilitate public participation by involving local communities in planning decisions through public hearings, feedback mechanisms, and engagement programs—an approach that strengthens transparency, accountability, and community empowerment in the planning process (Shamsudin et al., 2018).

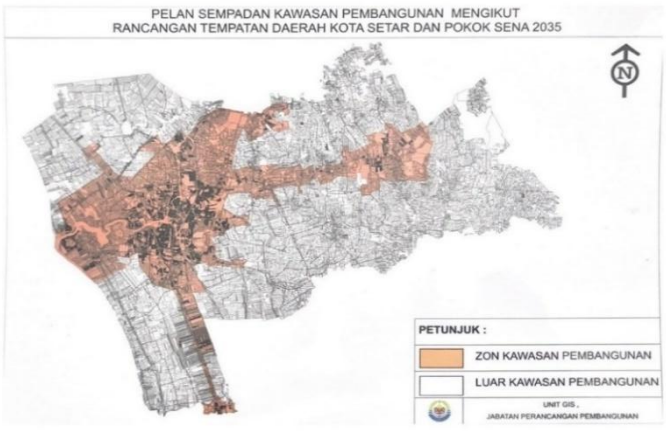


Figure 1 : MBSA administrative boundary

As shown in figure 1, the boundaries of local authority which is Majlis Bandaraya Alor Setar (MBAS) areas within the Kota Setar district. Within MBAS's planning jurisdiction, issues such as land use change, infrastructure upgrading, and public participation in development projects are actively managed through the OSC system.

2.2 Public knowledge and awareness towards planning development

In Malaysia, the promotion of awareness regarding planning and development initiatives is facilitated through a combination of government policies, public participation mechanisms, and educational efforts. The Malaysian government has made notable strides in fostering public engagement within the planning process by encouraging citizen feedback and participation in decision-making, particularly through planning hearings and stakeholder consultations (Ismail & Said, 2015). Educational initiatives, including tertiary-level academic programs in planning and built environment studies, as well as continuous professional development courses, further support the dissemination of planning principles and best practices among both professionals and the general public (JPBD, 2012).

Despite these efforts, several studies have highlighted that awareness and understanding of the One Stop Centre (OSC) Online system remain relatively limited, particularly among individual landowners, small-scale developers, and rural stakeholders (PLANMalaysia, 2021). This digital platform, designed to enhance transparency, efficiency, and accessibility in the development control process, is more commonly utilized by larger firms and urban-based professionals such as architects and town planners, who are better equipped to navigate its technical requirements (Abdullah, 2018). In contrast, many individuals in non-urban contexts are unfamiliar with the system's functions, procedures, and potential benefits.

The existing gap in public awareness may be attributed to several factors, including insufficient outreach and promotion, limited digital literacy among certain demographic groups, and the perceived complexity of the OSC Online interface and application workflow (Salleh & Yusof, 2020). Consequently, many users continue to prefer traditional manual submission methods, which not only prolong processing times but also hinder the effectiveness of Malaysia's broader digital transformation agenda in land use planning and development management.

Karavasilis et al. (2010) in Kamaruddin et al., (2020) elucidated that based on theory of reasoned action, a person's actual system usage is mostly influenced by his or her behavioural intentions towards a usage. In his process is not only technical but also requires active community participation. A lack of community understanding about the procedures, implications, and their rights in the development planning process can lead to conflicts, project delays, and exclusionary development outcomes.

According to Abdul Ghani (2017), effective community participation in urban planning is highly dependent on their level of knowledge concerning legal and procedural aspects used by local authorities. Similarly, Alias and Daud (2020) found that low public awareness often leads to misunderstandings about planned development projects, which can affect project sustainability and public trust.

2.3 Digital Literacy

Digital literacy has emerged as a foundational skill necessary for individuals and communities to participate effectively in the digital economy, governance, and social life. Similarly, Ng (2012) digital literacy is broadly defined as the ability to access, understand, evaluate, create, and communicate using digital technologies. In the context of development planning, enhancing digital literacy is increasingly recognized as a catalyst for inclusive growth, improved public service delivery, and empowerment. Within the community context, digital literacy involves not only individual competencies but also the collective capacity to use digital tools for communication, collaboration, problem-solving, and decision-making (Rheingold, 2012). This collective literacy enables communities to organize, participate in governance, and access development resources.

Recent studies confirm that digital literacy is a key enabler of empowerment at the community level. Digital tools such as mobile apps, online surveys, and participatory GIS systems allow communities to voice their needs and co-create solutions. However, the effectiveness of such tool's hinges on residents' digital literacy (UNDP, 2020).

Digital literacy such as web technology has become an increasingly critical competency in the effective implementation of modern development planning systems. It is playing a crucial role in enhancing transparency, accessibility, and engagement in the development planning process. Also, Salleh & Yusof (2020) planning authorities worldwide integrate digital tools such as Geographic Information Systems (GIS), online application portals, and data management platforms, the capacity of stakeholders to engage with these technologies significantly influences planning outcomes. In the Malaysian context, digital literacy among planners, developers, and the general public is essential to maximize the benefits of digital platforms like the One Stop Centre (OSC) Online system. In addition, Mohamad and Alias (2018) examined the role of e-participation in local government planning and found that web-based platforms enhance transparency and foster a sense of inclusion. They argued that digital platforms allow stakeholders to submit feedback, view updates on development proposals, and track the decision-making process without the need for physical presence.

Integrating digital literacy into national development plans has become a priority for many governments. For example, India's Digital India initiative includes large-scale digital literacy training as a central pillar, recognizing that infrastructure without skills would not yield transformational impact

(Mehrotra, 2017). Similarly, Kenya's Vision 2030 and South Africa's National Development Plan 2030 emphasize digital competence as essential for innovation and youth employment (Government of Kenya, 2013; NPC South Africa, 2012). Web-based tools can demystify complex technical data through interactive maps, 3D visualizations, and simplified guides. These tools also allow real-time feedback, enabling communities to voice concerns or support proposals directly, which increases public trust and accountability in the planning process. In Malaysia, initiatives such as PLAN Malaysia's Geoportal and smart city dashboards illustrate how web technologies are being integrated into planning workflows to promote more inclusive and informed community participation. Web technology plays Through interactive platforms, Geographic Information Systems (GIS), online public consultation portals, and digital dissemination of planning documents, the public can easily access relevant information about proposed developments, planning procedures, zoning regulations, and their rights. The consensus among scholars and international organizations between 2019 and 2025 affirms that digital literacy has become an integral component of inclusive, resilient, and equitable growth strategies.

Furthermore, Chigona et al., (2009), to support effective community development planning, digital literacy must be embedded in a broader framework that includes education, infrastructure, and local governance. Participatory training models where communities co-design their digital learning have been shown to be more sustainable and impactful Collaboration with local NGOs, schools, and telecentres can also expand reach and foster trust.

2.4 Research Model

This study was developed to determine the public's knowledge of land development procedures and to propose a web-based solution for more effective information dissemination As shown in Figure 1, the model outlines a basic structure where **digital literacy** and public **awareness** serve as independent variables, while **public knowledge** functions as the dependent variable.

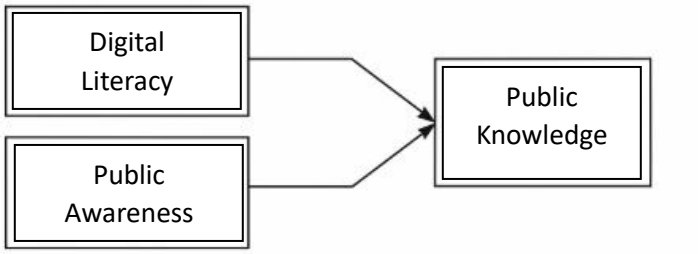


Figure 2: Systematic Diagram of Research Model

This model provides a brief but concise overview of the factors that influence the effectiveness of development planning implementation in Malaysia. Public awareness of the planning process and the functions of the OSC system plays a critical role in encouraging stakeholder participation. In turn, greater stakeholder participation particularly from landowners, developers, and the general public—contributes to improved planning outcomes through enhanced transparency, accountability, and inclusiveness. Moreover, digital literacy indirectly influences planning outcomes by enabling more active and informed stakeholder engagement. Understanding these interrelated factors is essential for enhancing the implementation and impact of planning systems in Malaysia's urban and rural development contexts.

3 METHODOLOGY

This study applied a quantitative method with a cross-sectional design to systematically collect data through questionnaires. Data were gathered at a single point in time, requiring respondents to complete a questionnaire distributed by the researchers. This method is suitable for obtaining factual information related to personal and social beliefs, attitudes, and perceptions, allowing the researchers to capture the real

3.1 Sampling and Data Collection

Kota Setar has a population of 374,051 people. The population for this study was derived from Department of Statistic Malaysia (DOSM). Based on Krejcie and Morgan (1970) sampling table, a sample of 384 respondents are required to be a sample. However, only 342 completed responses were obtained and included in the final analysis. The study utilised a simple random sampling method, where questionnaires were distributed exclusively to the selected participants. Participation was voluntary, and informed consent was obtained prior to survey completion. Data were collected through a structured online questionnaire, based on respondents' access and convenience. The data were analysed using IBM SPSS Statistics version 26 to validate the study's conceptual model.

3.2 Instrument

In this study, data was collected using questionnaires distributed to the respondents involved. All the questions used have been tested and used in previous studies (Saiful Afzan Baru et al., 2014). It consisted of a structured questionnaire using a 5-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. All the data obtained after the collection process, the validity test using Cronbach's alpha method is done first. This aims to ensure that each item to be tested reflects the characteristics to be measured. Additionally, Hair et al. (2010); and (Sekaran (2003) suggested a Cronbach's Alpha value above 0.6 is considered acceptable and indicates good reliability. Therefore, this section describes the measurement process of variables and constructs involved in the research. The independent variable in this research are assessment tools and student awareness and the dependent variables is student engagement. Table 1 presents a summary of the variable used in this study.

Table 1: Reliability Analysis of Variables

Variables	Item	Cronbach Apha
Public Konwledge	8	0.812
Digital Literacy	6	0.782
Public Awareness	5	0.868

For the item analysis of each construct, the respondent's responses fall into three groups. Constructs with a mean score of 1.00 to 2.33 fall into the low level of agreement. Meanwhile, if the mean score is between 2.34 and 3.66, the respondent's level of agreement reaches an average or neutral level. In addition, if the mean score is between 3.67 and 5.00, it is interpreted that the respondent has a high level of agreement. This adapted according to Lindell's (1997) level of inclination. Table 2 presents an interpretation of Mean Score table.

Table 2: Interpretation of Mean Score

Mean Score	Interpretation
1.00 to 2.33	Low/Negative
2.34 to 3.66	Average/Neutral
3.67 to 5.00	High/Positive

4 RESULTS

4.1 Descriptive analysis of demographic information

The research method used in this study is a descriptive survey method. There are 342 of the respondents involved in the study. It shows the percentage for each respondent's details according to the category placed in the questionnaire. All the data that has been collected is analysed and the results are summarized in a table. The demographic profiles are detailed in Table 3.

Table 3: Descriptive Statistics of Respondent Characteristics

Demographic Profile	Frequency	Percentage
Gender		
Male	177	51.8
Female	165	48.2
Race		
Malay	265	77.5
Chinese	50	14.6
Indian	27	7.9
Age		
18 - 25	44	12.9
26 - 33	72	21.1
34 - 41	129	37.7
42 - 49	83	24.3
> 50	14	4.1

4.2 Finding

The analysis for this study is divided into three parts, namely Part I is to identify public knowledge on development plan and local authority. Follow by part Part II is to identify community digital literacy used in planning development and the part III is to identify respondent on public awareness about development plan today. The following are the results of the analysis:

Table 4: Public Knowledge

No.	Item	Mean	Score
1.	Own land and intend to develop the land	2.82	Average/Neutral
2.	The existence of local authorities	3.85	Average/Neutral
3.	The application procedure for land development	2.84	Average/Neutral
4.	Identify documents for the purpose of land development	2.57	Average/Neutral
5.	Term and conditions that must be met for land development	2.46	Average/Neutral
6	Approval process from local authority	2.28	Low/Negative
7	Development plans for community	2.36	Average/Neutral
8.	Find out about the land use zoning status	2.54	Average/Neutral
	Average mean	2.71	Average/Neutral

Based on Table 4.1, the research question is the extent to which respondents understand the term of development plan and how development plans will affect the community. This part also identifies the existence of local authority as an agency managing development plans. Analysis recorded a mean of around 2.71, which is a average or neutral level. This shows a negative response where communities may not be exposed to document related to development plan agenda. This is referring to the extent to which citizens understand the objectives, content, and implications of spatial planning documents such as Structure Plans, Local Plans, and zoning regulations. In Addition, Rahman & Aziz, (2023), the overall effectiveness of development planning in Alor Setar is thus strongly dependent on the local authority's ability to integrate digital governance tools with proactive community outreach and sustained capacity-building efforts.

Table 5: Public Awareness

No.	Item	Mean	Score
1.	Geographical boundaries of my local authority area.	3.96	High/Positive

2.	Development on private land requires approval from the local authority.	2.84	High/Positive
3.	Kebenaran Merancang is important to ensure orderly development.	3.27	Average/Neutral
4.	People in community are not aware of planning permission requirements.	3.72	High/Positive
5.	understand the consequences of not obtaining planning permission.	2.46	Average/Neutral
6	"Planning Permission" (Kebenaran Merancang) must be obtained before building or land conversion.	2.28	Low/Negative
	Average mean	3.08	Average/Neutral

Based on Table 5, the results of the public awareness also at average/Neutral which is recorded 3.08. Lack of public awareness, on the other hand, often results in misunderstanding, resistance to new projects, and underutilization of rights to object or contribute to planning proposals. In many cases, development plans are seen as technical documents accessible only to professionals, leaving ordinary citizens unaware of how these plans affect their environment, mobility, housing, and land use (Shamsuddin et al., 2020). Therefore, increasing public education, improving transparency, and simplifying the communication of planning information are key to empowering communities and enhancing planning legitimacy.

Table 6: Digital Literacy

No.	Item	Mean	Score
1.	Browsing PBT's website for information	2.75	Average/Neutral
2.	Accessing online maps or GIS (e.g., Google Maps, plan.mygeoportal.gov.my)	3.69	Average/Neutral
3.	Reading planning-related information online (e.g., Rancangan Tempatan, RKK)	2.64	Average/Neutral
4.	Access One Stop Center Online	2.32	Low/Negative
5.	Clear with the OSC process	1.87	Low/Negative
	Average mean	2.654	Average/Neutral

Based on Table 6, the results of the digital literacy show average mean at 2.654, which is in average/neutral level. In contrast, many individuals in non-urban contexts are unfamiliar with the system's functions, procedures, and potential benefits. According to the Theory of Reasoned Action, an individual's actual use of a system is strongly influenced by their behavioural intention, which is shaped by their attitude toward the system and the perceived social norms surrounding its use (Fishbein & Ajzen, 1975).

In the context of development planning and digital literacy, public understanding and awareness of digital platform such as planning permission applications, GIS systems, and online public consultation portals play a crucial role in determining whether citizens will engage with these systems. When individuals hold a positive attitude toward the usefulness of these digital tools and perceive that their use is supported or expected by others (e.g., local authorities or community members), their intention to adopt the system is likely to increase. Therefore, enhancing digital literacy not only equips the public with technical skills but also fosters the positive attitudes and social reinforcement necessary for active digital participation in development planning processes.

5 CONCLUSION

Therefore, increasing public digital capacity particularly through awareness programs, local training, and user-friendly digital tools such as interactive web multimedia is essential for empowering citizens and enhancing transparency and accountability in urban governance. However, challenges remain in ensuring inclusive stakeholder engagement, especially in peripheral rural areas, where digital literacy and awareness of the development plan and system are relatively low.

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The Importance of STEM in 21st-Century Learning Elementary Science School Teachers

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ABSTRACT

Science, Technology, Engineering, and Mathematics (STEM) was developed to meet the challenges of the 21st-century, in which students are not only both cognitively gifted and skilled. STEM education helps students become competitive and job-ready in their chosen fields. STEM education provides numerous benefits, including improved critical thinking skills, creativity, logic, innovation, productivity, and a direct link to real-world situations. This study looks at the importance of STEM and the challenges of teaching in 21st-century learning through the perspectives of elementary science teachers. Six experienced elementary science teachers from Alor Setar, Kedah, were interviewed to gather qualitative data. The key themes discussed in this study include STEM education fosters students critical thinking and problem-solving skills, the large class size is the main challenges that negatively impacts teaching in 21st-century learning, and technology usage can help teachers and students find information online.

KEYWORDS: *STEM, challenges in 21st-century learning, elementary science school teacher*

1 INTRODUCTION

STEM was developed to meet the challenges of the 21st-century, in which students are not only cognitively gifted but also skilled. STEM education helps students become competitive and job-ready in their chosen fields. STEM education provides numerous benefits, including improved critical thinking skills, creativity, logic, innovation, productivity, and a direct link to real-world situations (Widya, 2019). One of the most important learning principles is that teachers must familiarise students with the knowledge they have gained so that they can apply it to real-world problems. Students' learning experiences should prepare them for the skills they need in the 21st- century. As a result, the student gained valuable knowledge that apply to real-world problems. This study is important because it aims to clarify the crucial connection between teacher involvement and the practical application of STEM education, illuminating the potentially transformative effects on teachers and students. The study's aimed to identify elementary school teachers' perspectives on the importance and challenges of incorporating STEM into science subjects.

In this 21st century, STEM education is crucial for preparing students to succeed in a world driven by technology and changing quickly. In addition to advancing technical knowledge, it cultivates the critical thinking, creativity, communication, and teamwork abilities required to participate in a digital society and adjust to employment needs (Clements & Sarama, 2023). However, there are several obstacles to incorporating STEM into elementary school curricula.

One of the primary obstacles to implementing STEM education is inadequate teacher preparation. Inadequate teacher preparation is a significant obstacle. Many elementary school instructors are undertrained in STEM disciplines, which makes them insecure and incompetent when instructing these subjects. This problem is made worse by a lack of professional development opportunities, particularly as primary school teachers must teach a various of courses without having specialist STEM knowledge (Langreo, 2024). Additionally, many teachers find it challenging to apply advanced differentiation strategies and resources needed to adapt STEM curricula to diverse student requirements (National Math and Science Initiative, 2023).

Another significant barrier to STEM education is a lack of resources. Funding for necessary supplies including lab equipment, engineering kits, and digital tools is limited in many schools, especially those in underprivileged areas. According to 21st Century Education (2023), children who lack these tools lose out on experiential learning opportunities vital for fostering STEM competency and technical literacy, both of which are requirements for future STEM professions.

These challenges make it clear that implementing STEM education in many elementary schools in the twenty-first century is difficult. For educators to become more confident and proficient in teaching STEM subjects, they require consistent and focused professional development. In order to make STEM topics accessible and fully incorporated into the educational process, schools also need to address resource constraints and rethink the subject's place within larger educational objectives (Brophy et al., 2020). The study aimed to determine the challenges, opinions, benefits, and drawbacks of incorporating STEM into 21st-century learning for elementary science school teacher.

2 LITERATURE REVIEW

2.1 Important of STEM in Elementary Education

STEM are critical components of general education that shape the public's knowledge and skills required in our future society. As a result, the teaching and learning process should be structured so that children's/learners' development progresses through successive educational stages, and learning is aligned with the principle of continuity in its broadest sense. Positive STEM experiences obtained in early childhood serve as the foundation for more meaningful STEM education. According to Mu'minah and Aripin (2019) state that STEM and ICT-based science education can help students develop 21st-century skills. STEM is an effective method of teaching science.

2.2 21st-Century Learning

Science and technology advancements correspond to an improvement in educational quality, particularly in terms of technological adoption. Technology in education facilitates the teaching process and provides students access to unlimited information at any time and from any location. Today, in the age of the fourth industrial revolution, schools must innovate to keep pace with rapidly changing technology. As a result, teachers should be able to leverage educational technology to improve students' skills and intelligence (Hermino & Arifin, 2020). The use of appropriate teaching models contributes to the achievement of teaching objectives while also motivating students. The selection of appropriate teaching models is critical for improving learning outcomes, mainly when teaching science.

Teaching science requires authentic teaching models, such as project-based learning. Model development aims to actively engage students in the teaching process and improve their understanding by designing, implementing, and selecting models to explain, predict, and control physical phenomena. As a result, teachers do not expect students to memorize teaching materials for their subjects, but rather to develop the necessary skills by using appropriate teaching models in the classroom. Communication, collaboration, critical thinking, and creativity are the four C skills of the 21st century. Teachers must facilitate education that equips students with 4C skills to meet the challenges of globalization (Teo, 2019). STEM correlates positively with 21st-century skills (Kan & Murat, 2018). Inquiry-based learning improves these skills, including STEM (Kembara et al., 2019; Tofel-Grehl and Callahan, 2014). STEM and 21st-century competencies are inextricably linked.

2.3 The Challenges in Implementing STEM in 21st-Century Learning

The systematic integration of science, technology, engineering, and mathematics (STEM) into STEM education teaching approaches has many benefits. However, it also raises several issues and challenges that must be addressed. Meanwhile, the fourth industrial revolution (4.0) has brought changes in educational innovation, such as the development of artificial intelligence, digital, physical frameworks and making humans interact with technology routinely (Shahroom & Hussin, 2018). Another challenge is the internet of things, big data, and cyber-physical systems (Jeon & Suh, 2017). These challenges require teachers to prepare students with the knowledge and skills to address these issues (Nordin & Norman, 2018). This is because the fourth industrial revolution encourages everyone to develop new knowledge and competencies so that the education system can quickly respond to existing developments and changes (Lee et al., 2018).

Implementing STEM as a learning approach is highly suitable in the fourth industrial revolution era (Hafni et al., 2020). Considering that STEM education integrates multiple subject areas to solve problems for future innovations creatively (Roberts, 2012). Based on Ni'mah et al.'s study (2019), students' motivation and experience to shape and create something increase through STEM-based learning. The pressure to implement STEM is reinforced by several advantages gained through STEM approach learning, including enhancing students' mathematical correlation abilities, improving students' critical thinking skills, enhancing creative thinking skills, improving systematic and logical thinking of students according to the demands of 21st-century skills, and enhancing students' problem-solving abilities. These findings confirm that STEM is a potentially beneficial approach for use in the 21st century and of the fourth industrial revolution era.

3 METHODOLOGY

3.1 Research Design

The research is mainly focused on primary school teachers' views about the importance of STEM in 21st century learning Elementary Science School Teacher. Additionally, a qualitative research design is the most suitable approach to achieve the objective of this inquiry. All data on the topic was collected through semi-structured interviews 6 elementary science school teachers.

3.2 Sample of the Study

In this study, a total of 6 science teachers were interviewed to ensure that the findings and results of this research are accurate and reliable. All the respondents are elementary teachers from various schools in Alor Setar, Kedah. Purposive sampling is used in this research.

The characteristics of the respondents are as follows:

a) Science school teachers.
b) The teaching experience is at least 10 years or above.
c) The respondents are including male and female teachers.
d) The respondents are teaching in lower and upper standards.

3.3 Biography of the respondents

Respondent	Gender	Years of Teaching	Grade
A	Female	15	Standard 3
B	Female	20	Standard 5
C	Male	13	Standard 4
D	Female	20	Standard 3 & 4
E	Female	16	Standard 4
F	Female	14	Standard 5

3.4 Instruments

The interview is being held through online and physical interviews, and the respondents are requested to use Bahasa Melayu. The interview sessions are being videotaped and transcribed to provide evidence and ensure the transparency of the interviews that are conducted. Each participant is provided with the same set of questions addressing the two research objectives. This study was discussed in thematic analysis.

All selected respondents were willing to participate, and a thorough was background check was conducted before they were selected for interviews.

4 FINDINGS AND DISCUSSION

The interviews that were conducted produced several themes including themes that had been set before the study.

4.1 The themes are as follows:

a) Theme 1: STEM education fosters critical thinking and problem-solving skills in students.
b) Theme 2: The large class size is the main challenge that negatively and positively impacts teaching in 21st-century learning.
c) Theme 3: Technology usage can help teachers and students find online information.

4.2 STEM education fosters critical thinking and problem-solving skills in students.

Four out of six respondents in this research mentioned and agreed that STEM education can foster students' critical thinking and problem-solving skills.

Respondent A:

". . . STEM education fosters critical thinking and problem-solving abilities in students because all important subjects such as Mathematics, Science, and RBT (Design and Technology) are combined. This allows students to use their knowledge to think better to solve problems."

Respondent B:

". . . Through STEM education, students are accustomed to using technology. Students do not easily accept something without evaluating it first. With today's technological advancements, students can filter and assess the truth without blindly accepting what is presented or conveyed. This indirectly encourages critical thinking and problem-solving abilities among students."

Respondent D:

". . . For example, students carry out science experiments, where the teacher is just a guide. The teacher tells what is needed for the experiment. But the students need to determine the purpose of the experiment and how to conduct the experiment based on the listed items or equipment. That's where we see their creative and critical thinking in solving problems."

Respondent E:

". . . For STEM, when we want to create something, there are phases. We need to form hypotheses, have ideas, and most importantly, there must be a problem to solve. This can stimulate creativity and problem-solving among students."

Based on the discussion, all of the respondents said that by involved in STEM will encourage critical thinking and problem solving. When the teacher assigns students with the project, they will solve by themselves, which called student-centred. This is where the teacher can evaluate their student's achievement in the classroom. According to Khalil et al. (2023), involving problem-based STEM activities significantly improves students' perceptions of their problem-solving abilities and critical thinking skills. STEM education engages students in real-world problems, helping them develop these fundamental abilities through hands-on experiences and interdisciplinary learning

4.3 The large class size is the main challenge that has a negative impact on teaching in 21st-century learning

Five out of six respondents in this research mentioned and agreed that the large class size is one of the main challenges impacting teaching in 21st-century.

Respondent A:

". . . The challenge is that elementary school teachers have to teach in classes with many students. Teachers cannot fully focus on the smart students because there are students who still cannot read in the same class."

Respondent B:

". . . Among the challenges is the large number of students, for example at my school, there are 40 students in a class. This is where various challenges for teachers begin when conducting activities."

Respondent C:

". . . The main challenge is the number of students in the class. I prefer classes with fewer students so that 21st-century learning can be applied closely with them."

Respondent E:

". . . Yes, controlling a class of 30 students is very challenging, and an hour is often not enough for effective teaching."

Respondent F:

". . . The first challenge is overcrowded classrooms, which is a national issue. In Kedah, we manage to keep the class size to around 25-30 students."

Based on this statement, all respondents disagree when the classroom has a big size or many students. Because the teacher cannot concentrate on delivering their teaching and the waiting time is too long and respondent C said that he prefers a small classroom size. Because it's easy to handle the students, to assign the activity, hands-on etc. While respondent F said, she still can manage the class size is around 25-30 students. Some of the reasons is if the students in the class show good behaviour, it might be easier to handle, if it is not, it is difficult for the teacher to handle it. (Organization for Economic Cooperation & Development (OECD), 2019) state that in crowded classrooms, it's hard for the teacher to handle the classroom. Believed that teachers feel more at ease managing smaller classes, offering personalized attention, preparing lesson plans, grading students, and providing feedback. As a result, this enhances their overall job satisfaction.

4.4 Technology usage can help teachers and students find information on the internet.

Two out of six in this research mentioned and agreed that technology usage can help teachers and students find information on the internet.

Respondent A:

". . . Technology greatly helps in the 21st-century learning environment because with technology, students and teachers can easily and quickly obtain information."

Respondent B:

". . . Technology greatly aids 21st-century learning, especially the use of gadgets. In the syllabus for year 5 and year 6, students are trained to become junior programmers. Without technology or the internet, the learning process would be hampered. Technology is essential for effective learning."

Based on the statement, technology plays a very important role in today's era, where everything is at our fingertips, and we can access a wealth of information. Teachers can find teaching materials on the internet to ensure their lessons align with the objectives in their daily teaching reports. Students can access more in-depth information about the subjects they learn at school. Additionally, with this technology, they can find and access new knowledge. American University's School of Education (2020) stated that

technology offers students easy access to information, speeds up learning, and provides engaging ways to practice their knowledge. It allows them to discover new topics and better understand complex concepts, particularly in STEM. Students can develop essential 21st-century technical skills for future careers by utilizing technology inside and outside the classroom.

5 CONCLUSION

In conclusion, this study emphasizes the importance of STEM education in developing critical thinking and problem-solving skills among Malaysian elementary students, which aligns with the demands of 21st-century learning. STEM education integration enables students to solve real-world problems through hands-on activities and interdisciplinary learning, improving their cognitive and practical abilities. However, the study identifies significant challenges for the elementary science teacher, particularly large class sizes, which impede effective teaching and personalized attention. Teachers often struggle to manage crowded classrooms, effecting the quality of STEM education and implementing 21st-century learning strategies. Furthermore, while technology plays an important role in STEM education by increasing access to information and facilitating learning, its integration presents challenges that must be addressed to maximize its benefits.

Several recommendations are made to address the issues raised in this study and improve the effectiveness of STEM education. First, Ministry of education Malaysia should discuss reducing class sizes to create more manageable and effective teaching environments that allow for personalised attention and better classroom management. Second, professional development programs for teachers should be developed to provide them with the skills and strategies required to integrate STEM education, even in large classrooms effectively. This includes technology-based training to support teaching and learning processes. Lastly, the education system should prioritize the development and implementation of innovative teaching models that are consistent with the principles of 21st-century learning, promoting critical thinking, creativity, collaboration, and communication among students. By addressing these issues, STEM education can be more effectively incorporated into the curriculum, preparing students for future challenges and opportunities. The suggestion for future researchers is to investigate students' perspectives on STEM education. Understanding students' perspectives on the challenges and benefits of STEM can assist in developing more effective educational strategies.

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Kajian Keberkesanan ChatGPT sebagai Alat Bantu Digital dalam Kursus Pengucapan Awam di Kolej Poly-Tech MARA Kota Bharu

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ABSTRAK

Kajian ini bertujuan meneroka keberkesanan penggunaan ChatGPT sebagai alat bantu digital dalam kursus Pengucapan Awam dalam kalangan pelajar semester 1 Diploma Pendidikan Awal Kanak-Kanak. Penekanan diberikan kepada peranan ChatGPT dalam membantu pelajar memilih tajuk ucapan, menyusun isi kandungan, serta meningkatkan keyakinan dan kemahiran penyampaian semasa menyediakan tugasan pembentangan akhir. Kajian ini menggunakan pendekatan kuantitatif deskriptif, melibatkan seramai 30 orang pelajar yang telah menggunakan ChatGPT dalam tugasan mereka. Data dikumpul melalui soal selidik yang menilai persepsi pelajar sebelum dan selepas menggunakan ChatGPT. Dapatan menunjukkan majoriti pelajar menghadapi kesukaran dalam menghasilkan ucapan yang tersusun dan meyakinkan sebelum menggunakan ChatGPT. Selepas penggunaan, pelajar melaporkan peningkatan dari segi struktur isi, kreativiti kandungan, serta keyakinan ketika berucap. Kajian ini menyimpulkan bahawa ChatGPT berpotensi sebagai alat sokongan yang efektif dalam pembelajaran kursus pengucapan awam, namun kesedaran dan kemahiran penggunaan secara beretika perlu diterapkan bagi memastikan keberkesanannya dimaksimumkan.

Kata Kunci: ChatGPT, Pengucapan Awam, Pendidikan Awal Kanak-Kanak, Literasi Digital, Kecerdasan Buatan, Persepsi Pelajar.

1 PENGENALAN

Kemajuan teknologi maklumat dan komunikasi (ICT) telah memberikan impak yang signifikan terhadap pelbagai aspek kehidupan manusia, termasuk dalam bidang pendidikan. Penggunaan teknologi kini bukan sahaja tertumpu kepada akses maklumat semata-mata, malah telah berkembang kepada pelbagai bentuk sokongan pintar seperti kecerdasan buatan (Artificial Intelligence, AI) yang mampu membantu dalam penyelesaian tugasan harian dengan lebih efektif dan efisien. Menurut Suruhanjaya Komunikasi dan Multimedia Malaysia (MCMC, 2024), tahap penggunaan platform digital dalam kalangan rakyat Malaysia semakin meningkat, dengan generasi muda menunjukkan kadar celik digital yang tinggi serta kecenderungan menggunakan teknologi sebagai alat bantu pembelajaran.

Dalam konteks pembelajaran dan pengajaran abad ke-21, pendekatan konvensional didapati kurang berkesan dalam memenuhi keperluan pelajar yang semakin cenderung kepada kaedah pembelajaran kendiri, interaktif dan berbantukan teknologi. Kajian oleh Kholidi et al. (2024) menunjukkan bahawa literasi digital dalam kalangan pelajar bukan sahaja meningkatkan capaian terhadap maklumat, malah mendorong

peningkatan dalam aspek pemikiran kritis dan ekspresi kendiri. Seiring dengan itu, perkembangan teknologi AI seperti ChatGPT telah memperkenalkan pendekatan baharu dalam pembelajaran, di mana pelajar dapat menggunakan teknologi ini untuk menjana idea, menyusun isi kandungan, dan menambah baik kemahiran komunikasi secara kendiri.

Berpaksikan kepada perkembangan ini, kajian ini bertujuan untuk meneroka keberkesanan penggunaan ChatGPT sebagai alat bantu digital dalam kursus Pengucapan Awam dalam kalangan pelajar semester satu Diploma Pendidikan Awal Kanak-Kanak. Penekanan diberikan kepada peranan ChatGPT dalam membantu pelajar memilih tajuk ucapan, menyusun isi kandungan, serta meningkatkan keyakinan dan kemahiran penyampaian semasa menyediakan tugasan pembentangan akhir. Kajian ini menggunakan pendekatan kuantitatif deskriptif, melibatkan seramai 30 orang pelajar yang telah menggunakan aplikasi ini dalam tugasan mereka. Data dikumpul melalui soal selidik yang menilai persepsi pelajar sebelum dan selepas penggunaan ChatGPT. Dapatan menunjukkan majoriti pelajar menghadapi kesukaran dalam menghasilkan ucapan yang tersusun dan meyakinkan sebelum menggunakan ChatGPT. Selepas penggunaannya, pelajar melaporkan peningkatan dari segi struktur isi, kreativiti kandungan, serta keyakinan ketika berucap. Kajian ini menyimpulkan bahawa ChatGPT berpotensi sebagai alat sokongan yang efektif dalam pembelajaran kursus Pengucapan Awam, namun kesedaran dan kemahiran penggunaan secara beretika perlu diterapkan bagi memastikan keberkesanannya dapat dimaksimumkan.

3 PENYATAAN MASALAH

Kemahiran pengucapan awam merupakan elemen asas dalam pembangunan komunikasi berkesan, khususnya dalam kalangan pelajar program Pendidikan Awal Kanak-Kanak yang kelak bakal menjadi pendidik kepada generasi akan datang. Walaupun kursus pengucapan awam diperkenalkan sebagai sebahagian daripada kurikulum pendidikan tinggi, sebilangan besar pelajar masih menunjukkan kelemahan dari segi struktur kandungan, susunan idea yang logik, penguasaan bahasa, dan keyakinan semasa membuat pembentangan. Kajian oleh Aminuddin dan Mohd Kiram (2023) mendapati bahawa kelemahan dalam wacana lisan dan ketidakmampuan mengawal bahasa formal menjadi antara punca utama penyampaian yang tidak meyakinkan dalam kalangan pelajar institusi pengajian tinggi.

Dalam era revolusi industri 4.0 dan ledakan teknologi maklumat, aplikasi berasaskan kecerdasan buatan (AI) seperti ChatGPT mula mendapat perhatian sebagai alat sokongan pembelajaran yang berupaya membantu pelajar dalam penjanaan idea, penyusunan isi kandungan, dan penyemakan bahasa. Penemuan oleh Mudreh dan Jamaludin (2023) menunjukkan bahawa pelajar yang menggunakan ChatGPT dalam tugasan akademik melaporkan peningkatan dari segi pemahaman konsep dan ketepatan struktur penulisan. Namun demikian, integrasi penggunaan AI dalam kursus seperti pengucapan awam masih belum diteroka secara menyeluruh, apatah lagi dalam kalangan pelajar semester awal yang mungkin masih bergelut dengan asas kemahiran komunikasi.

Tambahan pula, meskipun pelajar menunjukkan tahap literasi digital yang tinggi (MCMC, 2024), kebergantungan yang tidak terkawal terhadap sistem AI boleh menjejaskan pemikiran kritis dan kreativiti sekiranya tidak disertai dengan panduan etika penggunaan. Kambaruddin dan Aziz (2023) menekankan bahawa penggunaan ChatGPT perlu digabungkan dengan elemen pedagogi dan bimbingan yang sistematik bagi memastikan pelajar tidak hanya menjadi pengguna pasif teknologi, tetapi turut mampu membina kemahiran komunikasi yang autentik dan reflektif.

Justeru, terdapat keperluan mendesak untuk mengkaji keberkesanan penggunaan ChatGPT sebagai alat bantu dalam kursus pengucapan awam, khususnya dalam kalangan pelajar Diploma Pendidikan Awal Kanak-Kanak. Kajian ini bertujuan untuk meneroka bagaimana penggunaan aplikasi ini memberi kesan terhadap pemilihan tajuk, susunan isi kandungan, dan keyakinan penyampaian dalam tugasan pembentangan akhir pelajar, sekaligus memberikan gambaran awal terhadap potensi dan cabaran integrasi AI dalam pengajaran kemahiran komunikasi lisan.

4 OBJEKTIF KAJIAN

Fokus kajian ini adalah untuk menganalisis peranan ChatGPT dalam menyokong proses pembelajaran pelajar semester satu Diploma Pendidikan Awal Kanak-Kanak menyiapkan tugasan kursus Pengucapan Awam. Secara khususnya, kajian ini ingin mengenal pasti tahap penggunaan dan keterdedahan pelajar terhadap aplikasi ini dalam konteks pembelajaran komunikasi lisan. Penekanan turut diberikan kepada penilaian terhadap perubahan yang dialami oleh pelajar dari aspek struktur isi kandungan ucapan, kreativiti dalam penyusunan idea, serta tahap keyakinan sebelum dan selepas menggunakan sistem AI ini.

Selain itu, kajian ini juga bertujuan untuk mengenal pasti cabaran utama yang dihadapi pelajar semasa menggunakan ChatGPT, termasuk kekangan teknikal, pemahaman terhadap arahan sistem, dan kebergantungan yang berlebihan terhadap output AI. Kajian ini turut menilai persepsi keseluruhan pelajar terhadap potensi aplikasi ini sebagai alat sokongan pembelajaran jangka panjang, serta kecenderungan mereka untuk terus menggunakan teknologi ini dalam tugasan akademik yang akan datang. Melalui dapatan ini, kajian ini diharap dapat menyediakan asas empirik bagi mencadangkan strategi pedagogi digital yang lebih efektif dan beretika dalam pembelajaran abad ke-21.

5 LITERATUR KAJIAN

Kecerdasan buatan (AI) semakin mendapat tempat dalam dunia pendidikan tinggi, terutamanya sebagai alat bantu dalam penyediaan tugasan dan komunikasi akademik. ChatGPT, salah satu aplikasi AI generatif yang berasaskan model bahasa, telah mula digunakan dalam kalangan pelajar untuk menjana idea, menyusun kandungan, serta menyemak struktur penulisan. Kajian oleh Mudreh dan Jamaludin (2023) mendapati bahawa penggunaan ChatGPT memberikan impak positif terhadap pemahaman pelajar dalam menyusun tugasan secara lebih sistematik dan efisien. Dalam konteks kursus pengucapan awam, pelajar sering bergelut dengan aspek pemilihan tajuk, struktur isi, dan keyakinan semasa penyampaian — cabaran yang berpotensi diringankan dengan bantuan sistem AI seperti ChatGPT.

Zarien Nurlieyana Aminuddin dan Norazlina Mohd Kiram (2023) dalam kajian wacana lisan mendapati bahawa pelajar kerap mengalami kekaburan struktur dan kurang penguasaan bahasa yang sesuai dalam penyampaian formal. Hal ini menyokong keperluan kepada intervensi teknologi yang mampu membimbing pelajar secara kendiri sebelum berhadapan dengan khalayak. Di samping itu, Kambaruddin dan Aziz (2023) menekankan kepentingan membina kefahaman pelajar terhadap arahan sistem (prompting), serta perlunya kesedaran etika dalam penggunaan ChatGPT bagi mengelakkan kebergantungan mutlak dan penurunan daya fikir kritikal.

Kajian-kajian terdahulu menunjukkan bahawa tahap literasi teknologi memainkan peranan penting dalam menentukan keberkesanan penggunaan aplikasi digital dalam pendidikan. Berdasarkan laporan MCMC (2024), tahap penggunaan media digital dalam kalangan generasi muda menunjukkan peningkatan yang ketara, mewujudkan satu ekosistem pembelajaran yang lebih terbuka kepada integrasi AI dalam pedagogi.

6 METODOLOGI KAJIAN

Kajian ini menggunakan pendekatan kuantitatif deskriptif bagi menilai keberkesanan penggunaan ChatGPT dalam membantu pelajar semester satu Diploma Pendidikan Awal Kanak-Kanak dalam tugasan kursus Pengucapan Awam. Instrumen kajian berupa soal selidik dalam talian dibangunkan menggunakan Google Forms, dan telah diedarkan kepada 27 orang responden yang dipilih secara persampelan bertujuan (purposive sampling). Soal selidik terdiri daripada empat bahagian utama: (i) profil demografi, (ii) tahap penggunaan dan penguasaan teknologi, (iii) pengalaman sebelum dan selepas menggunakan ChatGPT, dan (iv) persepsi keseluruhan serta cadangan penggunaan masa hadapan..

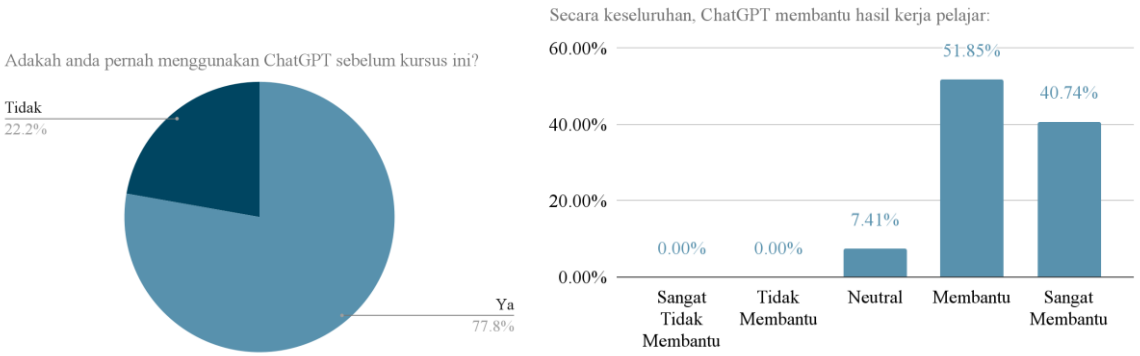
Item-item dalam soal selidik terdiri daripada skala Likert lima mata (1 = sangat tidak setuju, 5 = sangat setuju), pilihan pelbagai (*multiple choice*), dan soalan terbuka untuk menggali maklum balas kualitatif. Data dianalisis secara deskriptif menggunakan statistik asas seperti min, peratusan dan kekerapan bagi mengenalpasti pola penggunaan dan persepsi pelajar terhadap keberkesanan ChatGPT. Kajian ini turut

mengutamakan aspek etika dengan menjamin kerahsiaan maklumat responden dan penggunaan data semata-mata untuk tujuan akademik.

6 DAPATAN KAJIAN

6.1 Latar Belakang

Berdasarkan data dalam Rajah 1, majoriti pelajar yang terlibat dalam kajian ini menunjukkan tahap celik teknologi maklumat yang tinggi. Sebanyak 74% pelajar menilai diri mereka berada pada tahap 4 dan 5 dalam penguasaan teknologi, manakala 77.78% telah menggunakan ChatGPT sebelum mengikuti kursus Pengucapan Awam. Ini mencerminkan kesediaan dan kecekapan digital yang kukuh dalam kalangan pelajar, selari dengan perkembangan semasa di Malaysia.



Rajah 1: Tahap Penguasaan Teknologi.

Dapatan kajian menunjukkan bahawa majoriti pelajar yang terlibat memiliki tahap celik teknologi maklumat yang tinggi. Berdasarkan data Jadual 2, sebanyak 74% pelajar menilai diri mereka berada pada tahap 4 dan 5 dalam penguasaan teknologi, manakala 77.78% telah menggunakan aplikasi ChatGPT sebelum mengikuti kursus Pengucapan Awam. Angka ini jelas mencerminkan bahawa pelajar mempunyai kesediaan dan kecekapan digital yang kukuh, selari dengan trend transformasi digital semasa di Malaysia.

Kajian terdahulu oleh Kholidi et al. (2024) yang dijalankan di Universiti Teknologi MARA mendapati bahawa pelajar pascasiswazah mentakrifkan literasi digital sebagai keupayaan untuk memahami, mengakses dan mengaplikasikan bahasa serta alat teknologi secara bijak. Pelajar dalam kajian tersebut juga berpandangan bahawa literasi digital memainkan peranan penting dalam menyokong pencapaian akademik dan perkembangan profesional mereka. Hasil ini menyokong dapatan kajian ini yang menunjukkan keterbukaan pelajar terhadap penggunaan teknologi seperti ChatGPT dalam tugasan akademik.

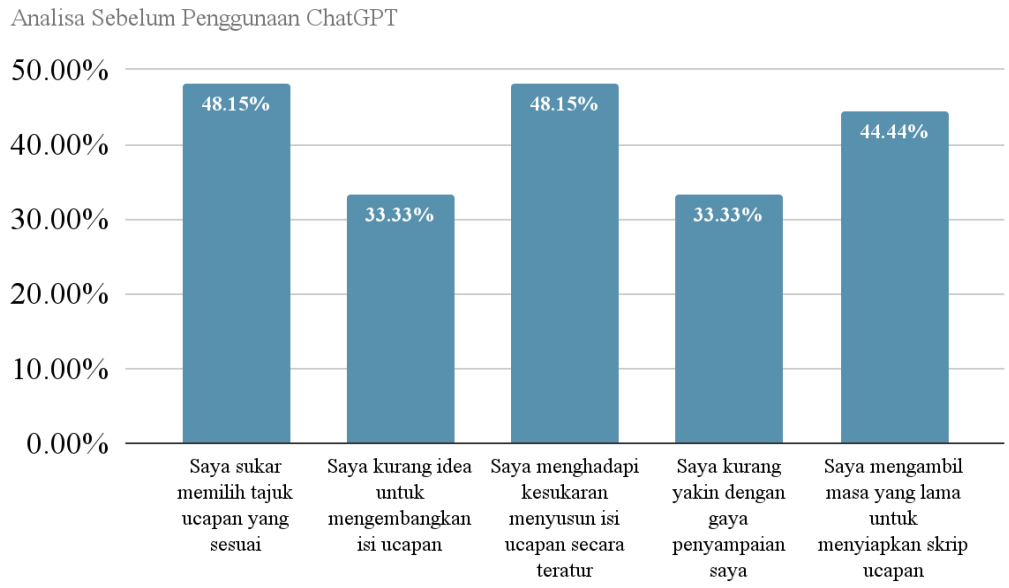
Tambahan pula, Suruhanjaya Komunikasi dan Multimedia Malaysia (MCMC) dalam laporan tahunannya pada Julai 2024 mencatatkan peningkatan ketara dalam penggunaan media sosial dalam kalangan rakyat Malaysia, dengan WhatsApp (71%), Facebook (51%), TikTok (49%), dan Instagram (45%) menjadi platform paling dominan. Perkembangan ini menunjukkan bahawa generasi muda, termasuk pelajar institusi pengajian tinggi, semakin terbiasa dengan interaksi digital dalam kehidupan seharian, dan ini secara tidak langsung menyokong penerimaan mereka terhadap teknologi pembelajaran baharu.

Namun demikian, cabaran masih wujud dalam memastikan akses yang adil dan saksama terhadap teknologi dalam kalangan pelajar yang berbeza latar belakang. Maslina Mastam (2024) menekankan bahawa pendekatan yang disesuaikan dengan gaya pembelajaran, sosioekonomi, dan keperluan khas pelajar adalah penting untuk memastikan tahap literasi digital dapat ditingkatkan secara inklusif. Hal ini selari dengan tanggungjawab institusi pendidikan dalam menyediakan sokongan teknologi yang menyeluruh dan mesra pengguna.

Secara keseluruhannya, dapatan daripada kajian ini menegaskan bahawa pelajar dalam program yang dikaji menunjukkan tahap celik digital yang tinggi dan bersedia untuk memanfaatkan teknologi seperti ChatGPT dalam pembelajaran. Walau bagaimanapun, usaha berterusan perlu digiatkan untuk memperkukuh literasi digital secara holistik agar semua pelajar, tanpa mengira latar belakang, dapat mengakses dan menggunakan teknologi secara berkesan dan beretika dalam konteks pendidikan tinggi.

6.2 Sebelum Penggunaan ChatGPT

Rajah 2 menunjukkan analisis data berkenaan tahap kesukaran yang dialami pelajar sebelum menggunakan ChatGPT dalam penyediaan tugasan pengucapan awam. Dapatan menunjukkan pelbagai cabaran yang dihadapi oleh pelajar, terutamanya dalam aspek pemilihan tajuk, pengembangan isi, dan gaya penyampaian.



Rajah 2: Analisa Data Sebelum Penggunaan ChatGPT.

Secara keseluruhan, 48.15% pelajar bersetuju atau sangat bersetuju bahawa mereka sukar memilih tajuk ucapan yang sesuai (Soalan 2). Ini menunjukkan sebahagian besar pelajar masih memerlukan rangsangan idea awal untuk memulakan ucapan. Masalah ini turut dikuatkan dengan dapatan bagi Soalan 3, di mana 33.33% pelajar mengaku kurang idea untuk mengembangkan isi ucapan. Kelemahan ini mungkin berpunca daripada kurangnya pendedahan kepada strategi *brainstorming* atau teknik penulisan kandungan lisan secara kreatif.

Lebih membimbangkan, sebanyak 48.15% pelajar turut menghadapi kesukaran menyusun isi ucapan secara teratur (Soalan 4). Ketidakupayaan dalam menyusun isi dengan baik boleh menyebabkan mesej utama ucapan gagal disampaikan secara berkesan kepada khalayak. Kajian oleh Aminuddin dan Mohd Kiram (2023) menyokong dapatan ini apabila mendapati bahawa pelajar menghadapi masalah dalam struktur wacana lisan, terutama dalam peralihan antara isi dan penggunaan bahasa formal yang sesuai dalam konteks pembentangan akademik.

Dari segi keyakinan, 33.33% pelajar menyatakan bahawa mereka kurang yakin dengan gaya penyampaian mereka (Soalan 5). Aspek keyakinan merupakan elemen penting dalam pengucapan awam, dan kelemahan ini lazimnya dikaitkan dengan kebimbangan komunikasi (*communication apprehension*) yang tinggi dalam kalangan pelajar institusi pengajian tinggi (Putwain & Symes, 2011).

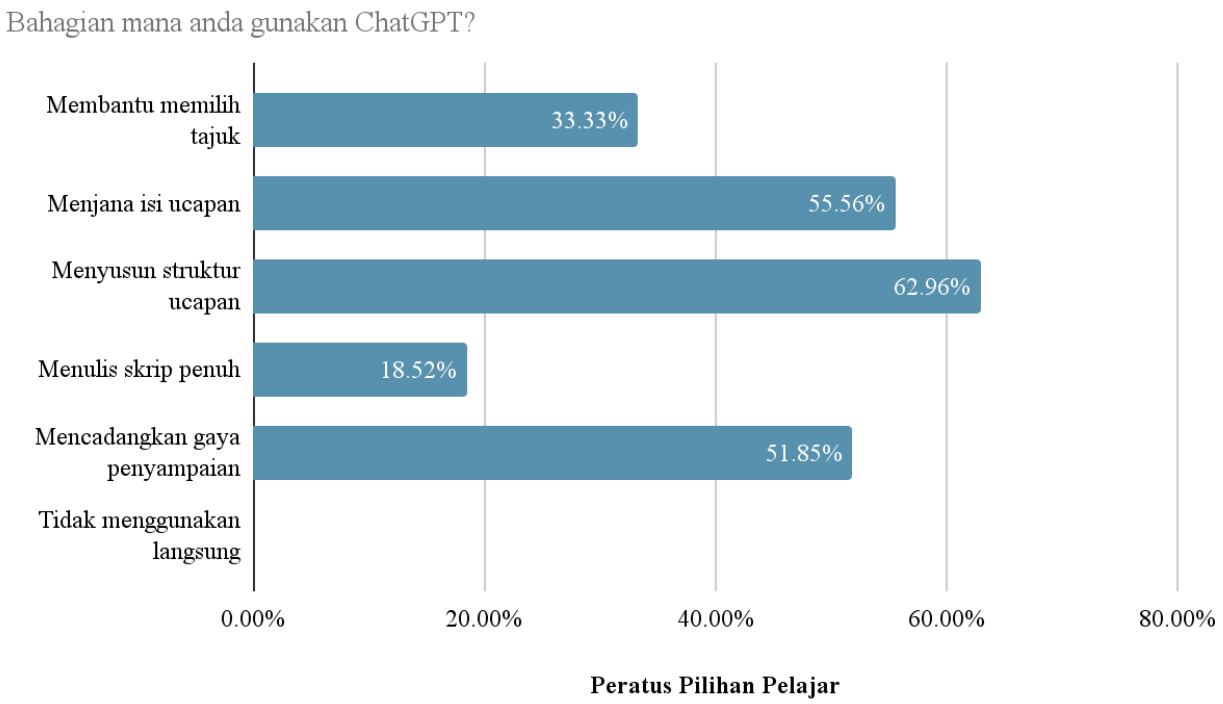
Selain itu, 44.44% responden bersetuju bahawa mereka mengambil masa yang lama untuk menyiapkan skrip ucapan(Soalan 6). Ini mencerminkan tahap kecekapan yang masih rendah dalam merancang kandungan ucapan secara sistematik. Menurut Lim et al. (2022), pelajar yang tidak didedahkan kepada alat perancang

idea atau template pembentangan selalunya memerlukan masa yang lebih panjang untuk menyusun ucapan mereka.

Dapatan-dapatan ini secara kolektif menggambarkan bahawa pelajar menghadapi pelbagai kekangan sebelum penggunaan ChatGPT, baik dari sudut kandungan mahupun penyampaian. Oleh itu, kehadiran teknologi seperti ChatGPT yang mampu menjana idea, mencadangkan struktur logik, dan menyediakan draf ucapan berasaskan arahan tertentu, berpotensi mengurangkan beban kognitif pelajar dan mempercepatkan proses penyediaan tugasan.

6.3 Selepas Penggunaan ChatGPT

Rajah 3 memaparkan analisis penggunaan ChatGPT dalam kalangan pelajar selepas mereka menggunakannya untuk tugasan kursus Pengucapan Awam. Dapatan menunjukkan bahawa pelajar menggunakan ChatGPT secara aktif dalam pelbagai peringkat penyediaan ucapan, dengan tumpuan utama kepada aspek struktur dan kandungan.



Rajah 3: Analisa Penggunaan ChatGPT.

Sebanyak 62.96% pelajar menggunakan ChatGPT untuk menyusun struktur ucapan, menjadikannya aspek paling dominan. Ini menunjukkan bahawa pelajar menghargai keupayaan ChatGPT dalam membantu mereka menyusun isi secara logik dan sistematik. Dapatan ini selari dengan dapatan Mudreh dan Jamaludin (2023) yang menunjukkan bahawa pelajar memanfaatkan ChatGPT untuk menyusun rangka isi tugasan secara lebih tersusun, sekaligus memudahkan proses penulisan akademik.

Selain itu, 55.56% pelajar menggunakan ChatGPT untuk menjana isi ucapan, manakala 51.85% pula menggunakannya untuk mencadangkan gaya penyampaian. Ini menggambarkan bahawa pelajar tidak hanya bergantung kepada ChatGPT untuk isi kandungan semata-mata, malah turut melihat potensi aplikasi ini dalam aspek retorik dan penyampaian – satu komponen penting dalam pengucapan awam yang meyakinkan (Kholidi et al., 2024).

Penggunaan ChatGPT untuk membantu memilih tajuk ucapan (33.33%) turut menunjukkan bahawa pelajar masih memerlukan bantuan awal dalam proses *brainstorming*. Ini bertepatan dengan cabaran yang dikenal pasti dalam Jadual 3, di mana hampir separuh pelajar sukar memilih tajuk sebelum menggunakan ChatGPT. Sementara itu, hanya 18.52% pelajar menggunakan ChatGPT untuk menulis skrip penuh,

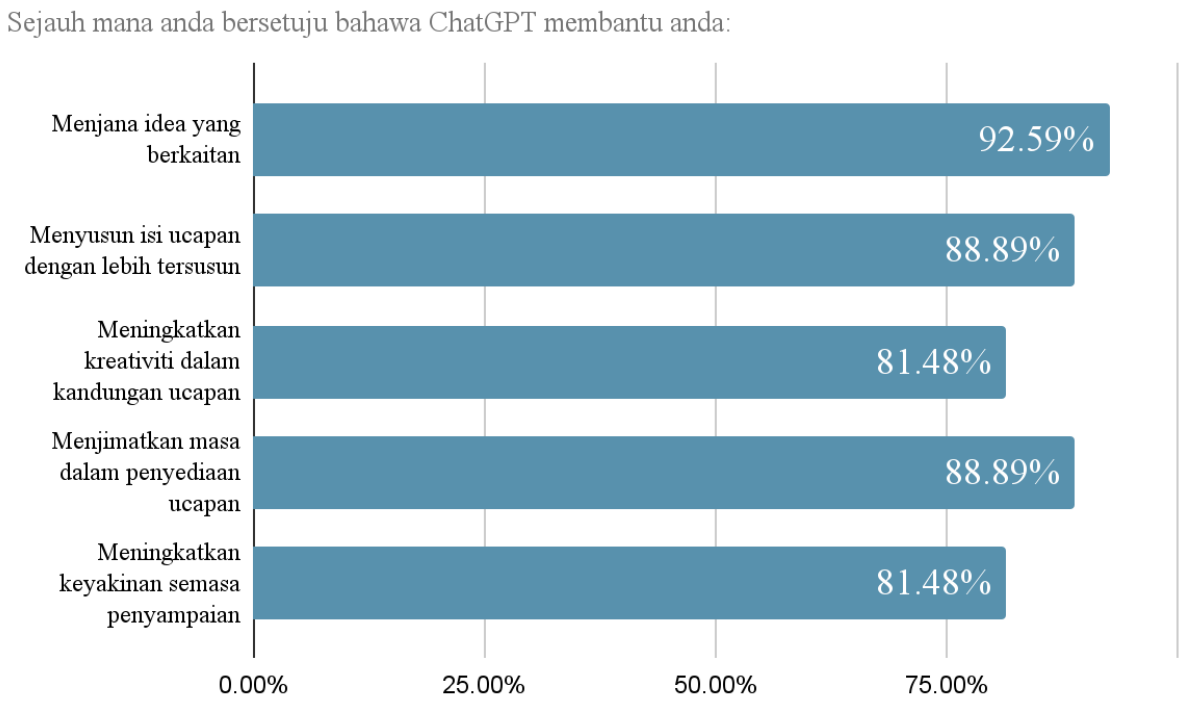
menunjukkan kebanyakan pelajar memilih untuk menggunakan teknologi ini secara sokongan, bukan sebagai alat penulisan penuh – satu tanda penggunaan yang lebih kritikal dan tidak bergantung sepenuhnya.

Menariknya, tiada pelajar (0%) yang melaporkan tidak menggunakan ChatGPT langsung, menunjukkan penerimaan yang sangat positif terhadap teknologi ini dalam proses penyediaan tugasan. Ini membuktikan bahawa tahap literasi digital dalam kalangan pelajar cukup tinggi untuk membolehkan mereka mengintegrasikan AI dalam pembelajaran mereka. Seperti yang dinyatakan dalam laporan Suruhanjaya Komunikasi dan Multimedia Malaysia (MCMC, 2024), generasi muda Malaysia menunjukkan keterbukaan tinggi terhadap teknologi baharu, termasuk AI generatif, apabila ia memberi manfaat praktikal dan segera.

Secara keseluruhannya, dapatan daripada Jadual 4 menunjukkan bahawa ChatGPT telah digunakan secara meluas dan berkesan oleh pelajar dalam pelbagai aspek penyediaan ucapan. Penggunaan yang paling tinggi dalam menyusun struktur menunjukkan bahawa AI mampu menyokong proses kognitif penting dalam pembelajaran, terutama dalam tugas yang menuntut kemahiran komunikasi dan pemikiran teratur. Namun begitu, bimbingan pedagogi masih diperlukan untuk memastikan penggunaan ini dilakukan secara beretika dan tidak menghakis kemahiran asas pelajar.

6.4 Keberkesanan Penggunaan ChatGPT

Rajah 4 menggambarkan tahap persetujuan pelajar terhadap keberkesanan penggunaan ChatGPT dalam pelbagai aspek penyediaan tugasan pengucapan awam. Secara keseluruhan, dapatan menunjukkan respons yang sangat positif daripada pelajar, khususnya dalam membantu mereka menjana idea, menyusun isi kandungan, dan meningkatkan keyakinan penyampaian.



Rajah 4: Tahap persetujuan pelajar terhadap keberkesanan penggunaan ChatGPT.

Aspek paling dominan ialah keupayaan ChatGPT menjana idea, di mana sebanyak 92.59% pelajar bersetuju atau sangat bersetuju (item 1). Hal ini menunjukkan bahawa ChatGPT telah berjaya berfungsi sebagai alat pencetus idea (idea generation tool) yang efisien bagi pelajar yang sebelum ini menghadapi kekangan untuk memulakan penulisan atau pembentangan. Menurut kajian oleh Nurul Ain Mudreh dan

Muhammad Hafiz Jamaludin (2023), pelajar yang menggunakan ChatGPT melaporkan peningkatan dalam keupayaan menjana isi penting serta mengembangkan kandungan dengan lebih teratur dan terarah.

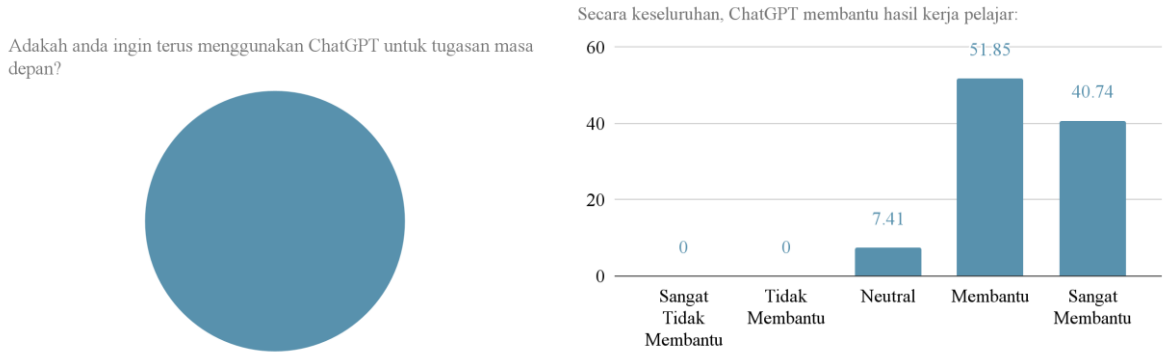
Tambahan pula, 88.89% pelajar bersetuju bahawa ChatGPT membantu mereka menyusun isi ucapan dengan lebih tersusun (item 2), satu aspek yang sebelum ini dikenal pasti sebagai cabaran utama dalam Jadual 3. Ini selari dengan dapatan oleh Aminuddin dan Mohd Kiram (2023) yang menyatakan bahawa kekaburan struktur dan transisi dalam wacana lisan merupakan antara kelemahan utama pelajar dalam pengucapan awam.

Sementara itu, 81.48% pelajar bersetuju bahawa ChatGPT meningkatkan kreativiti dalam kandungan ucapan(item 3). Hal ini mencerminkan keupayaan AI generatif bukan sahaja sebagai alat menjawab soalan, malah sebagai alat berinspirasi (inspirational assistant) yang membantu memperkaya kandungan secara lebih menarik dan pelbagai. Kajian oleh Kambaruddin dan Aziz (2023) turut menyokong dapatan ini dengan menyatakan bahawa pelajar dapat menggunakan ChatGPT untuk meneroka sudut pandang baharu dan mengembangkan naratif yang lebih berimaginasi dalam tugasan mereka.

Dari sudut praktikal, 88.89% pelajar bersetuju bahawa ChatGPT menjimatkan masa dalam penyediaan ucapan(item 4). Ini membuktikan bahawa penggunaan teknologi bukan sahaja memberi manfaat dari aspek kandungan, malah menjadikan proses penyiapan tugasan lebih efisien. Dalam konteks pelajar IPT yang sering berdepan beban tugasan pelbagai kursus, keupayaan menjimatkan masa adalah satu kelebihan penting (Lim et al., 2022).

Akhir sekali, 81.48% pelajar melaporkan peningkatan keyakinan semasa penyampaian (item 5) selepas menggunakan ChatGPT. Aspek ini sangat penting dalam penguasaan pengucapan awam, dan selari dengan dapatan oleh Putwain & Symes (2011) yang menyatakan bahawa latihan dan persediaan yang baik mampu mengurangkan kebimbangan komunikasi serta meningkatkan keyakinan lisan.

Secara keseluruhannya, dapatan dalam Rajah 4 mengesahkan bahawa ChatGPT berfungsi sebagai alat sokongan yang efektif dalam membantu pelajar bukan sahaja dari segi kandungan dan struktur, tetapi juga dari segi motivasi dan keyakinan kendiri. Namun begitu, adalah penting untuk mengiringi penggunaan ini dengan bimbingan pedagogi yang seimbang agar pelajar tidak menjadi terlalu bergantung, sebaliknya membina kebolehan komunikasi autentik mereka sendiri.



Rajah 5: Keberkesanan penggunaan ChatGPT secara keseluruhan serta kecenderungan mereka untuk terus menggunakannya dalam tugasan masa depan.

Rajah 5 menunjukkan tahap persepsi pelajar terhadap keberkesanan penggunaan ChatGPT secara keseluruhan serta kecenderungan mereka untuk terus menggunakannya dalam tugasan masa depan. Data menunjukkan penerimaan yang sangat positif terhadap penggunaan teknologi ini dalam konteks pembelajaran kursus Pengucapan Awam.

Dalam item pertama, 92.59% pelajar bersetuju bahawa ChatGPT membantu hasil kerja mereka, dengan pecahan sebanyak 51.85% memilih "membantu" dan 40.74% memilih "sangat membantu". Tiada pelajar yang menyatakan bahawa ChatGPT "tidak membantu" atau "sangat tidak membantu", dan hanya 7.41% bersikap neutral. Dapatan ini menunjukkan bahawa majoriti pelajar merasakan penggunaan ChatGPT telah memberi impak langsung terhadap kualiti dan kecekapan hasil kerja mereka. Ini disokong oleh kajian oleh Mudreh dan Jamaludin (2023), yang mendapati bahawa pelajar yang menggunakan ChatGPT melaporkan peningkatan prestasi akademik melalui tugasan yang lebih tersusun dan mudah difahami.

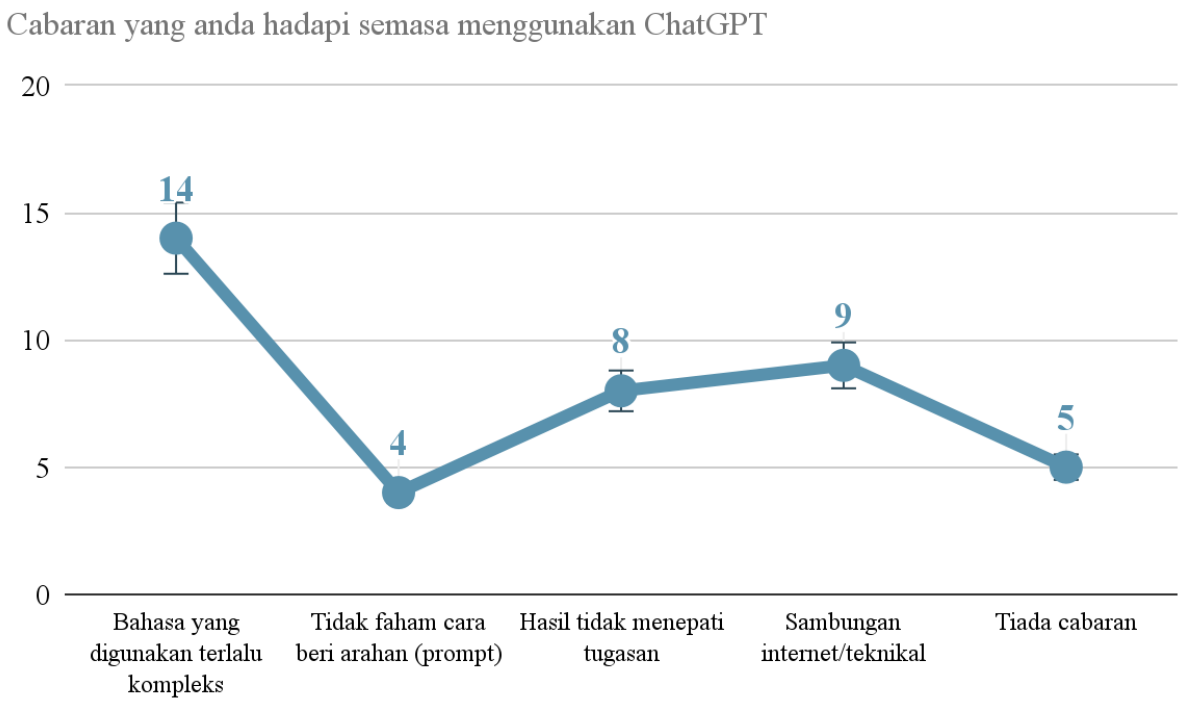
Item kedua pula menunjukkan bahawa 100% pelajar menyatakan mereka ingin terus menggunakan ChatGPT dalam tugasan masa depan. Ini adalah indikator yang kuat terhadap nilai praktikal dan kebolehgunaan aplikasi ini dalam konteks akademik. Dapatan ini konsisten dengan laporan oleh Kholidi et al. (2024), yang menyatakan bahawa pelajar universiti di Malaysia semakin cenderung menerima teknologi AI dalam pembelajaran selagi ia dapat menjimatkan masa, meningkatkan pemahaman, dan menghasilkan kerja berkualiti.

Kebergantungan sepenuhnya kepada ChatGPT bukanlah fokus utama, sebaliknya pelajar menggunakannya sebagai alat pelengkap untuk menyokong proses pembelajaran dan penyediaan tugasan. Ini menunjukkan adanya pendekatan penggunaan yang lebih kritikal dan bersifat reflektif. Menurut Kambaruddin dan Aziz (2023), pelajar yang diberikan pendedahan kepada etika penggunaan AI dan kemahiran prompting cenderung menggunakannya secara bertanggungjawab dan tidak bergantung secara membuta tuli terhadap sistem.

Selain itu, dapatan ini turut menyokong keperluan untuk integrasi alat AI seperti ChatGPT dalam kurikulum pengajaran, dengan syarat ia disertakan dengan garis panduan dan bimbingan pedagogi yang sesuai. Penggunaan teknologi perlu ditanamkan dengan nilai etika, agar pelajar bukan sahaja memperoleh manfaat teknologi tetapi juga kekal membina keupayaan kendiri dalam komunikasi dan penulisan.

6.5 Cabaran Penggunaan ChatGPT

Antara cabaran yang dihadapi oleh pelajar semasa menggunakan ChatGPT dalam tugasan kursus Pengucapan Awam digambarkan dalam Rajah 6. Walaupun dapatan sebelum ini menunjukkan kadar penerimaan dan keberkesanan yang tinggi, jadual ini mendedahkan beberapa aspek kritikal yang menghalang keberkesanan maksimum penggunaan ChatGPT dalam kalangan pelajar.



Rajah 6: Cabaran yang dihadapi pelajar ketika menggunakan ChatGPT

Cabaran utama yang dikenal pasti ialah "Bahasa yang digunakan terlalu kompleks", dilaporkan oleh 51.85% pelajar. Ini menunjukkan bahawa sesetengah pelajar mungkin mengalami kesukaran memahami respon yang dijana oleh ChatGPT, terutama apabila sistem menghasilkan teks dengan struktur dan kosa kata yang bersifat akademik atau terlalu formal. Kajian oleh Nurul Ain Mudreh dan Muhammad Hafiz Jamaludin (2023) menyatakan bahawa pelajar kerap melaporkan keperluan untuk "menterjemah" semula output AI agar

sesuai dengan tahap kefahaman mereka. Ini menandakan perlunya pembangunan literasi AI dalam kalangan pelajar agar mereka dapat menyesuaikan dan menilai maklumat yang dijana dengan lebih kritikal.

Selain itu, 14.81% pelajar menghadapi kesukaran memberi arahan atau prompt yang jelas kepada ChatGPT. Kemahiran memberi arahan (prompting skills) merupakan asas dalam berinteraksi dengan sistem AI generatif. Kegagalan dalam aspek ini menyebabkan hasil yang dijana tidak menepati jangkaan atau tidak berkaitan dengan kehendak tugasan. Kholidi et al. (2024) menekankan bahawa pelajar memerlukan latihan khusus dalam kemahiran memberikan arahan yang tepat untuk meningkatkan keberkesanan interaksi dengan ChatGPT.

29.63% responden melaporkan bahawa hasil yang dijana tidak menepati tugasan, manakala 33.33% menyatakan masalah sambungan internet atau teknikal sebagai halangan. Ini mencerminkan bahawa keberkesanan teknologi bukan hanya bergantung kepada kecanggihan sistem, tetapi juga pada infrastruktur dan sokongan digital yang mencukupi. Seperti yang dinyatakan oleh Maslina Mastam (2024), ketidaksamarataan akses teknologi dalam kalangan pelajar boleh menyumbang kepada ketidakseimbangan dalam penggunaan alat digital, khususnya bagi pelajar dari latar belakang sosioekonomi yang berbeza.

Walau bagaimanapun, sebanyak 18.52% pelajar melaporkan tiada cabaran langsung dalam penggunaan ChatGPT, menunjukkan bahawa sebahagian pelajar telah menyesuaikan diri dengan baik atau mungkin mempunyai tahap literasi digital yang lebih tinggi.

Secara keseluruhannya, dapatan ini menunjukkan bahawa walaupun ChatGPT mempunyai potensi besar sebagai alat sokongan pembelajaran, terdapat keperluan mendesak untuk intervensi pendidikan digital yang komprehensif. Ini termasuk latihan memberi arahan berkesan, penyederhanaan bahasa output, serta penyediaan akses teknikal yang lebih stabil agar teknologi ini dapat dimanfaatkan secara optimum dalam pembelajaran tinggi.

7 KESIMPULAN DAN CADANGAN PENAMBAHBAIKAN

Berdasarkan objektif kajian yang menumpukan kepada aspek struktur, kandungan dan keyakinan pelajar dalam tugasan pengucapan awam, hasil analisis mendapati bahawa penggunaan ChatGPT telah memberi impak positif dalam membantu pelajar menghasilkan ucapan yang lebih tersusun, kreatif dan meyakinkan. Penekanan diberikan kepada peranan ChatGPT dalam membantu pelajar memilih tajuk ucapan, menyusun isi kandungan, serta meningkatkan keyakinan dan kemahiran penyampaian semasa menyediakan tugasan pembentangan akhir.

Kajian ini menggunakan pendekatan kuantitatif deskriptif, melibatkan seramai 27 orang pelajar yang telah menggunakan ChatGPT dalam tugasan mereka. Data dikumpul melalui soal selidik yang menilai persepsi pelajar sebelum dan selepas menggunakan ChatGPT. Dapatan menunjukkan 33.33% sehingga 48.15% pelajar menghadapi kesukaran dalam menghasilkan ucapan yang tersusun dan meyakinkan sebelum menggunakan ChatGPT seperti ditunjukkan dalam analisa maklumbalas pelajar dalam Jadual 3. Selepas penggunaan ChatGPT, pelajar melaporkan peningkatan dari segi struktur isi, kreativiti kandungan, serta keyakinan ketika berucap. Analisa Rajah 4 menunjukkan 81.48% hingga 92.59% pelajar bersetuju dengan perkara ini. Secara keseluruhannya, kajian ini menyimpulkan bahawa ChatGPT berpotensi sebagai alat sokongan yang efektif dalam pembelajaran kursus pengucapan awam, namun kesedaran dan kemahiran penggunaan secara beretika perlu diterapkan bagi memastikan keberkesanannya dimaksimumkan.

Berdasarkan dapatan kajian ini menunjukkan keberkesanan penggunaan ChatGPT dalam membantu pelajar menghasilkan ucapan yang lebih tersusun, kreatif dan yakin, serta mengambil kira cabaran-cabaran yang dikenal pasti semasa proses penggunaan, beberapa cadangan dikemukakan untuk meningkatkan keberkesanan penggunaan ChatGPT secara holistik dalam konteks pendidikan tinggi.

Kajian mendapati sebahagian pelajar menghadapi kesukaran dalam memberikan arahan (prompt) yang tepat kepada ChatGPT, menyebabkan output yang dijana tidak memenuhi keperluan tugasan. Justeru, disarankan agar institusi pengajian tinggi melaksanakan latihan bersifat hands-on berkaitan asas penggunaan AI, dengan fokus kepada kemahiran memberi arahan secara berstruktur. Latihan ini boleh diintegrasikan ke dalam kursus asas ICT atau ditawarkan sebagai bengkel tambahan secara berkala. Latihan ini harus merangkumi komponen "*prompt engineering*", teknik semak semula output, serta amalan bertanggungjawab dalam penggunaan AI.

Bagi memastikan pelajar menggunakan ChatGPT secara berkesan dan beretika, penggunaan teknologi ini wajar disepadukan dalam aktiviti pembelajaran secara terarah. Pensyarah boleh mereka bentuk tugasan yang mewajibkan pelajar menganalisis, menyesuaikan, atau memperbaiki output yang dijana oleh ChatGPT, sekali gus menggalakkan pemikiran kritikal dan reflektif. Penggunaan AI dalam tugasan tidak seharusnya berbentuk pengganti kerja pelajar, tetapi sebagai alat bantu yang memupuk kefahaman dan kreativiti kendiri.

Dapatan menunjukkan 51.85% pelajar menghadapi kesukaran memahami bahasa kompleks yang dijana oleh sistem. Oleh itu, disarankan agar institusi dan pihak penyedia teknologi bekerjasama dalam menyediakan ciri-ciri mesra pelajar, seperti "mode pembelajaran" atau "penyederhanaan bahasa automatik". Pelajar juga boleh dilatih menggunakan arahan seperti *"jelaskan semula dalam bahasa mudah"* bagi memastikan interaksi lebih inklusif dan efektif.

Walaupun penggunaan ChatGPT menunjukkan manfaat yang jelas, masih wujud kebimbangan terhadap kebergantungan pelajar kepada sistem ini secara membuta tuli. Oleh itu, garis panduan institusi perlu dirangka untuk mengawal selia penggunaan teknologi AI dalam konteks akademik, termasuk cara membuat pengakuan penggunaan, pembezaan antara karya asli dan dibantu AI, serta amalan menyemak fakta dan sumber dengan kritikal. Penerapan nilai integriti dan tanggungjawab akademik harus menjadi komponen utama dalam usaha membina budaya celik teknologi yang etikal.

Bagi menangani isu teknikal seperti gangguan internet dan capaian tidak stabil yang dilaporkan oleh 33.33% responden, pihak institusi disarankan untuk memperluaskan kemudahan ICT yang boleh diakses secara adil oleh semua pelajar. Perkhidmatan internet percuma berkelajuan tinggi di perpustakaan, makmal komputer, dan ruang pembelajaran terbuka perlu dipertingkatkan agar tidak berlaku ketidaksamarataan dalam peluang penggunaan teknologi pembelajaran.

Secara keseluruhannya, ChatGPT mempunyai potensi yang tinggi sebagai alat bantu pembelajaran, khususnya dalam kursus yang memerlukan kemahiran penulisan, komunikasi dan kreativiti. Namun begitu, kejayaan integrasinya dalam pendidikan bergantung kepada reka bentuk pedagogi yang teliti, kesediaan infrastruktur, dan penanaman nilai etika dalam kalangan pelajar. Dengan melaksanakan langkah-langkah yang dicadangkan, institusi pendidikan dapat memastikan bahawa penggunaan ChatGPT bukan sahaja memberi nilai tambah, tetapi juga membentuk pelajar yang celik teknologi, bertanggungjawab, dan bersedia menghadapi keperluan masa depan.

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Cash Trail Adventure: Gamified Learning for Numeracy, Financial Literacy, and Islamic Finance in the 4IR Era

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ABSTRACT

As financial literacy becomes increasingly essential in today's digital economy, there is growing demand for educational tools that are innovative, values-driven, and grounded in practical relevance. Despite this need, innovative methods of teaching financial literacy, particularly those integrating real-world scenarios and ethical considerations remain scarce. This challenge is further magnified in the context of Islamic finance, where Shariah-compliant principles are often underrepresented in mainstream educational settings. Cash Trail Adventure introduces a gamified, scenario-based learning tool designed to support financial literacy, numeracy, and ethical financial decision-making. The game incorporates core Islamic finance principles such as risk-sharing along with budgeting and saving challenges. Rather than replacing traditional instruction, this tool offers a complementary, engaging platform for applied learning. A pilot study was conducted with 58 undergraduate students during a financial literacy workshop. Using pre- and post-survey assessments, the study evaluated changes in knowledge and engagement. Results revealed statistically significant improvements in 13 out of 15 financial literacy components ($p < 0.05$), with high internal consistency (Cronbach's Alpha = 0.96). Additionally, over 90% of participants rated the game as engaging and helpful in understanding complex concepts. Qualitative feedback indicated increased confidence in financial decision-making and appreciation for the game's real-life scenarios. Designed for flexible integration into classroom, workshop, or hybrid formats, Cash Trail Adventure contributes to Malaysia's national financial literacy agenda while supporting broader goals of educational innovation in the 4IR era. Future developments will focus on AI-driven personalization and digital adaptation to expand accessibility and long-term impact. This exploratory study provides early evidence of the tool's potential to enhance financial literacy through interactive, ethical, and culturally relevant learning.

KEYWORDS: Gamified Learning, Numeracy Skills, Financial Literacy, Islamic Finance Education, 4th Industrial Revolution (4IR), Ethical Decision-Making, Educational Innovation, Scalability and Adaptability

1 INTRODUCTION

The Fourth Industrial Revolution (4IR) is transforming the landscape of education, creating new demands for future-ready skills among learners. As societies become increasingly digital, individuals must be equipped with core competencies such as financial literacy, numeracy, and ethical decision-making to navigate complex financial environments (World Economic Forum, 2018; OECD, 2020). While financial education has gained global attention, innovative methods that integrate real-world application and values-based content remain scarce. This limitation is particularly evident in Islamic finance education, where concepts such as risk-sharing, prohibition of interest (riba), and ethical investment are often overlooked in

conventional curricula (Bank Negara Malaysia, 2010). Consequently, there is a pressing need to explore alternative, engaging approaches to deliver financial literacy in a culturally relevant and applied manner.

To address this gap, Cash Trail Adventure introduces a gamified, scenario-based learning tool designed to strengthen learners' financial understanding and decision-making skills. The tool embeds Islamic finance principles such as musharakah (risk-sharing) and the prohibition of riba, alongside everyday financial topics like budgeting, saving, and spending. Unlike traditional instructional models that rely on lecture-based delivery, this game offers learners an interactive experience where they can practice financial choices in a simulated environment. The aim is not to replace traditional methods, but to complement them, providing a more engaging and applied approach to financial literacy education. Grounded in gamification theory (Kapp, 2012) and behavioural financial literacy frameworks, this approach supports deeper learning through practice, reflection, and ethical awareness (Iqbal & Mirakhor, 2011).

A pilot study was conducted with 58 undergraduate students during a financial literacy workshop organized in collaboration with Pandu Puteri Malaysia. Participants engaged with the game and completed pre- and post-survey assessments measuring their knowledge and confidence in making financial decisions. Statistical analysis using the Wilcoxon signed-rank test revealed significant improvements in 13 out of 15 financial literacy components ($p < 0.05$), while a post-survey Cronbach's Alpha of 0.96 indicated strong internal consistency. Over 90% of participants rated the game as engaging and educational. Qualitative feedback highlighted the game's ability to simplify complex financial concepts and promote learner participation through relatable scenarios. Aligned with Malaysia's Financial Literacy Strategy 2019–2023, the Malaysia Education Blueprint 2013–2025, and the United Nations Sustainable Development Goals (SDGs), this study contributes to the national and global movement for practical, inclusive, and values-driven education. The modular design of Cash Trail Adventure makes it adaptable for use in various settings, including classrooms, hybrid learning environments, and financial literacy outreach programs. With further refinement, integration of AI-driven personalization, and expanded testing, this tool holds potential as a scalable solution to enhance financial literacy and ethical financial behaviour among diverse learner groups in the 4IR era.

The research framework guiding this study is grounded in gamification theory, behavioural financial literacy, numeracy skills and Islamic financial ethics. It outlines the key components from problem identification to methodological approach, emphasizing the integration of numeracy, financial literacy, and ethical values. The framework is illustrated in Figure 1.

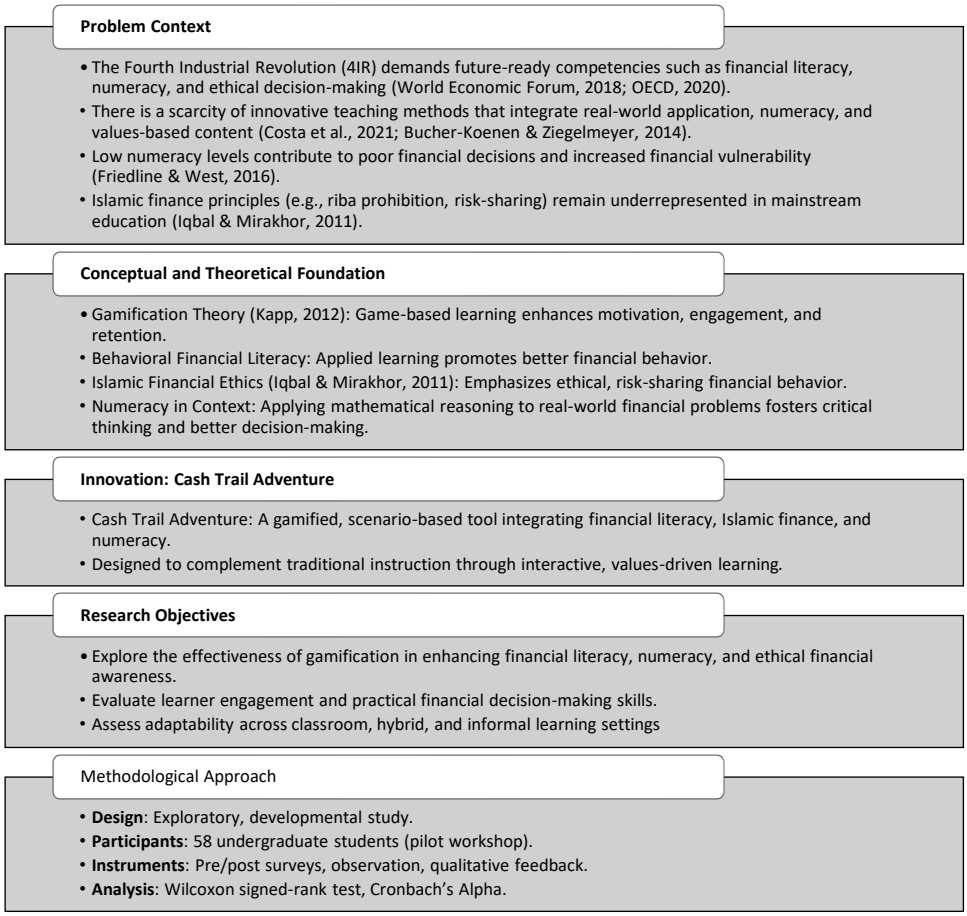


Figure 1: Research Framework

2 LITERATURE REVIEW

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All text paragraphs should be single-spaced, with the first line intended by 10 mm. Double spacing should only be used before and after headings and subheadings as shown in this example. Position and style of headings and subheadings should follow this example. No spaces should be placed between paragraphs.

2.1 Gamification in Financial Literacy

Gamification has gained prominence as a transformative tool in education, incorporating game mechanics such as points, rewards, challenges, and interactive decision-making to enhance engagement and learning outcomes (Kapp, 2012). Research indicates that gamified learning improves retention, motivation, and active participation, particularly in financial education, where abstract concepts often hinder learner comprehension (Zainuddin, 2023; James et al., 2024). The impact of gamification on learning outcomes was significantly observed during the COVID-19 pandemic, where digital gamified tools helped maintain engagement despite remote learning barriers (Zainuddin, 2023). Gamified mobile applications and financial simulations have been linked to improved retention, better decision-making, and increased enthusiasm for financial literacy topics (James et al., 2024). Additionally, empirical studies support a causal relationship between gamification and improved academic performance, especially when personalized game elements such as badges and rewards are included (Denny et al., 2018).

Despite these benefits, challenges exist in sustaining user engagement. One-size-fits-all gamification models can lead to user fatigue, loss of motivation, and reduced long-term effectiveness (Yang et al., 2024). Personalized gamification, tailored to individual learning preferences, has been shown to significantly enhance motivational, behavioral, and cognitive outcomes (Xiao & Hew, 2024). Cash Trail Adventure addresses this gap by integrating adaptive difficulty levels, Islamic finance decision-making components, and collaborative learning to sustain engagement and ensure a more inclusive gamified learning experience.

2.2 Numeracy and Financial Literacy: A Critical Need

Financial literacy encompasses the ability to understand, evaluate, and apply financial knowledge for informed decision-making, while numeracy skills enable individuals to analyze costs, manage budgets, and calculate financial risks (OECD, 2020). Studies have shown that financial literacy and numeracy together significantly impact financial resilience, influencing savings behavior, risk tolerance, and investment decisions (Costa et al., 2021). Low numeracy rates have been linked to financial distress, poor wealth accumulation, and an overreliance on high-cost financial services (Bucher-Koenen & Ziegelmeyer, 2014). Millennials, in particular, demonstrate concerning financial behaviors, with those possessing strong numeracy skills showing healthier financial habits, better savings discipline, and improved credit management (Friedline & West, 2016). Gamified financial education tools, like Cash Trail Adventure, offer an effective approach to strengthening numeracy by incorporating real-world budgeting challenges and financial decision-making tasks into an engaging, interactive format.

2.3 Islamic and Ethical Decision Making

Islamic finance is rooted in ethical principles, emphasizing risk-sharing (musharakah), prohibition of interest (riba), and social responsibility (zakat, waqf, sadaqat) (Iqbal & Mirakhor, 2011). These principles align with global sustainability efforts, particularly the United Nations' Sustainable Development Goals (SDGs), which emphasize ethical financial inclusion (Dirie et al., 2023). Islamic finance promotes financial stability and sustainability by ensuring equitable distribution of wealth, ethical investment practices, and prohibition of speculative transactions (gharar) (Harahap et al., 2023). However, despite its significance, Islamic financial literacy remains low, with many learners lacking exposure to its principles and applications (Wijaya et al., 2024).

Gamification offers an innovative solution to bridge this knowledge gap. By simulating real-world Islamic finance transactions, such as profit-sharing (mudharabah), leasing (ijarah), and donation-based financing (waqf), Cash Trail Adventure provides an immersive, interactive experience that enhances financial literacy while instilling ethical decision-making skills.Moreover, studies have shown that ethical financial decision-making can be reinforced through game-based learning, as players grasp abstract financial concepts more effectively through real-world scenarios (Pal et al., 2021). By integrating Islamic finance principles into its gameplay, Cash Trail Adventure ensures that learners engage with financial ethics in a meaningful and practical manner.

2.4 Transitioning Gamified Tools to Hybrid and Digital Environment

The successful integration of gamified financial education into digital learning ecosystems depends on technological agility, leadership in digital innovation, and strategic implementation (Bellis et al., 2024). Digital gamification has proven effective in increasing engagement, knowledge retention, and collaborative learning in educational settings (Tuamsuk et al., 2023). However, challenges exist in transitioning gamified tools into digital environments, including technological exhaustion, low user engagement, and difficulties in integrating gamification into formal education frameworks (Exploring the ineffectiveness of gamification health management, 2023). Strategic frameworks such as the Augmented Learning Environment (ALE) provide solutions by enhancing real-time feedback, adaptability, and user engagement through AI-driven customization (Brom et al., 2010). Cash Trail Adventure is designed with scalability and future AI-driven adaptability in mind. Future iterations will include personalized difficulty adjustments, real-time financial simulations, and mobile or web-based applications to expand accessibility. The inclusion of learning

analytics and progress tracking will further enhance learner engagement and retention, ensuring a seamless transition into hybrid and digital education settings.

2.5 Contribution of This Study

This study introduces Cash Trail Adventure as a game-based learning tool that integrates numeracy, financial literacy, and Islamic finance principles to create an engaging, impactful, and scalable financial education framework. Unlike conventional financial literacy programs, this approach leverages gamification to foster practical decision-making, ethical financial literacy, and real-world application of financial concepts. The study contributes to national and international financial education strategies, aligning with Malaysia's Financial Literacy Strategy 2019–2023 (Financial Education Network, 2019), Malaysia Education Blueprint 2013–2025 (Ministry of Education Malaysia, 2013) and United Nations Sustainable Development Goals (SDGs) (Dirie et al., 2023). By combining interactive learning, gamification mechanics, and ethical financial principles, Cash Trail Adventure serves as a scalable educational model, paving the way for future AI-driven personalization and digital financial literacy innovations.

3 METHODOLOGY

3.1 Research Design

This study employs a developmental and exploratory research design, focusing on the design, implementation, and assessment of Cash Trail Adventure as a gamified financial literacy tool. The research aims to evaluate the feasibility, usability, and educational impact of the game on numeracy skills, financial literacy, and ethical financial decision-making. The study follows a pre- and post-intervention approach, where participants engaged in Cash Trail Adventure during a structured session at the Pandu Puteri event. The research examines whether financial literacy scores improved after gameplay and explores participants' engagement, perceptions, and learning outcomes. Since the Cash Trail Adventure Module remains in development, this study serves as a foundational step in demonstrating the game's effectiveness and potential for structured educational implementation.

3.2 Participants

The study involved 58 Year 1 undergraduate students aged 20 and above, who participated in a financial literacy session at the Pandu Puteri event. This demographic was selected as it represents young adults in the early stages of financial independence, making financial literacy a crucial skill for their future decision-making. The voluntary participation of these students provided valuable insights into the effectiveness of gamification in financial education. Participants were introduced to the game, provided with pre-surveys to assess their initial financial literacy, and then engaged in interactive gameplay. Following the session, a post-survey was conducted to evaluate their learning progress. To ensure ethical research practices, informed consent was obtained, and participants were assured of anonymity in their responses.

3.3 Gamified Tool Development: Cash Trail Adventure

Cash Trail Adventure was developed as an interactive, scenario-based financial literacy game designed to enhance numeracy skills, improve financial literacy, and introduce ethical financial principles. The game integrates real-world financial challenges and decision-making tasks to simulate everyday financial experiences. The gameplay mechanics of Cash Trail Adventure incorporate scenario-based decision-making, where players navigate budgeting, investment, and risk assessment tasks. It includes numeracy-based calculations, requiring participants to compute interest rates, compare financial products, and evaluate spending choices. Additionally, the game features ethical financial literacy principles, aligning with Islamic finance concepts such as risk-sharing and fairness. By providing real-time financial implications, the game allows players to observe how financial decisions affect long-term financial stability. The modular nature of the game allows for future digital adaptations and structured integration into financial

literacy curricula, ensuring scalability and alignment with Malaysia's Financial Literacy Strategy 2019–2023 and Education Blueprint 2013–2025.

3.4 Data Collection Instruments

In order to measure the effectiveness of Cash Trail Adventure, the study employed three primary data collection instruments: pre- and post-survey assessments, participant feedback forms, and observational checklists. The pre- and post-survey assessments were designed to measure changes in financial literacy and numeracy skills before and after gameplay. The questions covered key areas such as budgeting, debt management, investment knowledge, and Islamic finance principles. Responses were recorded using a 5-point Likert scale, assessing participants' confidence and understanding of financial concepts. The participant feedback forms gathered qualitative insights on engagement, usability, and learning effectiveness. Open-ended questions allowed participants to share their experiences, identifying what aspects of the game were most useful and engaging. Additionally, an observational checklist was used to record participant behaviour during gameplay. Researchers noted engagement levels, collaboration, and financial decision-making strategies, providing a qualitative perspective on the game's educational impact. These observations complemented the survey findings by offering a deeper understanding of how participants interacted with the game.

3.5 Data Analysis

A mixed-methods approach was applied to analyse the collected data, incorporating both quantitative and qualitative analyses. For quantitative analysis, descriptive statistics were used to assess pre- and post-survey responses, calculating measures such as mean, median, and standard deviation. These statistics provided insights into the overall improvement in financial literacy scores. Boxplot visualizations were also generated to illustrate the distribution of pre- and post-survey scores, highlighting any significant shifts in participant performance. A reliability test (Cronbach's Alpha) was conducted to assess the internal consistency of the survey instrument with threshold of 0.7.

To determine whether the data followed a normal distribution, a Shapiro-Wilk normality test was performed. The hypothesis statement is:

H_0: The data follows a normal distribution.

H_1: The data does not follow a normal distribution.

Since most of p-values < 0.05, these indicates non-normality of the questions. Due to this, the Wilcoxon signed-rank test was used to assess the significance of improvements in financial literacy scores. The hypothesis statement is:

H_0: There is no significant difference between the pre-survey and post-survey scores.

H_1: There is a significant difference between the pre-survey and post-survey scores.

If the questions demonstrated statistically significant improvements, hence its p-value should be less than 0.05, validating the effectiveness of Cash Trail Adventure as a learning tool.

For qualitative analysis, thematic coding was applied to participant feedback. Responses were categorized into key themes such as engagement, learning impact, and usability. A word cloud visualization was generated to highlight frequently mentioned terms, further reinforcing the game's effectiveness in promoting financial literacy. Observational data on participant behaviour during gameplay were also analysed, providing insights into how players approached financial decision-making and collaborated with peers.

3.6 Ethical Consideration

This study adhered to ethical research practices to ensure the well-being of participants and the integrity of data collection. All participants were informed about the study's objectives, and verbal consent was obtained before their participation. Anonymity and confidentiality were maintained, with all collected data used solely for research purposes. Additionally, the game's design incorporated ethical and cultural sensitivity, particularly in integrating Islamic finance principles. Care was taken to ensure that financial

scenarios reflected Shariah-compliant decision-making, making the game inclusive and relevant for diverse learners.

4 RESULTS AND FINDINGS

4.1 Reliability Test (Cronbach's Alpha)

To ensure the internal consistency of the pre- and post-survey assessments, a Cronbach's Alpha test was conducted. As in Table 1, the pre-survey Cronbach's Alpha score was 0.89, indicating good reliability, while the post-survey Cronbach's Alpha score of 0.96 demonstrated excellent reliability. These results confirm that the questionnaire effectively measured financial literacy and numeracy improvements among participants. The high post-survey reliability score suggests that after engaging with Cash Trail Adventure, participants provided more consistent responses, reinforcing the robustness of the instrument in assessing financial literacy learning outcomes.

Table 1: Cronbach's Alpha Reliability Test

Survey	Cronbach's Alpha	Reliability Level
Pre-Survey	**0.89**	Good
Post-Survey	**0.96**	Excellent

4.2 Descriptive Analysis

Descriptive statistics were used to compare pre- and post-survey responses, analysing the mean, median, and standard deviation for each financial literacy component. As in Table 2, the findings indicate a notable improvement in financial literacy and numeracy skills following engagement with Cash Trail Adventure. The mean scores for all financial literacy-related questions increased post-survey, while standard deviation values decreased, suggesting that participants' knowledge and confidence in financial decision-making became more consistent. The improvement in median scores further confirms that the game successfully enhanced participants' understanding of financial concepts.

A closer examination of the results shows that questions with initially lower mean scores in the pre-survey demonstrated the most significant improvements post-intervention. This suggests that participants who had weaker financial literacy skills before playing the game benefited the most from the learning experience. The consistency in post-survey responses, as evidenced by the reduced standard deviation, indicates that participants reached a more uniform understanding of the financial literacy concepts introduced in the game.

Table 2: Descriptive Statistics (Pre- and Post-Survey Scores)

Question	Mean (Pre)	Mean (Post)	Median (Pre)	Median (Post)	Std. Dev (Pre)	Std. Dev (Post)
Q1	3.57	4.42	3.5	4	1.02	0.57
Q2	2.69	4.33	3	4	0.95	0.61
Q3	3.50	4.50	3.5	5	0.88	0.54
Q4	3.69	4.44	4	5	0.86	0.63
Q5	4.33	4.46	4	5	0.61	0.61
Q6	3.52	4.38	3	4	0.84	0.63
Q7	2.63	4.22	3	4	0.97	0.66
Q8	3.50	4.39	3	4	0.72	0.56
Q9	3.44	4.44	3	4.5	1.00	0.60

4.3 Normality Test

A Shapiro-Wilk normality test was conducted to determine whether the pre- and post-survey data were normally distributed. The results indicated that all financial literacy-related questions had p-values below 0.05, signifying that the data did not follow a normal distribution. The only exception was the AGE variable, which had a p-value of 1.0 (as in Table 3), confirming that there was no variation in participants' ages. Given the non-normal distribution of the data, the Wilcoxon signed-rank test was selected as the appropriate statistical method to assess the significance of changes in financial literacy scores.

Table 3: Normality Test

Question	p-value	Normality
AGE	1.0	Normally Distributed
Q1	0.0000	Not Normally Distributed
Q2	0.0000	Not Normally Distributed
Q3	0.0000	Not Normally Distributed
Q4	0.0000	Not Normally Distributed
Q5	0.0000	Not Normally Distributed
Q6	0.0000	Not Normally Distributed
Q7	0.0000	Not Normally Distributed
Q8	0.0000	Not Normally Distributed
Q9	0.0000	Not Normally Distributed
Q10	0.0000	Not Normally Distributed
Q11	0.0000	Not Normally Distributed
Q12	0.0000	Not Normally Distributed
Q13	0.0000	Not Normally Distributed
Q14	0.0000	Not Normally Distributed
Q15	0.0000	Not Normally Distributed

4.4 Wilcoxon Signed-Rank Test Results

The Wilcoxon signed-rank test was applied to evaluate the significance of differences between pre- and post-survey responses. As in Table 4, the results demonstrated that 13 out of 15 financial literacy components showed statistically significant improvements ($p < 0.05$), confirming that Cash Trail Adventure effectively enhanced financial literacy skills. Questions such as Q1, Q2, Q3, and Q7 exhibited the most significant changes, with p-values approaching zero. These findings align with participants' feedback, which emphasized improved understanding and engagement in financial decision-making.

Two questions, Q5 and Q14, did not reach the threshold for statistical significance. The p-value for Q5 (0.1266) suggests that participants had already attained a relatively high level of understanding in this area prior to playing the game, leading to minimal change post-intervention. Meanwhile, Q14 ($p = 0.00073$) demonstrated a slight improvement but did not show as strong a shift as other financial literacy components. These results suggest that while the game was broadly effective, certain topics may require further enhancement to maximize learning gains across all financial literacy domains.

Table 4: Wilcoxon Signed-Rank Test Results

Question	p-value	Interpretation
Q1	0.0000	Significant improvement
Q2	0.0000	Significant improvement
Q3	0.0000	Significant improvement
Q4	0.0000	Significant improvement
Q5	0.1266	Not significant
Q6	0.0000	Significant improvement
Q7	0.0000	Significant improvement
Q8	0.0000	Significant improvement
Q9	0.0000	Significant improvement
Q10	0.0000	Significant improvement
Q11	0.0000	Significant improvement
Q12	0.0000	Significant improvement
Q13	0.0000	Significant improvement
Q14	0.0000	Slightly significant improvement
Q15	0.0000	Significant improvement

4.5 Boxplot Analysis of Pre- and Post-Survey Scores

A boxplot analysis was conducted to visualize the distribution of pre- and post-survey scores across all financial literacy components. The results in Figure 2 clearly illustrate an upward shift in median scores, reinforcing the statistical findings from the Wilcoxon signed-rank test. The narrowing of interquartile ranges in post-survey results suggests that participants' responses became more consistent after engaging with the game. A significant observation from the boxplot analysis is the reduction in outliers in the post-survey results. While the pre-survey responses included several extreme values, particularly on the lower end of the score distribution, these outliers were minimized post-gameplay. This indicates that participants who initially exhibited weaker financial literacy skills were able to catch up with their peers, leading to a more homogeneous distribution of knowledge and confidence in financial decision-making. Additionally, the upper quartile (top 25%) exhibited an upward shift, highlighting that a larger proportion of participants achieved higher financial literacy scores following the intervention. These findings reinforce the effectiveness of Cash Trail Adventure in improving financial literacy in an engaging and interactive manner.

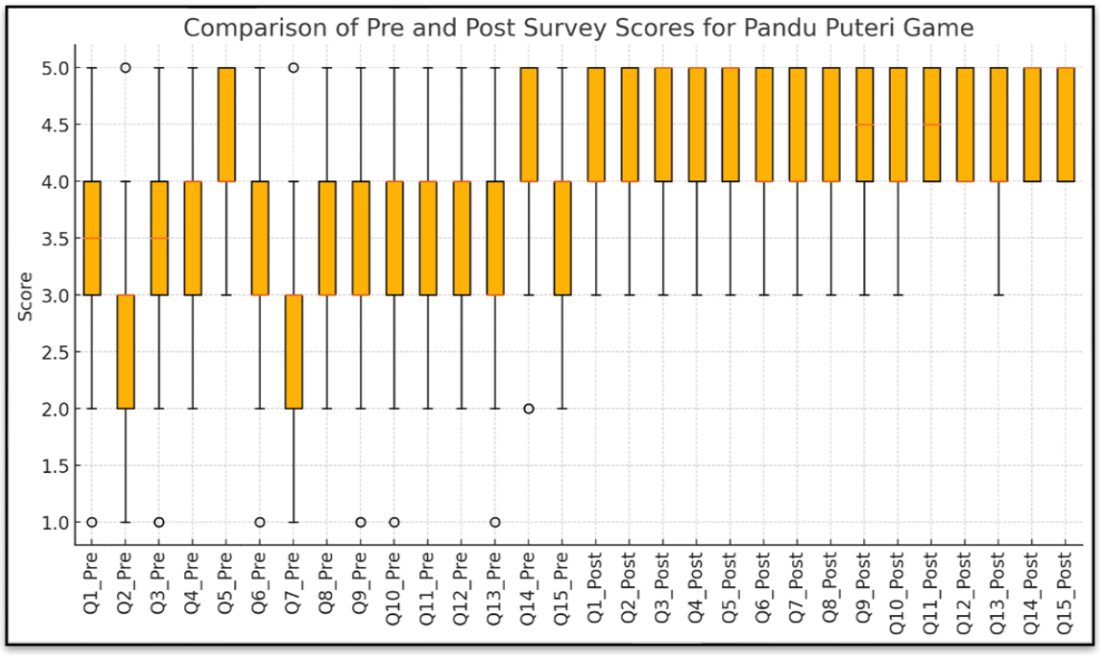


Figure 2: Comparison of Pre- and Post- Survey Scored for Cash Trail Adventure (Boxplot Analysis)

4.6 Participant Feedback and Word Cloud Analysis

The qualitative feedback provided by participants further supports the statistical findings. Over 90% of respondents rated the game as engaging, educational, and enjoyable, highlighting its effectiveness as a financial literacy tool. The feedback emphasized three key themes: engagement, knowledge acquisition, and requests for game expansion.

Many participants described the game as fun and interactive, making complex financial concepts more accessible and easier to understand. Others noted that the game encouraged critical thinking and decision-making, reinforcing their ability to apply financial literacy principles in real-life scenarios (refer to Table 5). The word cloud analysis (Figure 3) of participant responses provides a visual representation of the most frequently mentioned words, including "fun," "game," "enjoy," "love," "knowledge," and "understand." These keywords confirm that participants found the game engaging and educational. Many respondents also expressed enthusiasm for additional stations, new challenges, and future iterations of the game, suggesting strong potential for expansion and scalability.

Table 5: Summary of Participant Feedback

Key Feedback Theme	Example Quotes
Engagement & Fun	"This game was fun! I really enjoyed it."
Financial Knowledge	"It helped me understand financial concepts better."
Critical Thinking	"It made me think critically about financial decisions."
Requests for Expansion	"Hope you add more stations and activities!"

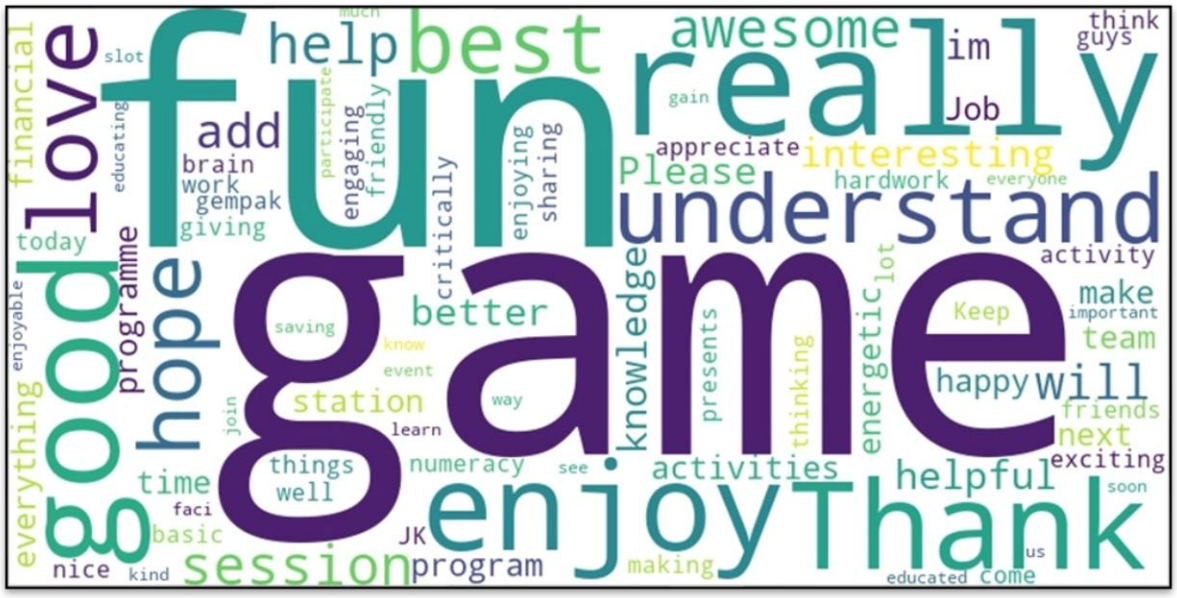


Figure 3: Participant Feedback Word Cloud Highlighting Key Themes

4.7 Discussion

The findings from this study demonstrate that gamified learning through Cash Trail Adventure is an effective strategy for enhancing financial literacy and numeracy skills. The statistically significant improvements in post-survey responses indicate that the game successfully engaged participants and improved their understanding of financial concepts. The positive feedback further reinforces the game's impact, with participants reporting that they found the learning experience enjoyable, interactive, and valuable. The integration of Islamic finance principles within the game represents an innovative approach to ethical financial education. By incorporating scenarios that reflect real-world financial challenges, the game encourages participants to apply financial literacy knowledge in decision-making situations, aligning with best practices in educational gamification. The findings suggest that gamified approaches can bridge the gap between traditional financial education methods and the practical application of knowledge, making financial literacy more accessible to learners.

Furthermore, the observed improvements in financial literacy suggest that Cash Trail Adventure can be an effective tool for financial education programs. The game's potential for scalability and future integration with AI-driven learning models further supports its role in enhancing financial education in Malaysia and beyond. The slight limitations observed in certain financial literacy components (Q5 and Q14) indicate areas for improvement, suggesting that future iterations of the game could incorporate additional learning reinforcements for these topics. Overall, the study supports the growing body of research advocating for gamification in education, particularly in financial literacy. The combination of quantitative statistical improvements and positive qualitative feedback provides strong evidence that Cash Trail Adventure is a valuable tool for financial education. Future enhancements, such as personalized learning pathways and digital expansion, could further increase the impact and accessibility of the game for diverse learner groups.

5 CONCLUSION AND FUTURE RECOMMENDATIONS

5.1 Conclusion

This study highlights the effectiveness of Cash Trail Adventure as an innovative gamified tool for enhancing financial literacy, numeracy skills, and ethical financial decision-making. The findings indicate a significant improvement in financial literacy scores, as confirmed by Wilcoxon signed-rank test results, with 13 out of 15 components showing statistically significant gains. The high Cronbach's Alpha reliability score (0.96 for the post-survey) further supports the consistency and robustness of the assessment instrument,

ensuring that the improvements observed were not due to chance. The positive feedback from participants, as captured in both qualitative responses and word cloud analysis, reinforces the game's effectiveness in making financial learning engaging, interactive, and practical. The results demonstrate that the gamified approach successfully bridges the gap between financial theory and real-world application, a crucial factor in ensuring that learners develop practical financial decision-making skills. Furthermore, the boxplot analysis illustrated a clear upward shift in median scores, showing that participants not only gained financial knowledge but also achieved a more uniform understanding across all skill levels.

The study also validates the integration of Islamic finance principles into gamified learning, addressing a critical gap in ethical financial literacy education. The game successfully engaged participants in Shariah-compliant financial decision-making, reinforcing concepts such as risk-sharing, ethical investing, and responsible financial behaviour. This alignment with Islamic finance and ethical decision-making frameworks ensures that the game remains culturally and contextually relevant, particularly in Malaysia's financial literacy agenda. By aligning with Malaysia's Financial Literacy Strategy 2019–2023, the Malaysia Education Blueprint 2013–2025, and the global Sustainable Development Goals (SDGs), Cash Trail Adventure provides a scalable and impactful solution for addressing financial literacy gaps. The success of this study suggests that gamified learning is a powerful tool for enhancing financial resilience, economic empowerment, and lifelong learning in the Fourth Industrial Revolution (4IR) era.

5.2 Future Recommendations

Building on the success of Cash Trail Adventure, several key recommendations can enhance its impact, scalability, and long-term effectiveness in financial education. One of the most crucial next steps is the development of a structured financial literacy module that accompanies the game. While Cash Trail Adventure has already demonstrated its effectiveness in improving financial literacy, a comprehensive module will ensure that educators can integrate the game into formal curricula, maximizing learning outcomes. The module should include theoretical concepts, structured lesson plans, guided activities, and real-world financial case studies to reinforce financial literacy principles. This will enable structured implementation in schools, universities, and community financial education programs. Another essential advancement is the integration of AI-driven personalization and digital enhancements. AI can be used to customize game experiences based on individual learning levels, providing adaptive challenges and real-time feedback to learners. A digital version of Cash Trail Adventure—whether as a mobile app, web-based game, or VR-enhanced experience—would significantly expand accessibility, allowing individuals from diverse backgrounds to engage with financial literacy education beyond physical classroom settings. The incorporation of digital learning analytics would also enable educators and researchers to track longitudinal improvements in financial literacy skills over time.

Nationwide scalability is another critical direction for the future of Cash Trail Adventure. The game has demonstrated strong potential for implementation on a larger scale, making it an ideal candidate for nationwide financial literacy programs. Collaboration with government agencies, financial institutions, and educational policymakers can support the game's expansion into schools, universities, and community programs. Partnering with Bank Negara Malaysia, the Financial Education Network (FEN), and Islamic finance institutions could further enhance institutional support and funding opportunities. By implementing the game on a broader national level, it can help bridge financial literacy gaps across different demographics, particularly among youth and underserved communities. To further validate and improve the game's effectiveness, conducting longitudinal studies will provide deeper insights into behavioural changes over time. While the pre- and post-survey results indicate immediate improvements in financial literacy, tracking participants over an extended period will determine whether the knowledge and skills gained from the game translate into long-term financial resilience. Future research should focus on assessing the game's impact on financial behaviors, savings patterns, and investment decisions to establish a stronger link between gamified learning and real-world financial sustainability.

Additionally, expanding the game's scope to cater to different demographics will enhance its inclusivity and relevance. While the current study focused on undergraduate students, future iterations of Cash Trail Adventure can be adapted for working professionals, entrepreneurs, and underprivileged communities. Tailoring the game to specific financial literacy needs, such as entrepreneurship finance, retirement planning, or microfinance education, will allow it to serve as a valuable financial education tool

for diverse audiences. Lastly, integrating Islamic financial literacy components into the game will further strengthen its relevance for Muslim participants. By incorporating interactive lessons on Islamic finance products, Waqf, Zakat, and Halal investing, the game can align with Malaysia's broader Islamic financial literacy agenda. This will also position the game for adoption in other Muslim-majority countries that seek innovative tools for ethical finance education.

In conclusion, Cash Trail Adventure stands as a transformative, scalable, and technology-driven financial literacy solution. The study's findings confirm that gamified learning enhances financial knowledge, engagement, and real-world application, making it a powerful tool in financial education. With strategic enhancements, including AI integration, structured modules, national expansion, and demographic adaptation, the game has the potential to become a benchmark model for financial literacy education in Malaysia and beyond. By leveraging the latest advancements in educational technology and gamification, Cash Trail Adventure can continue to empower individuals with financial decision-making skills, fostering long-term financial sustainability in the 4IR era.

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Integrating Play and STEM in Early Childhood Education: Learning the Respiratory System Through Fun and Engaging Activities

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ABSTRACT

Early childhood education (ECE) plays a pivotal role in shaping foundational cognitive, emotional, and social competencies. Integrating play with STEM (Science, Technology, Engineering, and Mathematics) not only engages young learners but also fosters inquiry-based learning and cross-disciplinary skills. This research explores how a hands-on, play-based activity using a model of the human respiratory system enhances conceptual understanding in children aged 4–6 years. Using Vygotsky's social constructivism, Piaget's cognitive development theory, and Gardner's multiple intelligences as theoretical frameworks, this qualitative study investigates the impact of role-play, storytelling, and model construction on young children's scientific knowledge and holistic development. Findings indicate that combining STEM with playful learning boosts engagement, promotes collaboration, strengthens language and numeracy, and builds body awareness. This paper advocates for integrative, child-centred approaches in ECE STEM curricula to build lifelong learners equipped with 21st-century skills.

1 INTRODUCTION

Early childhood is a crucial phase in human development where foundational learning experiences significantly shape a child's cognitive, emotional, and physical growth. According to research in neuroscience and developmental psychology, the early years are marked by rapid brain development and synaptic formation, making them ideal for introducing meaningful and engaging learning activities (Shonkoff & Phillips, 2000). During this critical period, children develop core capabilities such as attention, memory, self-regulation, and reasoning skills that are fundamental for later academic success.

The early years of a child's life are critical for cognitive development. Neuroscience and educational psychology consistently affirm that early experiences influence brain architecture, setting the stage for future learning, behavior, and health. Among various pedagogical strategies, play-based learning stands out for its ability to engage young children in meaningful and joyful exploration (Ginsburg, 2007). At the same time, there is a growing demand to introduce STEM education from an early age to build a pipeline of scientifically literate citizens and problem-solvers.

In early childhood education (ECE), play is more than mere recreation it is the primary context for learning. Play-based learning enables children to explore, experiment, and make sense of the world in ways that are developmentally appropriate and intrinsically motivating (Wood, 2013). It supports the holistic development of children by integrating social interaction, emotional regulation, cognitive processing, and language acquisition into a unified experience. Given its versatility and child-centered nature, play is an ideal platform for integrating emerging domains like STEM (Science, Technology, Engineering, and Mathematics) into early learning.

Concurrently, there is a growing global interest in promoting STEM education from the early years. Early exposure to STEM supports critical thinking, inquiry, creativity, and problem-solving skills capabilities that are essential for future academic and career success in a rapidly changing, technologically driven world (NRC, 2012). However, incorporating STEM into early childhood settings requires thoughtful integration with play-based pedagogies to ensure developmentally appropriate practices are maintained (Hirsh-Pasek et al., 2009).

However, teaching abstract scientific concepts, such as human anatomy, to young children presents unique challenges. This study addresses this gap by examining how the human respiratory system typically considered too complex for early learners can be taught effectively through a play-based, hands-on STEM activity. Children built a simple respiratory model using everyday materials, engaged in doctor-patient role-play, and explored their own bodies' functions through movement and observation.

1.1 Background of the Study

Early childhood represents a critical period for cognitive, social, and emotional development. During this stage, children's brains exhibit heightened neuroplasticity, making them especially responsive to environmental stimuli and learning experiences (Center on the Developing Child, 2007). Play-based learning during this phase provides rich opportunities for exploration, problem-solving, and social interaction, all of which are essential for holistic development. Neuroscientific and developmental psychology research highlights that enriching experiences in the early years lay the foundation for future academic achievement and emotional well-being (Shonkoff & Phillips, 2000; Whitebread et al., 2012).

Despite the increasing emphasis on STEM, the life sciences particularly topics like human anatomy are often overlooked in early childhood curricula. This omission is largely due to the perception that biological systems are too complex for young learners to grasp. However, recent pedagogical research suggests that when abstract concepts are presented through concrete, hands-on, and playful experiences, young children are capable of meaningful scientific understanding (Eshach & Fried, 2005). There is a growing need to design interdisciplinary activities that promote scientific literacy and health awareness among young children in ways that align with their natural learning styles.

Play-based learning has been widely recognized as an effective pedagogical approach in early childhood education (ECE), as it nurtures children's curiosity, creativity, and problem-solving skills while aligning with their natural modes of learning (Bodrova & Leong, 2007). Through guided play, children engage in meaningful exploration and experimentation, which supports cognitive and socio-emotional development. Concurrently, there is a growing global emphasis on the integration of STEM (Science, Technology, Engineering, and Mathematics) in early childhood settings to foster scientific literacy, critical thinking, and inquiry-based learning from an early age (National Research Council, 2012; Lippard et al., 2019). By combining play with STEM concepts, educators can create engaging, developmentally appropriate experiences that lay the foundation for lifelong learning.

Despite the growing emphasis on STEM integration in early childhood education, the teaching of biological sciences particularly human anatomy remains underrepresented in early years curricula, largely due to perceptions of its complexity and developmental inappropriateness (Turkmen, 2008; Patrick & Tunnicliffe, 2010). However, emerging research suggests that with developmentally appropriate strategies, even complex biological systems such as the respiratory system can be introduced effectively to young learners. By leveraging integrative and play-based STEM activities, educators can make abstract concepts more accessible, engaging, and meaningful for children (Brenneman, Stevenson-Boyd, & Frede, 2009; Fleer, 2011).

This study builds on that foundation by exploring the use of a play-based STEM activity designed to teach the respiratory system to preschool-aged children. Through constructing a simple model using plastic bottles, straws, and balloons, and engaging in guided role-play scenarios, children interact with abstract biological concepts in a tangible and enjoyable manner.

1.2 Problem Statement

Despite increasing global and national efforts to strengthen STEM (Science, Technology, Engineering, and Mathematics) education in early childhood, there remains a critical gap in its practical application particularly in the area of biological sciences. Research has shown that topics like human anatomy are often excluded from early childhood education (ECE) curricula due to perceptions of their complexity and educators' limited confidence in simplifying these concepts for young learners (Sarama & Clements, 2020; Toma & Menon, 2022). As a result, young children are often denied opportunities to develop early scientific literacy and body awareness through structured, age-appropriate learning experiences.

This issue has been further exacerbated by the disruptions caused by the COVID-19 pandemic. Prolonged school closures and shifts to remote learning led to widespread learning loss, especially among

preschool and early primary-aged children, who missed out on tactile, interactive, and socially rich learning environments (Dorn et al., 2021). This period highlighted the importance of restoring hands-on, engaging learning strategies particularly in subjects that require embodied understanding, such as the human respiratory system.

Moreover, recent reports have raised concern over declining physical activity and health literacy among young children. According to UNICEF (2022), early learners are spending more time in sedentary, screen-based activities, with reduced awareness of their own physical wellbeing. Teaching biological functions such as breathing through play and movement-based activities can directly contribute to reversing this trend by making health education accessible, memorable, and fun.

Despite policy frameworks like Malaysia's STEM4All Strategy (Ministry of Education Malaysia, 2021) emphasizing the importance of early STEM exposure, classroom implementation remains inconsistent due to a lack of teacher training and confidence in STEM integration. There is an urgent need for practical, developmentally appropriate strategies that align STEM concepts with play-based pedagogies, making scientific learning meaningful and engaging for young children.

This study seeks to address these intersecting challenges by examining the effectiveness of a play-integrated STEM activity that teaches the human respiratory system to pre-schoolers. By using hands-on modeling and role-play, the study aims to offer a replicable, child-centred approach to bridging the gap between policy, pedagogy, and real classroom practice.

While STEM integration in early childhood education (ECE) is gaining momentum, the incorporation of life sciences particularly human anatomy remains significantly underrepresented. This is largely due to the scarcity of age-appropriate teaching strategies that make complex biological systems comprehensible and engaging for preschool-aged children. Educators often face challenges in translating abstract scientific content into developmentally appropriate experiences that align with how young children learn best through play, hands-on activities, and meaningful social interactions (Eshach & Fried, 2005). As a result, young learners are frequently excluded from opportunities to explore foundational scientific knowledge about their own bodies. This exclusion not only limits their scientific literacy but also their awareness of health and bodily functions. There is, therefore, a pressing need for innovative, play-integrated teaching approaches that make science both accessible and developmentally appropriate, while fostering holistic learning in early childhood settings.

1.3 Purpose of the Study

The purpose of this study is to explore the effectiveness of integrating play and STEM principles to teach the human respiratory system to children aged 4 to 6 years. Specifically, the study investigates how hands-on model-making, interactive role-play, and cross-disciplinary activities can enhance scientific understanding and foster engagement, collaboration, and holistic development in early learners.

1.4 Research Questions

a) How does integrating play and STEM influence children's understanding of the human respiratory system?
b) What role does interactive model construction and role-play play in promoting engagement and conceptual learning?
c) How does the activity support development across multiple learning domains (e.g., language, math, art, physical awareness)?

1.5 Research Objectives

a) To examine the impact of play-based STEM activities on children's conceptual understanding of the respiratory system.
b) To evaluate the effectiveness of hands-on modeling and role-play in promoting scientific inquiry and engagement.
c) To analyze how integrating multiple disciplines through a single activity supports holistic development in early childhood education.

This paper aims to:

a) Explore the effectiveness of integrating play and STEM in ECE through the lens of a biological science activity.

b) Examine how role-play and interactive modeling affect understanding of the respiratory system.

c) Analyze how cross-disciplinary learning enhances developmental outcomes in language, math, art, and physical health.

2 THEORETICAL FRAMEWORK

2.1 Vygotsky's Social Constructivism

Lev Vygotsky emphasized the importance of social interaction in cognitive development, asserting that learning occurs most effectively within the Zone of Proximal Development (ZPD) the range between what a child can do independently and what they can achieve with guidance from a more knowledgeable peer or adult (Vygotsky, 1978). In the context of early childhood education, play especially role-play provides an ideal framework for activating the ZPD. When children engage in guided play, such as a "Doctor's Visit" scenario to explore the human respiratory system, they participate in shared social experiences that scaffold their understanding of abstract scientific concepts. Constructing a model of the lungs and simulating the breathing process not only reinforces their cognitive grasp of bodily functions but also allows them to co-construct meaning through interaction, questioning, and imitation. The presence of educators or peers during these activities serves as a scaffold that helps children internalize complex knowledge, such as inhalation and exhalation, in ways that align with their developmental stage. This aligns with Vygotsky's belief that knowledge is co-constructed and mediated through social tools, including language and symbolic play, making such STEM-integrated, play-based learning activities both meaningful and developmentally appropriate.

2.2 Piaget's Theory of Cognitive Development

Jean Piaget identified the preoperational stage (approximately ages 2 to 7) as a critical period in which children begin to develop symbolic thinking, imagination, and rapid language acquisition, but still struggle with abstract reasoning (Piaget, 1954). During this stage, young learners rely heavily on tangible, sensory-rich experiences to make sense of the world. In this context, integrating STEM learning through play becomes particularly powerful. Activities such as constructing a model of the human respiratory system using balloons and straws provide children with concrete, hands-on opportunities to explore abstract biological functions like inhalation and exhalation. By physically manipulating the model watching the balloons expand and contract as they simulate breathing children build cognitive schemas that represent real-life biological processes. This aligns with Piaget's assertion that children in the preoperational stage learn best when they can actively engage with and experiment within their environment. Such experiences not only strengthen conceptual understanding but also support the transition from concrete to more abstract thinking, laying the groundwork for future scientific learning.

2.3 Gardner's Multiple Intelligences

Howard Gardner's theory of multiple intelligences emphasizes that intelligence is not a single, fixed attribute, but rather a diverse set of modalities through which individuals process and express knowledge (Gardner, 1983). In early childhood education, this perspective supports a holistic and inclusive pedagogy, where children are encouraged to engage with content in ways that resonate with their individual strengths. The hands-on respiratory system activity in this study—constructing lung models, engaging in role-play, and narrating health-related scenarios—provides opportunities to activate multiple intelligences simultaneously. Linguistic intelligence is engaged as children describe the breathing process and participate in storytelling; logical-mathematical intelligence is applied when counting breaths and measuring changes in breathing rate; bodily-kinesthetic intelligence emerges as they manipulate materials and simulate breathing; and visual-spatial intelligence is fostered through model-building and drawing the respiratory system. Additionally,

interpersonal intelligence is evident as children collaborate in role-play, while intrapersonal intelligence is strengthened through increased body awareness and self-reflection. This multifaceted engagement not only enhances conceptual learning but also ensures that all children, regardless of their dominant learning style, have meaningful access to STEM education.

3 LITERATURE REVIEW

Play is a natural and developmentally appropriate medium for learning in early childhood. It fosters curiosity, creativity, collaboration, and the exploration of complex ideas through concrete, enjoyable experiences. Research consistently shows that when play is guided with clear educational intent, it significantly enhances academic achievement, executive functioning, and social-emotional development (Ginsburg, 2007). Purposeful play allows children to internalize new concepts through physical manipulation, narrative construction, and social interaction all of which are key modes of learning in the early years.

In recent years, there has been growing recognition of the need to embed STEM (Science, Technology, Engineering, and Mathematics) education in early childhood curricula. Although once considered too advanced for young learners, studies now affirm that children as young as four can grasp foundational STEM concepts when taught through hands-on, play-based methods. For instance, Brennan et al. (2017) demonstrated that pre-schoolers could understand basic engineering principles by engaging in block-building and design-based challenges. Similarly, Worth and Grollman (2003) showed that inquiry-based science activities significantly enhanced young children's vocabulary, reasoning, and observational skills.

More recent studies from 2020–2025 continue to emphasize the importance of integrating STEM into early years education. Toma and Menon (2022) reported that structured, inquiry-driven STEM experiences in preschool settings promoted not only content understanding but also children's confidence, collaboration, and metacognitive skills. Furthermore, a study by Alford et al. (2023) found that embedding STEM within socio-dramatic play contexts improved children's retention of science content and increased their motivation to explore scientific ideas. The researchers highlighted that young learner were particularly responsive to activities that linked science to real-life phenomena, such as bodily functions, weather changes, or mechanical movement.

Despite these promising developments, biological sciences particularly human anatomy remains underrepresented in early childhood education. The complexity of internal bodily systems, coupled with limited teacher training and a lack of age-appropriate resources, contributes to the marginalization of life science topics (Sarama & Clements, 2020). Children are often introduced to plants, animals, and environmental science, but receive little to no formal instruction about their own bodies beyond superficial health messages.

While numerous studies have emphasized the benefits of integrating STEM in early childhood through playful approaches (Brenneman, Stevenson-Boyd & Frede, 2009; Clements & Sarama, 2016), a critical gap remains in how these approaches address foundational scientific concepts like the respiratory system. Most research prioritizes mathematical and engineering aspects (e.g., building structures, coding games), leaving physiological systems underrepresented in playful STEM activities. Moreover, studies such as Davis (2018) focus predominantly on structured play, while others (e.g., Fleer, 2010) argue for more open-ended, child-led exploration. This inconsistency signals a need to reconceptualize how play is leveraged across STEM domains, especially in biological education for young learners.

This gap is concerning, given the increasing focus on health literacy and bodily autonomy in early education. Recent data from UNICEF (2022) and McLaughlin et al. (2024) emphasize that young children are capable of understanding bodily systems when these are introduced through sensory-rich, playful learning experiences. Studies indicate that such instruction not only deepens children's scientific knowledge but also contributes to self-awareness and physical confidence. For example, incorporating activities that teach how the lungs work using tangible materials like balloons and straws allows children to visualize and understand respiration in a meaningful way (Daher et al., 2021).

Moreover, cross-disciplinary STEM activities have been shown to boost holistic learning. According to Torres-Crespo et al. (2021), integrating science with art, math, and storytelling in preschool lessons fosters deeper conceptual understanding and nurtures multiple intelligences. Activities that blend disciplines such as drawing the respiratory system after a model-building exercise or measuring breathing before and after physical activity promote critical thinking, fine motor skills, vocabulary development, and social collaboration.

In summary, although early STEM education has gained significant traction over the past decade, there remains a critical need to broaden its scope to include biological sciences like human anatomy. Play-based, integrated STEM activities represent a powerful strategy for addressing this gap. They not only make abstract scientific concepts accessible to young children but also empower them to become curious, confident, and health-aware learners from an early age.

4 METHODOLOGY

4.1 Research Design

Qualitative research is defined as a method of inquiry that seeks to understand human behaviour and the reasons that govern such behaviour, focusing on the "how" and "why" rather than the "what" or "how many" (Merriam & Tisdell, 2016). It is particularly valuable in early childhood education settings, where children's learning experiences are shaped by rich social, emotional, and environmental contexts. Within qualitative research, the case study approach allows for an in-depth, holistic examination of a specific phenomenon within its real-life context (Yin, 2018).

In this study, a qualitative case study design was employed to investigate how play-integrated STEM activities influence young children's understanding of the human respiratory system. The aim was to explore not only what children learned but also how they engaged with the activity, how they collaborated with peers, and how multiple learning domains were activated during the experience. By focusing on a single group of learners in a real-world early childhood classroom, the study provided a detailed, contextualized understanding of the learning process.

The case study approach was appropriate for this research because it enabled the researcher to observe complex interactions between children, educators, and materials over time. It also supported the analysis of non-verbal behaviours, role-play scenarios, and creative outputs (e.g., drawings and model-building), which are crucial components of early childhood learning but difficult to capture through quantitative methods.

The research was interpretivist in nature, grounded in the belief that knowledge is socially constructed and best understood through the perspectives of those directly involved (Creswell & Poth, 2018). The flexible, open-ended nature of qualitative inquiry made it possible to capture children's spontaneous questions, imaginative narratives, and embodied expressions of learning all of which contributed to a comprehensive view of how STEM and play can be effectively integrated in early education.

4.2 Participants

In qualitative research, participants are selected not to represent a population statistically, but to provide deep, contextual insights into the phenomenon under study (Patton, 2015). Purposeful sampling is commonly used to identify individuals or groups who are especially knowledgeable or experienced with the topic being explored (Merriam & Tisdell, 2016). In early childhood education research, young children are considered valuable participants because their behaviours, expressions, and interactions offer authentic perspectives on learning processes in real-time contexts.

This study involved a purposeful sample of 20 children, aged 4 to 6 years, from a local early childhood education center in a semi-urban setting. The group included 12 girls and 8 boys from diverse socio-economic backgrounds. The selection criteria were based on the children’s age group, developmental readiness for structured play-based learning, and the center’s willingness to collaborate in a research project focused on STEM integration.

Two experienced early childhood educators, each with over five years of teaching experience, facilitated the learning sessions. They played a dual role as both instructors and observers, maintaining

structured observation logs and providing narrative reflections on children's engagement and responses throughout the activity period.

This participant group was chosen because children within this age range are developmentally situated in Piaget's preoperational stage, a period characterized by symbolic thought and rapid language development—ideal conditions for learning through guided play and hands-on exploration (Piaget, 1954). Their active participation in constructing, manipulating, and reflecting on a model of the respiratory system offered meaningful insights into how play-integrated STEM strategies support conceptual understanding in early learners.

4.3 Procedure

The project was designed to engage children in a comprehensive exploration of the respiratory system through interactive and fun activities, blending play and STEM concepts. Over the span of five days, each day offered a unique experience that reinforced key concepts related to the lungs and breathing in a developmentally appropriate way for early childhood learners. Below is a detailed breakdown of the procedure for each day:

Day 1: Introduction to Lungs Through Storytelling and Body Exploration

The first day of the project was focused on introducing the concept of lungs and breathing. Storytelling was used as a vehicle to capture children's attention and connect the topic to their everyday experiences. A story about a character learning how their lungs work helped to personalize the concept. Children then engaged in body exploration activities where they practiced deep breathing and felt the rise and fall of their chests, linking the physical experience to the concept of breathing.

Day 2: Group Construction of the Respiratory Model

On Day 2, the children were introduced to the process of building a simple model of the respiratory system. Using common materials such as plastic bottles, straws, balloons, and rubber bands, the children worked together in small groups to construct a functioning model that demonstrated how the lungs work. This hands-on activity emphasized teamwork, problem-solving, and understanding of the mechanics of breathing. The children learned how air enters and exits the lungs, with the balloons representing the lungs' expansion and contraction.

Day 3: Role-Play Session ("Doctor's Visit")

Day 3 focused on reinforcing the knowledge acquired so far through a role-play activity. Children participated in a "Doctor's Visit," where they used the respiratory model, they built to demonstrate how a doctor might explain how the lungs work. This session allowed children to actively engage with the concept of respiration, taking on roles as doctors, patients, or nurses. The role-play encouraged the children to apply their new knowledge in a realistic context, making learning both meaningful and enjoyable.

Day 4: Drawing and Describing the Respiratory Process

On Day 4, the children had the opportunity to creatively express what they had learned. They were tasked with drawing a picture of the respiratory system and labelling the parts, including the lungs, diaphragm, and windpipe. Alongside the drawing, they were asked to verbally describe the respiratory process, reinforcing their understanding. This activity allowed children to synthesize the knowledge they had gained in a way that integrated both artistic expression and scientific learning.

Day 5: Physical Activity and Reflection on Breathing

The final day of the project involved physical activity, such as running or jumping, to encourage the children to experience first-hand the changes in their breathing during exercise. Afterward, children gathered to reflect on how their breathing had changed during physical exertion, discussing how the body responds to activity. This reflective discussion helped to connect the concept of breathing to real-life experiences, reinforcing the relevance of the respiratory system in their daily lives.

The sequence of activities was designed to ensure that the children were engaged through multiple learning modes, including storytelling, hands-on building, role-playing, creative expression, and physical activity. The combination of these elements was intended to promote a deeper understanding of the respiratory system while integrating play and STEM in early childhood education.

4.4 Data Collection

Data collection in this project was designed to capture a comprehensive picture of children's learning and engagement throughout the five-day process. A variety of methods were employed to ensure that both qualitative and quantitative aspects of the children's responses, behaviours, and interactions were documented. The following data collection methods were used:

a) Educator Journals

Educator journals served as an essential tool for documenting the children's responses and behaviours during the activities. The educator took detailed notes on individual and group interactions, highlighting any notable changes in understanding or behaviour, as well as how children engaged with the activities. The journals also provided insight into how the children processed the information and how their understanding evolved throughout the project. According to Dewey (1938), reflective journaling by educators is an effective tool for assessing children's learning and development, allowing for a deeper analysis of their cognitive and emotional engagement.

b) Video and Audio Recordings

To supplement the written records, video and audio recordings were used to capture the children's verbal and non-verbal interactions during the activities. These recordings provided rich data on how children communicated their understanding of the respiratory system, both in terms of language and physical expression. Through video, the researcher could analyse children's gestures, facial expressions, and group dynamics, while audio recordings captured the nuances of their verbal exchanges. This method aligns with Vygotsky's (1978) theory, which emphasizes the role of social interaction and language in cognitive development. The use of video and audio recordings allowed for a more accurate and comprehensive analysis of the children's learning experiences.

c) Artifacts

Artifacts from the project, including children's drawings, breath-count logs, and model designs, were also collected as tangible evidence of their learning process. The drawings provided a visual representation of the children's understanding of the respiratory system, allowing for the analysis of how they conceptualized the components of the system. Breath-count logs, in which children recorded their breath rates before and after physical activity, offered a quantitative measure of their understanding of how physical exertion affects breathing. The model designs provided insight into how children understood the mechanical process of breathing and the role of the lungs in respiration. Artifacts such as these align with Piaget's (1952) constructivist theory, which posits that children actively build knowledge through interactions with their environment and through creating physical representations of abstract concepts.

These three data collection methods—educator journals, video/audio recordings, and artifacts—provided a multifaceted approach to documenting and analysing children's learning throughout the project. This comprehensive data collection process allowed for a deeper understanding of how play-based learning and STEM activities contribute to early childhood education.

4.5 Data Analysis

Data analysis in this study was conducted using thematic analysis, following the method outlined by Braun and Clarke (2006). Thematic analysis is a widely used qualitative research technique that allows for the identification, analysis, and reporting of patterns or themes within data. It is particularly effective for analyzing rich, qualitative data and provides insights into participants' experiences, behaviours, and interactions. In this study, thematic analysis was applied to the diverse data collected from educator journals, video/audio recordings, and artifacts to identify key themes related to children's learning of the respiratory system.

a) Inductive Coding

The data were initially coded inductively, meaning that codes were generated from the data itself rather than based on pre-existing theoretical concepts. This approach allowed for the emergence of themes

grounded in the children's experiences during the project. According to Braun and Clarke (2006), inductive coding ensures that the analysis remains closely aligned with the data, enabling the researcher to capture the participants' perspectives without being influenced by preconceived notions.

b) Theme Development

Once initial codes were developed, these were grouped into broader themes. The themes that emerged from the data analysis process included:

c) Engagement

Engagement was a key theme, as it captured how involved and motivated the children were throughout the activities. This theme was particularly important because active engagement is a fundamental component of effective learning in early childhood education (Deci & Ryan, 2000). Instances of engagement were identified through children's enthusiasm, participation, and sustained attention during the activities.

d) Comprehension

Comprehension themes were drawn from the children's ability to understand and explain the concepts related to the respiratory system. This theme was evident through the children's verbal responses, their ability to describe the process of breathing, and their application of the knowledge in role-play and model construction activities.

e) Social Interaction

The theme of social interaction highlighted how children interacted with their peers and educators during the activities. This theme was important in understanding the collaborative nature of learning, as children worked together to build the respiratory model and participated in group discussions. Vygotsky (1978) emphasized the significance of social interaction in cognitive development, particularly in shared activities that promote learning.

f) Cross-Domain Skill Transfer

This theme explored how the children transferred skills from one domain of learning to another. For example, children used their fine motor skills during the construction of the respiratory model, as well as their artistic skills during the drawing activity. The concept of cross-domain skill transfer aligns with Piaget's (1952) idea that children's cognitive development is enhanced when they engage in activities that require them to apply knowledge and skills in various contexts.

By identifying and analyzing these themes, the data analysis process provided valuable insights into how the children engaged with the concept of the respiratory system and how their learning progressed throughout the project. Thematic analysis allowed for the identification of key patterns and highlighted the impact of play-based learning and STEM activities on early childhood education.

5 FINDINGS

5.1 Scientific Understanding

One of the key findings of this project was the children's ability to describe the basic mechanics of breathing using accurate scientific terminology. After engaging in a range of activities designed to explore the respiratory system, children were able to verbally articulate their understanding using terms such as "inhale," "lungs fill," and "air goes in." This demonstrated not only their comprehension of the fundamental process of respiration but also their ability to use appropriate vocabulary to express this knowledge. According to Piaget (1952), children actively construct knowledge through direct interaction with their environment, which was evident in their ability to apply specific terms learned through hands-on activities.

In addition to using the correct terminology, children demonstrated an understanding of the physical mechanics of breathing, explaining that "lungs expand with air" and "contract when air is released." This was reinforced through the hands-on construction of the respiratory model, where children could visualize and manipulate the elements to observe the mechanics of lung expansion and contraction. This aligns with

Vygotsky's (1978) concept of the zone of proximal development, as children were able to grasp complex ideas through guided interaction with peers and educators.

Several children also made connections to their own bodies, further deepening their understanding of the respiratory system. For example, one child commented, "When I run, my lungs go faster!" These types of statements indicate that the children were able to relate the scientific concepts they learned to their own experiences and bodily sensations. This type of experiential learning is critical in early childhood education, as it allows children to build knowledge through personal relevance and real-world application (Bransford, Brown, & Cocking, 2000).

These findings suggest that play-based activities, such as storytelling, model construction, and physical activity, can effectively support the development of scientific understanding in young children. The use of accurate terminology and the ability to make personal connections to the respiratory process highlights the potential for STEM integration in early childhood education to promote both cognitive and physical learning.

5.2 Engagement and Motivation

Engagement and motivation are key indicators of effective learning in early childhood education. Engagement refers to the level of attention, curiosity, interest, and enthusiasm that children exhibit during learning activities, while motivation involves the internal drive to initiate and sustain participation in those activities (Fredricks, Blumenfeld, & Paris, 2004). In this study, the integration of storytelling and role-play proved to be powerful strategies for enhancing both engagement and motivation among the children.

The storytelling activity on Day 1 introduced the concept of lungs in an imaginative and relatable context, sparking initial interest and providing a narrative framework for the learning that followed. Storytelling has long been recognized as an effective pedagogical tool in early childhood settings because it supports emotional connection, language development, and conceptual understanding (Isbell et al., 2004).

Role-play, particularly during the "Doctor's Visit" activity on Day 3, significantly boosted motivation and social participation. Children eagerly assumed roles as doctors and patients, took turns using the respiratory model, and explained how lungs function. This imaginative engagement fostered a sense of ownership and pride in their learning. According to Vygotsky (1978), role-play allows children to operate within their zone of proximal development, facilitating the acquisition of new knowledge through social interaction and scaffolding.

Children also demonstrated emotional investment and enthusiasm in their creations, frequently admiring and discussing the models they had built. Their motivation was evident in the way they carefully handled materials and showed excitement in explaining their work to peers and educators. This pride in learning aligns with Deci and Ryan's (1985) Self-Determination Theory, which posits that intrinsic motivation is enhanced when learners feel competent, autonomous, and connected to others.

Curiosity emerged as another strong indicator of engagement. Children asked insightful questions such as, "What happens if a lung pops?" and "Why do we need two lungs?" These inquiries show that children were not only absorbing information but also actively thinking about the implications and deeper mechanisms of the respiratory system. This type of questioning reflects higher-order thinking and suggests that the play-based STEM approach successfully stimulated cognitive curiosity and investigative thinking.

In summary, the integration of storytelling and role-play effectively enhanced engagement and motivation in the children. The approach encouraged active participation, emotional investment, and the pursuit of deeper understanding, thereby supporting meaningful learning experiences in early science education.

5.3 Social Collaboration

Social collaboration in early childhood education refers to the ways in which children work together, share ideas, and support one another's learning through interaction. Collaborative learning environments promote communication skills, empathy, cooperation, and shared problem-solving critical components of both cognitive and social-emotional development (Bodrova & Leong, 2007). In this study, social

collaboration emerged as a significant theme, particularly during group-based STEM activities such as the construction of the respiratory system model.

The group construction task on Day 2 required children to work collectively, share materials, and negotiate roles, naturally encouraging teamwork and turn-taking. These cooperative behaviors were evident as children passed around supplies, discussed how to assemble parts of the model, and waited for their turn to contribute. This process fostered a sense of community and mutual responsibility, reinforcing the value of working together toward a shared goal.

Peer learning was a central component of this collaboration. For example, one child took the initiative to explain how the model worked to a peer, using gestures and simplified language to convey the concept of lung expansion. This act of peer teaching reflects Vygotsky's (1978) concept of scaffolding within the Zone of Proximal Development (ZPD), where a more competent peer supports the learning of another, enabling understanding that may not have been achieved independently. Such interactions underscore the idea that learning is inherently social and is often facilitated through meaningful exchanges between children.

Additionally, social collaboration was observed during role-play and reflection sessions. Children helped each other recall scientific terms and re-enact the function of lungs using the model, further emphasizing the reciprocal nature of learning in a collaborative environment. These moments illustrate how social interaction not only supports content knowledge but also strengthens communication, leadership, and empathy skills.

In line with sociocultural learning theory, the collaborative structure of the activities provided opportunities for children to co-construct knowledge and develop deeper scientific understanding through social means. This supports the assertion that well-designed group tasks in early STEM education can simultaneously nurture both cognitive and social growth.

5.4 Cross-Disciplinary Integration

Cross-disciplinary integration in early childhood education refers to the purposeful blending of content and skills from multiple subject areas into a unified learning experience. This approach is especially effective in STEM education, as it mirrors real-world problem-solving and supports deeper, more meaningful learning across cognitive domains (Beers, 2011). Integrating disciplines such as mathematics, science, art, language arts, and physical education enables children to explore concepts holistically and apply knowledge in diverse, interconnected ways.

In this project, the activities were intentionally designed to promote cross-disciplinary learning, allowing children to engage with the concept of the respiratory system through multiple lenses:

Mathematics: Children engaged in counting their breaths per minute, using timers to record the number of breaths before and after physical activity. They compared their results across different time points and among peers, practicing basic numeracy, data collection, and comparison. These tasks support the development of early mathematical reasoning and problem-solving (Clements & Sarama, 2009).

Art: On Day 4, children were encouraged to illustrate the respiratory system through colorful, labeled diagrams. This artistic representation allowed them to express scientific understanding visually, reinforcing anatomy concepts while nurturing creativity and fine motor skills. Integrating visual arts into science learning supports dual coding and enhances retention (Eisner, 2002).

Language Arts: Throughout the week, children participated in storytelling and narrative exercises related to doctor visits, breathing experiences, and the function of lungs. They used descriptive language, dialogue, and sequencing to convey their understanding, which fostered both language development and scientific communication. According to Nicolopoulou (1997), storytelling is a key tool for making abstract ideas concrete and personal in early childhood settings.

Physical Education: On Day 5, children engaged in physical activities such as running, then measured and reflected on how their breathing changed. This kinaesthetic approach helped them connect bodily sensations to scientific concepts. Physical education experiences like this also contribute to health awareness and self-regulation (Gallahue & Ozmun, 2006).

This cross-disciplinary integration not only made learning more engaging and accessible but also encouraged children to transfer knowledge across domains a hallmark of deep learning. It illustrates how complex concepts like the respiratory system can be effectively taught through a rich, multi-modal curriculum in early childhood education.

6 DISCUSSION

Integrating STEM and play in early childhood education offers a powerful pedagogical approach that supports both conceptual understanding and developmental growth. STEM education, when merged with play-based strategies, allows young children to explore complex scientific ideas in developmentally appropriate, meaningful, and enjoyable ways (NRC, 2009). This study demonstrated that teaching the respiratory system through storytelling, role-play, and hands-on model construction significantly enhanced children's engagement, comprehension, and ability to relate science to their lived experiences.

The use of a physical model, paired with imaginative play, aligns strongly with Piaget's (1952) theory of cognitive development, which emphasizes that young children learn best through direct manipulation of their environment. By building and using a lung model, children could simulate inhaling and exhaling, thereby concretizing abstract biological processes. These sensorimotor interactions made the concept of breathing tangible and memorable, validating Piaget's view that active exploration fosters deeper learning in early childhood.

Moreover, the interdisciplinary design of the activities merging science, mathematics, art, language arts, and physical education reflected authentic, real-world learning scenarios. This holistic integration allowed children to encounter the respiratory system through multiple entry points, enabling a broader range of learners to connect with the content in ways that resonated with their individual strengths. Here, Gardner's (1983) theory of Multiple Intelligences was particularly helpful in explaining how different children engaged with the material. Some demonstrated deep understanding through artistic representation, others through storytelling or movement, highlighting the value of offering diverse modes of expression and learning.

Importantly, the project also supported the development of health literacy a critical but often overlooked component of early childhood education. As children learned how lungs function and how breathing changes during physical activity, they began to build awareness of their own bodies and health. This type of learning fosters a sense of body ownership and can empower young children to make informed decisions about their well-being. Health literacy, especially when introduced through developmentally appropriate science content, contributes to the broader goals of holistic education, which aims to nurture the cognitive, emotional, physical, and social dimensions of the child (WHO, 1998).

In summary, this study highlights the transformative potential of combining STEM and play. By situating science within stories, movement, art, and hands-on construction, children not only grasped the function of the respiratory system but did so with enthusiasm, curiosity, and personal relevance.

6.1 Implications for Early Childhood Education

The findings from this study have several important implications for early childhood education, particularly in how educators, curriculum developers, and families can support young children's scientific learning through integrative and play-based methods.

Firstly, curriculum design in early childhood education should prioritize integrative approaches that blend STEM content with play, storytelling, arts, and movement. Embedding STEM learning from the ground up ensures that young children are introduced to scientific thinking in a way that is developmentally appropriate and engaging. A curriculum that allows for cross-disciplinary connections not only supports cognitive growth but also nurtures creativity, problem-solving, and critical thinking from an early age.

Secondly, teacher training is essential to the success of such integrative approaches. Educators must be equipped with the knowledge, resources, and confidence to design and implement STEM-rich activities that align with the developmental needs of young children. Training should include strategies for hands-on

learning, classroom management during exploratory play, and techniques for guiding inquiry through open-ended questions. When teachers understand the pedagogical foundations of play-based STEM learning, they are better able to facilitate meaningful learning experiences.

Thirdly, parental engagement plays a vital role in reinforcing STEM learning beyond the classroom. Parents should be informed about the benefits of hands-on science activities at home and encouraged to use everyday materials to foster curiosity and inquiry. Simple activities such as observing nature, building with recyclable items, or discussing bodily functions like breathing can spark valuable conversations and learning opportunities. Strengthening the home-school connection helps create a consistent and enriched learning environment for the child.

Lastly, the study underscores the importance of alternative assessments in early childhood education. Traditional tests may not effectively capture the depth of young children's understanding. Instead, tools such as portfolios, observational notes, video recordings, and student-created artifacts (like drawings and models) offer a more comprehensive view of learning outcomes. These forms of assessment honor the diverse ways children express knowledge and provide educators with meaningful insights into each child's developmental progress.

In sum, this study advocates for a holistic, integrated, and collaborative approach to early science education one that supports young children in becoming confident, curious, and capable learners.

7 LIMITATIONS AND RECOMMENDATIONS

While the findings of this study are encouraging and demonstrate the effectiveness of integrating STEM and play in early childhood education, several limitations must be acknowledged.

One key limitation is the small sample size, which was restricted to a single early childhood center. This limits the generalizability of the results to broader populations. Larger, more diverse samples would provide a more representative understanding of how different groups of children respond to similar interventions.

Another limitation is the short duration of the project. Conducted over just five days, the study provided only a snapshot of children's learning and engagement. While immediate responses were positive, it remains unclear how well the children retained their understanding over time or how deeply their conceptual knowledge developed. Future research should consider longer-term studies to explore the sustainability of learning and the potential for deeper cognitive growth.

Additionally, the study focused specifically on the respiratory system, which, while effective, represents only one aspect of human biology. To further validate the model, future research could apply similar play-based STEM approaches to other bodily systems, such as the digestive or circulatory systems. This would help determine whether the instructional framework is adaptable and effective across a broader range of scientific content.

Based on these limitations, several recommendations are proposed for future research. Longitudinal studies that track children's learning over extended periods would offer insight into retention and conceptual development. Moreover, studies involving larger and more diverse populations including children from different cultural, linguistic, and socioeconomic backgrounds would strengthen the generalizability and applicability of the findings. These efforts would contribute to a deeper understanding of how integrated, play-based STEM education can be scaled and adapted to various early learning environments.

8 CONCLUSION

Integrating play and STEM principles in early childhood education significantly enhances children's engagement, motivation, and understanding of complex scientific concepts, such as the respiratory system. Through hands-on activities like model construction, role-playing, storytelling, drawing, and physical exploration, young learners can grasp abstract biological processes in ways that are meaningful and developmentally appropriate. These strategies not only facilitate cognitive development but also support physical, social, and emotional growth.

The study's findings extend sociocultural theories of learning (Vygotsky, 1978) by demonstrating how collaborative, play-based STEM activities serve as cultural tools that mediate children's understanding of abstract biological systems. Additionally, the integration of embodied learning through role-play and sensory experiences suggests a refinement of Piagetian principles by illustrating how concrete operations can support comprehension of internal, invisible systems like respiration. This theoretical contribution underscores the value of aligning content-specific STEM goals with developmentally appropriate pedagogies, paving the way for more nuanced models of early childhood STEM education.

The findings from this study support existing research that highlights the value of play-based STEM learning in fostering inquiry, creativity, and critical thinking among young children (Brenneman, Stevenson-Boyd, & Frede, 2009). When children are given the opportunity to explore scientific ideas through multiple modes of expression—whether through building, movement, dialogue, or art—they are more likely to engage deeply and retain knowledge. Furthermore, the interdisciplinary nature of the activities mirrors real-life learning experiences and encourages children to make connections across subjects, promoting holistic development (Moomaw, 2013).

Importantly, this approach also nurtures a love for learning by making science enjoyable, relatable, and relevant to children's everyday lives. By blending structured content with imaginative play, educators can create enriched learning environments that prepare children not just for future academic success, but also for lifelong curiosity and problem-solving.

In conclusion, this study affirms the pedagogical value of integrating STEM and play in early childhood settings. It emphasizes that playful, hands-on learning is not merely a supplementary method, but a foundational strategy for cultivating confident, competent, and enthusiastic learners from an early age.

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Play, Reflect, Succeed: Harnessing Gamification to Empower Future-Ready Graduates

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ABSTRACT

This study explores the use of gamification teaching method through online business simulation in business education, aiming to enhance pedagogical practices and empower future-ready graduates. As higher education shifts toward more interactive, student-centred learning approaches, gamified strategies have emerged as powerful tools for cultivating essential skills such as critical thinking, problem-solving, and creativity. These skills are vital for preparing graduates to meet the demands of the modern workforce. During the seminar, students engaged with a business simulation application that replicates real-world business scenarios, requiring strategic decision-making, collaboration, and problem-solving. This hands-on experience fostered critical thinking and practical application of business concepts. After the seminar, students were required to write a reflection on their experiences, aligning their insights with Curtin University's six graduate capabilities. Findings indicate that gamification fosters the application of academic knowledge in real-world contexts, enhances innovation and entrepreneurship skills, and supports the development of digital competency and effective communication. Additionally, students' engagement with global business practices and cross-cultural collaboration was emphasised, broadening their cultural competence. Overall, this study highlights the importance of integrating gamification into higher education to enhance graduate capabilities, improve critical skills, and prepare students for the demands of the modern workforce through innovative, experiential learning strategies.

KEYWORDS: Higher education, Gamification, Student reflection, Online business simulation, Graduate Capabilities

1 INTRODUCTION

Gamification has emerged as a transformative approach in higher education, integrating game design elements into learning environments to enhance student engagement and foster essential graduate capabilities (Hwang et al., 2022). As traditional lecture-based instruction gives way to more interactive and student-centred pedagogies, gamified learning strategies have been increasingly recognised for their potential to cultivate critical thinking, problem-solving, creativity, and industry readiness (Foster & Stagl, 2018; Issa, 2017). These skills are crucial in preparing graduates for the demands of the modern workforce, where adaptability and experiential learning play a significant role in professional success.

One of the models used as the teaching method is the Mobile Technology–Supported Decision, Reflection, and Exercise (MDRE) model, which underscores the impact of gamification on students' cognitive and reflective processes. Well-designed gamified approaches can outperform traditional teaching

methods by enhancing engagement and improving knowledge retention (Hwang et al., 2022). Incorporating reflective practices within gamified learning settings deepens learning, helping students internalise experiences and develop a stronger grasp of course material (Donovan & Hood, 2021).

Educational technology plays a vital role in enhancing gamified learning by providing interactive and immersive experiences. Cloud-based platforms, collaborative digital tools, and online business simulations facilitate deeper engagement and active learning, allowing students to apply concepts in dynamic environments (Schneckenberg, 2014). However, while gamification has been shown to improve motivation and participation, its effectiveness in fostering long-term skill development depends on thoughtful implementation. Aligning gamified approaches with pedagogical objectives is essential to ensure meaningful learning outcomes that extend beyond engagement to real-world application (Smith, 2013).

Thus, this study explores the use of gamification through online business simulations in business education, aiming to enhance pedagogical practices and empower future-ready graduates.

2 LITERATURE REVIEW

2.1 Gamification in Teaching and Learning

Gamification has become an influential pedagogical approach in business education, enhancing student engagement and fostering essential professional competencies. Luna et al. (2022) highlight that incorporating serious games and simulations into challenge-based learning cultivates soft skills such as integration, trust, communication, and collaboration, capabilities crucial for navigating the digital economy. Likewise, Pashkov et al. (2020) emphasise the growing need for innovative educational methods, including gamification, to bridge the gap between academic training and industry expectations.

Beyond traditional classroom settings, gamification has proven effective in online learning environments. Rincón-Flores et al. (2020) found that gamified elements significantly enhance student engagement and course completion rates in massive open online courses (MOOCs), particularly among highly qualified learners. This aligns with broader findings that gamification can improve motivation and academic achievement across various educational contexts. Expanding on this, Cheong (2023) examines the role of gamification in legal education, demonstrating its capacity to engage adult learners while reinforcing practical skill development, further underscoring its adaptability across disciplines.

Despite its benefits, gamification presents challenges in ensuring sustained learning outcomes. While gamified environments often increase motivation and participation, improvements in academic performance are not always consistent (Ng & Lo, 2022). This underscores the need for well-structured implementation strategies that align with pedagogical objectives. Palová & Vejačka (2022) further emphasise that incorporating gamification into digital learning platforms, such as Moodle, can enhance interactive and immersive educational experiences, provided it is strategically designed to support meaningful learning.

Technological advancements continue to shape the effectiveness of gamification in business education. Sari et al. (2023) explored virtual reality (VR)-based gamification for teaching business ethics, finding that while VR immersion enhances engagement, it can also lead to cognitive overload, depending on individual learning styles. Similarly, Legaki et al. (2020) and Yang (2024) highlight the success of gamification in domains such as statistics education and extended reality (XR) training with 5G technology, demonstrating its potential to improve both engagement and learning outcomes. These findings suggest that the effectiveness of gamification is highly dependent on aligning technological complexity with learner adaptability, reinforcing the need for thoughtful integration into educational curricula.

2.2 Graduate Capabilities

2.2.1 Apply Discipline Knowledge, Principles, and Concepts

The integration of discipline-specific knowledge into practical applications was essential for graduates entering the workforce. McKellar (2020) underscored the value of experiential learning in entrepreneurship education, equipping students with the ability to apply theoretical knowledge in real-world contexts. Schubert et al. (2019) similarly emphasised curricula that focused on innovation and practical applications to ensure students could translate theory into solutions. Bedford et al. (2016) highlighted the need for knowledge management education to align with industry demands, while Hasan et al. (2006) demonstrated that structured research lab practices enhanced students' ability to apply theoretical concepts in practical research settings. Hannon et al. (2005) advocated for innovative teaching methods that fostered entrepreneurial thinking, and Woodley & Shackleton (2012) argued for a balanced integration of technical expertise and professional skills. Al Lamki & Al Omairi (2022) further emphasised the significance of real-world training programmes, such as Oman's "Ruwad," in preparing graduates for industry challenges.

2.1.2 Globally Engaged and Responsive

In the global economy, graduates needed to be adaptable, digitally literate, and socially responsible (Jackson et al., 2023). The rapid transformations brought by Industry 4.0 necessitated competencies in cross-cultural collaboration and global engagement. Fuentes et al. (2016) stressed the ethical implications of professional decisions, particularly in engineering. Gilbert (2012) highlighted entrepreneurial education's role in preparing students for global market challenges, while Molla & Cuthbert (2019) called for higher education institutions to evolve with socio-economic transformations. Anderson et al. (2014) examined how Asia-born, New Zealand-educated graduates navigated global markets, highlighting the need for international networks. Cotgrave & Riley (2013) supported employability initiatives such as the World of Work (WoW) project to enhance global credentials.

2.1.3 Innovative, Creative, and Entrepreneurial

Entrepreneurial education was vital for fostering innovation in business. Ikebuaku & Dinbabo (2018) suggested integrating business incubation initiatives within entrepreneurship education to develop students' capabilities. Bilić et al. (2011) emphasised well-structured curricula that positively influenced students' entrepreneurial aspirations. Hannon et al. (2005) proposed co-learning models involving students and local entrepreneurs to promote deeper engagement. McKellar (2020) asserted that fostering an entrepreneurial mindset should extend beyond students to faculty, embedding practical enterprise education. Lee (2015) argued that traditional business plans were insufficient for competency development and instead advocated for experiential learning. Similarly, Rasiah et al. (2019) highlighted entrepreneurship accelerators as valuable tools for contextual learning and entrepreneurial readiness.

2.1.4 Culturally Competent to Engage Respectfully with Local First Peoples and Other Diverse Cultures

Cultural competence was increasingly recognised as an essential capability in business education. Passey (2015) underscored this in the Petrofac Academy's Graduate Development Programme, noting that adapting training tools to diverse cultural backgrounds enhanced graduates' preparedness. Ivanitzki & Mueller (2023) advocated for integrating cross-disciplinary and cross-cultural competencies, as seen in the International Research Experience for Students (IRES) programme. Hassan & Chin (2019) proposed the "Thirdspace" pedagogical framework, which incorporated cultural awareness into education, improving graduates' global workforce preparedness. Hepple (2017) explored the role of study abroad programmes in developing intercultural competence, while Unah (2021) argued that inclusivity and multiculturalism in higher education enhanced students' engagement in diverse cultural environments.

2.1.5. Effective Communicators with Digital Competency

Digital competency was a fundamental skill in contemporary business education. Karstina (2022) highlighted how digital transformations reshaped communication skills and academic programmes. Dissanayeke et al. (2024) illustrated that incorporating digital tools into curricula improved students' communication, digital literacy, and teamwork. Allen et al. (2012) emphasised social media's role in fostering digital literacy and communication. Bhatti et al. (2023) acknowledged the significance of communication skills but argued for a blended teaching approach incorporating both traditional and digital methodologies. Alvarez et al. (2011) showed that tablets enhanced student communication more effectively than netbooks, reinforcing the value of digital tools in education. Cochrane (2009) supported this by demonstrating that digital tools like the Virtual-i Presenter enhanced students' presentation and communication abilities.

2.1.6. Industry Connected and Career Capable

Industry-linked education played a crucial role in graduate employability. Akili (2007) highlighted the importance of collaboration between industry practitioners and academic programmes in fostering practical experience. Capstone courses and senior projects enhanced students' hands-on skills, bridging the gap between academia and professional practice. Papadopoulos & Armatas (2013) emphasised the need for integrating business learning with industry collaborations, enhancing students' employability. Lopez et al. (2023) extended this perspective through their study on operational oceanography programmes, showing how real-time industry data enhanced career preparedness. Wells et al. (2007) argued that systems modelling, and scenario analysis improved educational strategies by simulating real-world challenges. Additionally, Yusof et al. (2023) demonstrated that structured competency development frameworks were instrumental in preparing students for leadership roles within industry settings.

3 METHODOLOGY

3.1. Research Design

This study involved students enrolled in the final-year unit, "*MGMT3029: Enhancing Your Business Mind*". Students were divided into small groups of 4-5 members, where they collaborated to address real-world business problems. Each team was given one hour to work across various business departments, including Research & Development, Marketing, Production, Finance, Sales, and Human Resources. Throughout the simulation, students encountered business challenges with a twist, which they had to solve to progress in the exercise.

3.1. Data Collection

After the seminar, Students were requested to prepare and submit reflective writing to discuss their experiences with the gamified activities. They are allowed to use AI-generated tools like ChatGPT to compare their reflections with AI-generated ideas. The contents of reflection writing cover Curtin University's six Graduate Capabilities: (1) Application of knowledge and concepts; (2) Global engagement and responsiveness; (3) Innovation and entrepreneurship; (4) Cultural competence; (5) Effective communication and digital competency; and (6) Industry connectivity and career readiness.

4. FINDING

4.1. Graduate Capability 1: Apply discipline knowledge, principles, and concepts

Students 1 and 9 recognise how they leveraged their major-specific knowledge in their work. Student 1 emphasises leadership and teamwork concepts from previous seminars, while Student 9 applied their expertise in accounting and finance to solve complex mathematical problems, acknowledging the value of interdisciplinary knowledge.

Student 1: *"... I think this is an opportunity for using the knowledge relating to our major and then we can know which roles we should play in this team and demonstrating our expertise, which can be recalled on the previous seminar about teamwork and leadership."*

Student 9: *"... I majored in accounting and finance, so I was the one who did the calculation questions, while other teammates from different majors were trying to find solutions based on the clues." "A professional must master a variety of talents beyond their specific area of expertise to succeed in today's rapidly changing business environment. For instance, even though I was studying accounting and finance, I still needed other business-related knowledge, such as corporate laws and marketing skills."*

Students 2 and 3 highlight the importance of teamwork and how they applied their knowledge to the simulation. Student 2 notes the division of tasks according to expertise, while Student 3 emphasises how the online seminar mirrored real-world problem-solving, showcasing the application of team-based knowledge in practical settings.

Student 2: *"We study and solve the question carefully together as a team. The puzzle question is mostly solved by the female members in our team because I think they are more experienced about the puzzle question. Me and the other 2 male members mostly contributed on solving the mathematical question."*

Student 3: *"The topic of the seminar in week 9 is online problem-solving. The seminar is conducted online via Blackboard Collaboration. The activity of the seminar is Capsm Inbox: Escape Room which is online-based problem-solving games that modify the real-life work environment."*

Students 4 and 5 discuss the communication skills they developed, especially in an online setting. Student 4 reflects on the necessity of understanding problem scenarios, while Student 5 links team dynamics to the real-world working environment, applying concepts of collaboration and communication to achieve success.

Student 4: *"The tool used in this activity is Capsim Inbox Simulation. This game provides scenarios to test my skills or strategies for responding to those questions and how I communicate with other team members online."*

Student 5: *"Throughout this Capsim Inbox Simulation activity, I have learned that how crucial team dynamics are, especially in online meeting."*

Students 6 and 7 remark on the real-world application of the Capsim Inbox simulation, highlighting how it tested their skills under pressure and mirrored challenges found in the workplace, demonstrating the practical use of their academic training.

Student 6: *"I was surprised by the simulation game in the aspect of its similarities with the real workplace situation especially when plenty of people email to me at the same time which is very burning me out."*

Student 7: *"We didn't have the luxury of discussing things thoroughly, and this might have affected the quality of some decisions we made."*

Student 8 focuses on the role of problem-solving skills in dealing with unexpected situations, reinforcing the practical knowledge gained through the exercise. Finally, Student 10 reflects on how the activity allowed them to apply theoretical concepts, showcasing how academic learning aligns with real-world tasks.

Student 8: *"This is because in an online session or activities can strengthen the communication and teamwork via online since e-commerce platforms are used mostly by everyone nowadays." "To strengthen my problem-solving skill, I must learn how to tackle situations such as unexpected circumstances which will occur commonly in the workplace and I must learn to understand the problem to solve it."*

Student 10: *"Reflecting on the situation I realised how it encapsulated many of the key learnings from our course. It was a practical application of theoretical concepts, allowing us to experience first-hand the challenges and rewards of managing a product launch." "For instance, questions from the R&D department needed us to have a small understanding of product specifications and development strategies, while queries from the marketing team focused on market analysis and promotional strategies."*

4.2. Graduate Capability 2: Innovative, creative, and entrepreneurial

Students 1 and 9 highlight the importance of agile thinking, particularly under pressure, which enabled them to adapt quickly and creatively to changing scenarios. Similarly, Student 2 notes the role of leadership in fostering innovation, describing how one member's initiative helped break the silence and sparked creative collaboration within the group.

Student 1: *"Moreover, I also realised that this online learning problem solving can make us to implement agile thinking. The aspect of this learning made me to utilised agile thinking skill was that the journey of completing the tasks on this platform has timer, which is a practice of developing the ability to change different thinking styles."*

Student 2: *"I also experienced that the group will always need someone to cheer up all the member in a team. This will help to break the silence in the team and everyone will start to actively communicate with each other after it."*

Student 9: *"This pressure encouraged me to leave my comfort zone, adapt to new situations, and think more outside the box." "We solved the problem together... even though sometimes we were just guessing, we still managed to complete all questions before the time was up."*

Student 3 shares how a team member's use of screen-sharing maintained focus, showcasing creativity in enhancing team interaction during the problem-solving task. Meanwhile, Student 7 and Student 8 describe how individual actions, such as breaking the ice and understanding puzzle patterns, facilitated innovative problem-solving and team collaboration.

Student 3: *"[One of the members] opens the microphone to communicate directly and share his screen to complete the activity. This is a smart way to let the members focus on the problem-solving process by avoiding the high frequency of changing the web page backstage."*

Student 7: *"Eventually, one team member took the lead by opening their mic and initiating the discussion. This small action became the turning point for us, as it broke the initial hesitation and allowed the conversation to flow more naturally."*

Student 8: *"In addition, there were one puzzle that we take a while to solve which is puzzle #1-pricing. As my teammates were trying to solve the puzzle, I realise and understood the pattern of the puzzle and managed to solve it."*

Students 4 and 6 reflect on their approaches to solving problems: Student 4 prefers understanding the problem before acting, while Student 6 favours a trial-and-error method, even under time constraints, demonstrating an experimental approach to problem-solving.

Student 4: *"I will choose a strategy other than trial and error theory I applied in this activity to solve problems because I like to solve a question with understanding."*
Student 6: *"I recommended my team to solve the question using trial and error method whenever a tough one arises even though there is a slight reduction of time for every wrong option chosen. However, it is a very effective one even though it doesn't sound like a smart way to deal with it."*

Student 5 describes how initiative, or the lack of it, significantly impacted their group's performance, illustrating how taking the first step can drive entrepreneurial action. Lastly, Student 10 emphasises the importance of cross-functional collaboration, central to entrepreneurial success in real-world business settings.

Student 5: *"Another key thing I learned throughout this activity is that the importance of taking initiative. All of our group members did not take the initiative during the meeting; hence our team were stuck until one of our members went and started the Capsim Inbox Simulation alone by himself."*

Student 10: *"The simulation also highlighted the importance of cross-functional collaboration. In a real-world business environment, success often hinges on the ability to work seamlessly with colleagues from different departments, each with their own expertise and priorities." "The time constraint added another layer of complexity...we had to prioritise our tasks and manage our time efficiently."*

4.3. Graduate Capability 3: Effective communicators with digital competency

Students 1 and 6 acknowledge the role of communication in achieving success during the simulation, noting how digital tools enabled collaboration but also presented challenges. Similarly, Student 10 emphasises the importance of effective communication via platforms like Webex for strategy discussions and task management, underlining the digital competencies required in modern business environments.

Student 1: *"CapsimInbox does work on the communication skills of among my fellow members and I as this learning process requires us to help each other for solving the puzzles from the incoming emails."*

Student 6: *"Fortunately, one of my teammates, Alex chose to be the one who breaks the ice and leads the team. He mentioned that we are out of time so had to speed up a bit to make it done within the ticking clock. Meanwhile, I realised everyone starts to turn on their mics and start to collaborate smoothly."*

Student 10: *"Working in groups, we quickly realised the importance of effective communication. Webex acted as our lifeline as we discussed strategies, shared insights and delegated tasks." "At the end, they required thoughtful and strategic response...we had to prioritise our tasks and manage our time efficiently."*

Two students highlight the struggles faced when communicating through digital platforms. Student 2 and Student 4 discuss their initial difficulties, with Student 4 particularly pointing out how text-based communication limited efficiency.

Student 2: *"I realised that it is very hard to communicate with each other in a team by using words typing method. We only able to proceed the activity smoothly after the 1 man start speaking with his microphone."*

Student 4: *"The communication barrier is the most challenging part because every team member becomes inactive when speaking online. We just communicated with each other through texting in the chat, but this method significantly reduced our group's efficiency, including some team members who contributed and engaged less in this activity."*

In a related response, Student 3 shares insights on how email and online platforms delayed communication, making the process less effective than face-to-face interactions.

> Student 3: *"Communication through online platforms, such as email in CapsmInbox, and collaboration via BlackBoard Collaboration, are not as effective as face-to-face discussion. The late receipt or reply in email or chat may extend the problem-solving process and the effectiveness of work progress."*

Technical issues were also noted by students as obstacles to effective communication. Student 7 describes challenges with microphone and login problems, emphasising the critical role of digital literacy in overcoming communication barriers. Student 8 further reflects on how technical issues, along with the lack of visual cues, hindered effective interaction during online communication.

> Student 7: *"Technical difficulties early on. Several members had trouble logging into CapsimInbox, which delayed our progress and put additional pressure on the team. These login issues created an air of frustration, and time that could have been spent strategising was instead wasted on troubleshooting the platform." "Some members had issues with their microphones, which made it difficult to hear their contributions clearly. This led to moments of confusion where people had to repeat themselves, further delaying our progress."*

> Student 8: *"Communicating is very important especially in a groupwork as online were less effective compared to physical group discussion. It is because I had a hard time catching up to them as they were fast and it was harder for me to express my words because my teammates could not see me." "As for the internet issue, as my teammates and I were solving the last puzzle, I got immediately disconnected from the internet and must re-enter the session back."*

Finally, students stress the importance of clarity in communication. Student 5 emphasises the need for clear verbal and non-verbal communication to ensure team cohesion and smooth progress, while Student 9 appreciates how communication fosters team cooperation and problem-solving, noting its value in real-world corporate environments.

> Student 5: *"I also learned that good communication skill is very important and essential during teamwork. With clear communication, team members can work effectively with clear roles and clear job responsibilities." "Effective communication skill is not just about talking, but also about ensuring all the team members are on the same page."*

> Student 9: *"Reflecting on this seminar, I realise that the Capsim Inbox was more than simply an academic exercise, it delivered invaluable insights that I can apply to my future career... I was able to get a better understanding of the significance of abilities such as communication, cooperation and flexible thinking, which are essential for achieving success in any corporate environment."*

4.4. Graduate Capability 4: Globally engaged and responsive

Students 1 and 6 highlight the essential role of global communication tools, such as email and Google Suite, for successful team coordination across distances. They emphasise how these digital tools facilitate collaboration in diverse work environments.

> Student 1: *"Also, I have understood that sometimes being a solo or a maverick person cannot successfully complete a particular project before deadline as nowadays the mode of communication is email and usage of office suite components through google suite for enabling the convenience of different departments to work together easily."*

Student 6: *"I was surprised by the simulation game in the aspect of its similarities with the real workplace situation especially when plenty of people email to me at the same time which is very burning me out."*

Similarly, Student 7 points out the flexibility of online collaboration, noting how it reduces geographical constraints and allows participation from remote locations. Student 8 further appreciates the enhanced time management skills gained through online collaboration, which helps maintain a better work-life balance in today's globalised business world.

Student 7: *"Online collaboration allows for more flexibility. We didn't have to be in the same physical space, which is convenient for remote participation."*

Student 8: *"This online activity helped enhance time management skills, making it easier to balance work and study."*

In terms of developing global business understanding, Student 2 reflects on the unfamiliarity of online problem-solving but acknowledges how the experience expanded their understanding of global business practices. Student 5 echoes this, emphasising the valuable lessons learned through the simulation, particularly in adaptability and problem-solving in diverse business contexts. In a similar vein, Student 10 shares how the simulation mirrored global business challenges, applying theoretical concepts to practical challenges like managing product launches in a competitive global market.

Student 2: *"This week topic is about online problem solving. During the online seminar, we are assigned into different group by our tutor. We need to solve the puzzle and business-related question provided by CapsimInbox. I think this is very new experience for me because normally we only have in class problem solving session, but this time is through online."*

Student 5: *"... I have learned many meaningful and valuable lessons throughout this stimulation which can be carried into my future career."*

Student 10: *"Reflecting on the situation I realised how it encapsulated many of the key learnings from our course. It was a practical application of theoretical concepts, allowing us to experience first-hand the challenges and rewards of managing a product launch."*

Student 3 compares email communication in the simulation to the more systematic communication practices in mature companies, pointing out its relevance in professional settings. Meanwhile, Student 4 stresses that the transition from physical to online work did not significantly affect their performance, underlining those problem-solving skills are universally applicable, regardless of the work mode.

Student 3: *"The work mode through email is unfamiliar to me in real life, it is a new experience for me. This work mode is more likely used by mature and systematic companies from my knowledge."*

Student 4: *"For me, there is nothing different between online and physical work because my limitations are the same in both situations, which are related to inherent factors. Problem-solving-based activity happens everywhere, so I should try to overcome my anxiety when participating in this kind of activity."*

Lastly, Student 9 acknowledges the necessity of mastering a broad range of skills beyond their field of study to thrive in today's interconnected global economy.

Student 9: *"Even though I was studying accounting and finance, I still needed others business-related knowledge, such as corporate laws and marketing skills... A professional*

must master a variety of talents beyond their specific area of expertise to succeed in today's rapidly changing business environment."

4.5. Graduate Capability 5: Culturally competent to engage respectfully with local First Peoples and other diverse cultures

Students 1, 4, and 5 reflect on the value of cross-cultural collaboration in problem-solving and the importance of respecting differing perspectives. Student 1 highlights how working with diverse team members from different majors enhanced their cultural competence, while Student 4 and Student 5 emphasise respect for diverse contributions and perspectives in achieving success.

> Student 1: *"The most unique aspects of CapsimInbox that I try to think about is that it is a platform for testing and practicing solving issues on online as in through email because I also find that CapsimInbox also assists me and my group members to solving problems through email with given puzzles and some principles for us to solve as my members are from different majors."*

> Student 4: *"I also work with team members who have mutual understanding and tolerance with each other. Hence, there is nothing that needs to be worried too much, if so, I can require more time for understanding and thinking when I am needed so I can make a clear direction or decision for the team and perform well by using a better strategy."*

> Student 5: *"One of our team members just kept giving non-constructive ideas which led to delay of work." "I realised that effective communication is not just about talking, but about ensuring everyone is on the same page." "I learned that it is important that we need to be thoughtful and accountable for our own contribution during group discussion."*

Students 2 and 3 stress the importance of mutual respect and tolerance in team dynamics, with Student 3 noting how supporting each other and tolerating mistakes contributed to creating a culturally sensitive environment.

> Student 2: *"We have 5 group members in our team. In the beginning of the activity, we are struggling to find out how could we start the problem-solving question. This is because all of us didn't have any experience about using CapsimInbox. We remain silence during the first 15 minutes and finally someone opened microphone to speak in the group. After the man first started speaking in the group, everyone opened microphone to finally start solving the question."*

> Student 3: *"The impressive team members carry and support the team to complete the activity on time. I am always lucky and meet good team members. A leader whose confidence and responsibility are the keys to making good team collaboration toward the target. They are willing to respect each other's opinions and tolerate the mistake without any negative emotions."*

Students 6 and 8 recognise the importance of navigating cultural and communication barriers in digital platforms, stressing that understanding and tolerance are essential for smooth interaction. Student 7 emphasises the need for empathy and cultural sensitivity, especially when non-verbal cues are harder to interpret in virtual teams.

Student 6: *"The team dynamic became great and effective which was out of expectation. Everyone voices out their ideas actively during the problem solving."*

Student 8: *"In an online group setting, communication was less effective compared to in-person discussions. I had a hard time expressing myself, and it was harder for me to catch up with my teammates, who were faster."*

Student 7: *"I found myself hesitant to speak up, likely because everyone else seemed equally reluctant. This was a striking contrast to in-person settings where body language and social cues often encourage someone to break the silence."*

Student 9 points out the significance of a broad skill set that includes understanding cultural nuances in business settings.

> Student 9: *"We solved the problem together... each member contributed and overcame challenges, and even though sometimes we were just guessing, we still managed to complete all questions before the time was up."*

Finally, Student 10 reflects on how collaborating across diverse functions and engaging with various perspectives is key to effective problem-solving and innovation.

> Student 10: *"The simulation also highlighted the importance of cross-functional collaboration. In a real-world business environment, success often hinges on the ability to work seamlessly with colleagues from different departments, each with their own expertise and priorities."*

4.6. Graduate Capability 6: Industry connected and career capable

Students 1, 9, and 10 emphasise how the simulation provided valuable insights into real-world business scenarios, helping them develop industry-specific skills such as financial calculations, market analysis, and product launch management. These experiences are seen as directly relevant to their future careers, particularly through cross-functional collaboration.

> Student 1: *"In this learning activity of using CapsimInbox, I find this platform to be interesting as it enables us to learn and have an idea what is really like to work on certain administrative tasks at a corporate under a commercial sector."*

> Student 9: *"Reflecting on this seminar, I realise that the Capsim Inbox was more than simply an academic exercise, it delivered invaluable insights that I can apply to my future career." "A professional must master a variety of talents beyond their specific area of expertise to succeed in today's rapidly changing business environment."*

> Student 10: *"The skills we honed during this exercise—communication, collaboration, problem-solving, and time management—are essential for our future careers." "In conclusion, the Capsim inbox simulation was an enriching and enlightening experience...It not only reinforced the concepts we've been learning in class but also provided a realistic glimpse into the complexities of business management."*

Students 2, 3, and 6 also reflect on how the simulation mirrored industry conditions, bridging the gap between academic learning and real-world practices. They note how exposure to workplace dynamics, the use of digital tools, and the time constraints in decision-making helped them enhance their career readiness.

> Student 2: *"After experienced the online problem solving using CapsimInbox, I feel that I gain a very valuable experience throughout this session."*

> Student 3: *"The best thing you can do is the right thing, the worst thing you can do is nothing at any moment. So, just do and try, someone brave can enjoy their life joyfully and early."*

> Student 6: *"I enjoy the simulation very much as it gives us the chance to play a role within an organisation to deal with problems regarding new product development. I learnt the idea and completed steps needed to launch a new product." "Meanwhile, I also learnt that time management is a crucial one to master to deal with problems especially in this digitalised era.*

We should make good use of every minute to keep things run smoothly and ensure the effective use of all resources to meet the best possible outcome in the workplace."

Students 4, 5, 7, and 8 highlight the importance of skills such as initiative, leadership, clear communication, collaboration, adaptability, and time management, which are all crucial for career success in the business world. These students emphasise how the simulation helped them refine these skills and prepare for the challenges they will face in their future professional environments.

Student 4: *"I believe that practicing more is how to train me to develop my emotional stability when solving a problem, which can also apply to my future career. As a good team player, I should also communicate with my team members and notice someone inactive, then distribute tasks to that team member or listen to his/her opinion so he/she can feel valued and engaged in the problem-solving process."*

Student 5: *"I have learned that it is important for us to take initiative during an online groupwork, without the initiative, work cannot be conducted. ... These important key elements... leadership, initiative and responsibility are skills that are very important for my future."*

Student 7: *"Despite the technical setbacks, I was surprised at how smoothly the rest of the session went. We didn't have major disagreements as everyone seemed to be on the same page in terms of ideas and strategy." "On the positive side, online collaboration allows for more flexibility. We didn't have to be in the same physical space, which is convenient for remote participation."*

Student 8: *"As I only manage to solve one puzzle which I am not satisfied with myself. As a result, I find that I must develop and improve more skills considering that it will be useful towards my future corporate jobs or any events that I joined." "By enhancing these skills, one may begin the path to personal development which allows to maximise potentials and to accomplish the career goals within the time frame."*

5 DISCUSSION

5.1 Graduate Capability 1: Apply Discipline Knowledge, Principles, and Concepts

Gamified learning experiences through the online business simulation offers students an opportunity to bridge theoretical knowledge with practical applications. Students demonstrated their ability to apply discipline-specific knowledge by actively engaging in the simulation and incorporating their major-specific expertise into solving complex problems. For instance, students in this study showcased how leadership principles and teamwork strategies could be leveraged in real-world settings, aligning with McKellar (2020) and Schubert et al. (2019), who highlight the significance of experiential learning and curricula that link theory to industry demands. These findings are consistent with Hannon et al. (2005), who advocate for innovative teaching methods that foster entrepreneurial thinking, underscoring the importance of applying academic concepts in dynamic environments.

5.2 Graduate Capability 2: Innovative, Creative, and Entrepreneurial

Gamification promotes innovation, creativity, and entrepreneurial thinking, with students reflecting on how they adapted their strategies and responded to challenges in novel ways. The findings align with Bilić et al. (2011), who argue that well-structured curricula positively influence students' entrepreneurial aspirations, and with Lee (2015), who emphasises the need for experiential learning to cultivate entrepreneurial readiness. The students' reflections demonstrate the impact of agile thinking in the face of uncertainty, where collaboration and quick decision-making became key drivers of innovation. This creativity was evident when students discussed how specific actions, such as breaking the ice or identifying problem-solving patterns, facilitated both individual and team success. Furthermore, as Rasiah et al. (2019)

suggest, entrepreneurship accelerators, akin to the gamified simulation, serve as valuable tools for contextual learning that enhances entrepreneurial capabilities.

5.3 Graduate Capability 3: Effective Communicators with Digital Competency

The integration of digital platforms in gamified learning environments offers students opportunities to develop their communication skills in virtual settings, as emphasised by Karstina (2022) and Dissanayeke et al. (2024). While students reported success in using digital tools to collaborate, challenges such as technical issues and communication delays were also prevalent. These challenges underscore the significance of digital literacy, as noted by Bhatti et al. (2023), who argue for a blended teaching approach that incorporates both traditional and digital communication methods. The difficulties students faced, including technical glitches and limited efficiency of text-based communication, highlight the growing need for graduates to be adept in digital communication. The ability to overcome such obstacles is crucial in the modern business world, where digital competency is central to effective interaction, as supported by Allen et al. (2012) and Alvarez et al. (2011).

5.4 Graduate Capability 4: Culturally Competent to Engage Respectfully with Local First Peoples and Other Diverse Cultures

The discussions around communication and collaboration in gamified learning reflect the increasingly important role of cultural competence in global business environments. As students from diverse backgrounds engaged in team-based problem solving, students demonstrated their capacity to interact respectfully and work effectively in multicultural teams. This is consistent with Passey (2015) and Ivanitzki and Mueller (2023), who highlight the importance of integrating cross-cultural competencies in educational practices. The dynamic, multicultural settings of gamified simulations provide a rich context for students to develop intercultural competence, as they engage with peers who may bring different perspectives and approaches to problem solving.

5.5 Graduate Capability 5: Globally Engaged and Responsive

The challenges and successes that students experienced in the online business simulation also reflect their ability to navigate the complexities of global markets. As industry continues to become more interconnected, graduates need to be adaptable and responsive to rapid changes, a theme echoed by Jackson et al. (2023) and Gilbert (2012). The students' reflections on cross-functional collaboration, leadership, and the impact of agile thinking in dynamic settings align with the global competencies emphasised in the literature. By applying global business strategies and engaging in virtual, international collaborations, students were able to develop the skills necessary to thrive in the fast-evolving global economy.

5.6 Graduate Capability 6: Industry Connected and Career Capable

Industry-linked education remains a pivotal element in enhancing career capabilities and ensuring that graduates are well-prepared for professional challenges. The findings from this study reinforce Akili's (2011) perspective on the value of academic-industry collaborations. Students' ability to apply their academic knowledge in realistic scenarios demonstrates the importance of simulations as a bridge between classroom learning and industry practice. Moreover, the use of gamified elements in the simulation, mirroring real-world scenarios, highlights how such educational methods can enhance students' employability and readiness for leadership roles, as emphasised by Yusof et al. (2023). Through the development of practical skills, students are not only able to understand theoretical concepts but also gain the hands-on experience that is crucial for their career development.

6 CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

6.1 Conclusion

This study examined the role of gamification through online business simulations, in developing essential graduate capabilities and equipping students for the workforce in the Fourth Industrial Revolution (4IR) era. The findings suggest that gamification fosters a dynamic and interactive learning environment that enhances student engagement, critical thinking, problem-solving, communication, and digital literacy, key competencies for future-ready graduates. By integrating these elements into the curriculum, students gain experiential learning opportunities that bridge the gap between theoretical knowledge and real-world

applications, fostering adaptability, innovation, and teamwork. While challenges such as technical constraints and communication barriers persist, the overall impact of gamified learning on student development is significant. As industries increasingly demand professionals who can navigate digital transformation and complex problem-solving, gamification emerges as a powerful educational tool to cultivate the necessary graduate capabilities. Ultimately, embracing gamification in business education contributes to preparing students to thrive in an ever-evolving, technology-driven global economy.

6.2 Theoretical Implications

This study advances the theoretical understanding of gamification in higher education by demonstrating its role in enhancing graduate capabilities, a critical requirement in the 4IR era. This study highlights the connection between gamification and 6 key graduate capabilities ((1) apply discipline knowledge, principles and concepts; (2) Innovative, creative and entrepreneurial; (3) Effective communicators with digital competency; (4) Globally engaged and responsive; (5) Culturally competent to engage respectfully with local First Peoples and other diverse cultures; and (6) Industry connected and career capable). By integrating experiential learning within gamification, students develop essential skills such as problem-solving, adaptability, and decision-making, which are vital in the digital economy. Additionally, this study highlights the alignment between gamification and key 4IR-driven competencies, including innovation, digital literacy, and global collaboration. These insights contribute to the broader academic discourse on innovative pedagogies, emphasising the need for educational models that prepare graduates to thrive in technology-driven and interconnected industries.

6.3 Practical Implications

The findings provide practical recommendations for educators and institutions looking to implement gamification strategies. First, gamified learning environments, such as online business simulations, should be designed to enhance not only engagement but also critical graduate skills like communication, problem-solving, and teamwork. Educators are encouraged to use tools that facilitate collaboration, such as cloud-based platforms and interactive simulations, while being mindful of the potential challenges posed by technology, including connectivity issues and the need for digital literacy training. Additionally, integrating real-world scenarios into gamified activities can enhance the practical applicability of the skills learned, ensuring that students are better prepared for future career challenges. The research suggests that universities should provide training for faculty members to effectively incorporate gamification into their curricula, ensuring that it aligns with learning objectives and promotes the desired graduate capabilities.

6.4 Managerial Implications

For academic leaders and managers, the study highlights the importance of investing in innovative pedagogical tools that incorporate gamification, as these can significantly enhance student engagement and skill development. Furthermore, creating an environment that supports the seamless integration of technology in learning processes is crucial to overcoming the technical barriers that may hinder effective communication and collaboration. Institutions should consider offering professional development programs for educators to equip them with the knowledge and skills needed to implement gamified learning strategies effectively. Additionally, partnerships with industry stakeholders can enrich gamified simulations by incorporating real-world challenges and ensuring that students develop industry-relevant skills. Ultimately, academic leaders should view gamification not as a standalone tool but as part of a broader strategy to enhance graduate employability and prepare students for the demands of an increasingly digital and interconnected world.

6.5 Limitations and Future Research

One of the limitations of this study is its focus on a specific set of graduate capabilities, which may not fully capture the broader impact of gamification in business education. Future research should address this gap by examining how gamification influences other essential competencies, such as leadership and cultural competence. Expanding the scope of study to include these aspects would provide a more comprehensive understanding of gamification’s role in developing well-rounded graduates equipped for the evolving demands of the workforce.

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Analisis Spesifikasi Telefon Pintar Dan Faktor Pemilihan Terhadap Prestasi Kelajuan Sambungan Internet Dalam Kalangan Pelajar Kolej Poly-Tech MARA Batu Pahat

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ABSTRACT

Teknologi memainkan peranan penting dalam pelbagai aspek kehidupan, termasuk penggunaan internet untuk pembelajaran yang semakin popular di kalangan pelajar. Telefon pintar dengan akses internet yang pantas, stabil dan boleh dipercayai mampu meningkatkan produktiviti serta keberkesanan sesi pembelajaran di kelas. Dalam konteks kajian ini, kelajuan capaian internet menjadi salah satu faktor utama dalam pemilihan telefon pintar. Kajian ini menggunakan pendekatan kuantitatif dan kualitatif untuk menganalisis, membandingkan dan mencadangkan pilihan telefon pintar berdasarkan prestasi kelajuan internet. Seramai 319 orang pelajar daripada program "Diploma in Computer System & Networking", "Diploma in Information Technology", "Diploma in Graphic Design" dan "Diploma in Human Resource" di Kolej Poly-Tech MARA Batu Pahat dipilih menggunakan kaedah pensampelan bukan kebarangkalian - *convenience sampling*. Manakala, 30 orang pelajar telah dipilih untuk menjalani kaedah pemerhatian. Data diperoleh melalui pemerhatian, soal selidik dan ujian kelajuan internet menggunakan aplikasi pengukur kelajuan, sebelum dianalisis dengan perisian Excel dan SPSS. Hasil kajian dijangka mengenal pasti perbezaan jenama telefon pintar pelajar terhadap kelajuan internet. Kajian ini juga akan memberikan cadangan yang relevan berdasarkan keperluan pelajar terhadap teknologi dan spesifikasi telefon pintar yang dapat mengoptimumkan prestasi capaian internet.

KEYWORDS: Telefon pintar, akses internet, kelajuan capaian internet, pembelajaran

1 PENGENALAN

Pandemik Covid-19 telah mengubah cara pelaksanaan pendidikan, terutama melalui pembelajaran dalam talian (Nur Farhana et al.,2022). Dalam konteks ini, pemilihan spesifikasi telefon pintar memainkan peranan penting kerana ia boleh mempengaruhi kelajuan capaian internet. Pemilihan spesifikasi telefon pintar, termasuk kecepatan pemproses, kapasiti RAM, dan teknologi jaringan, memainkan peranan penting dalam menentukan pengalaman internet yang dicapai oleh pelajar (Dasari et al., 2018). Dalam situasi ini, kelajuan internet yang stabil dan pantas amat diperlukan bagi menyokong proses pembelajaran secara digital,

kerana pelajar perlu mengakses serta mengurus pelbagai bahan pendidikan dengan berkesan (Mohamad, 2023). Oleh itu, pemilihan spesifikasi telefon pintar memainkan peranan penting kerana komponen seperti RAM, pemproses (CPU), serta sokongan terhadap rangkaian moden seperti 4G atau 5G dapat mempengaruhi prestasi capaian internet. Peranti dengan spesifikasi rendah berisiko menghadapi kelewatan, gangguan sambungan, atau kelambatan aplikasi, yang akhirnya boleh menjejaskan pengalaman pembelajaran dalam talian secara keseluruhan.

Kajian menunjukkan bahawa penggunaan telefon pintar berkualiti tinggi dengan spesifikasi yang sesuai dapat mengurangkan masalah penimbalan (buffering) dan meningkatkan kecekapan dalam mengakses aplikasi pendidikan serta sumber dalam talian. Namun begitu, terdapat juga faktor luaran yang perlu dipertimbangkan, termasuk kekuatan isyarat rangkaian dan lokasi geografi (Yanto et al., 2022). Dalam konteks pelajar kolej, memahami hubungan antara pemilihan spesifikasi telefon pintar dan kelajuan internet adalah sangat penting bagi membantu mereka memanfaatkan potensi teknologi ini sepenuhnya dan seterusnya meningkatkan prestasi akademik. Oleh itu, kajian ini akan meneliti dengan lebih mendalam bagaimana aspek pemilihan telefon pintar boleh mempengaruhi kelajuan internet

2 KAJIAN LITERATUR

Pelajar menunjukkan tahap penerimaan yang sederhana namun bersikap positif terhadap penggunaan telefon pintar dalam pembelajaran. Walaupun mereka bersetuju dengan kegunaan telefon pintar untuk tujuan pembelajaran, dapatan menunjukkan bahawa peranti tersebut belum dimanfaatkan secara menyeluruh untuk pencarian ilmu dan aktiviti akademik. Keadaan ini menunjukkan bahawa penggunaan telefon pintar dalam kalangan pelajar masih lebih tertumpu kepada hiburan dan media sosial, berbanding dengan penggunaan untuk aplikasi pendidikan dan e-pembelajaran (Nur Hazwani Nerrahim, 2022). Kajian tersebut turut menyarankan bahawa pelajar perlu didedahkan dengan manfaat dan kemudahan telefon pintar dalam konteks pendidikan. Ini termasuk memberikan pendedahan tentang penggunaan aplikasi pembelajaran, pelantar pendidikan digital, dan teknik pembelajaran mudah alih (mobile learning) yang berkesan. Selain itu, penglibatan ibu bapa, guru, dan pihak institusi adalah penting dalam membimbing pelajar menggunakan teknologi ini secara optimum dan beretika.

Kelajuan internet merupakan salah satu faktor utama yang mempengaruhi keberkesanan penggunaan telefon pintar dalam pembelajaran dalam talian. Dalam satu kajian prestasi rangkaian oleh penyedia perkhidmatan mudah alih, ujian di luar bangunan (outdoor drive test) mendapati bahawa purata maksimum kelajuan muat turun dan muat naik ialah 14.3 Mbps dan 7.1 Mbps, manakala purata minimum ping dan kehilangan data masing-masing ialah 36.5 ms dan 0.14% (Ayman A. El-Saleh et al., 2022). Ini menunjukkan prestasi rangkaian yang agak stabil di kawasan terbuka. Walau bagaimanapun, pengukuran di dalam bangunan menunjukkan bahawa kadar kelajuan data hanya mencapai sekitar 2 Mbps, yang walaupun boleh diterima, mungkin tidak mencukupi untuk aplikasi pembelajaran digital yang memerlukan penggunaan data tinggi seperti video langsung atau konferens dalam talian.

Pemproses berfungsi sebagai otak kepada telefon pintar, yang secara langsung mempengaruhi keupayaannya untuk mengendalikan pelbagai tugasan, menjalankan aplikasi, dan memproses data dengan cekap. Menurut kajian oleh Pan dan Yang (2024), telefon pintar moden kini dilengkapi dengan pemproses canggih yang menyumbang kepada peningkatan prestasi dan keupayaan melakukan pelbagai tugasan serentak (multitasking). Mereka menyatakan bahawa penambahbaikan dalam teknologi pemproses boleh membawa kepada pengalaman internet yang lebih baik kerana pengendalian data merentasi aplikasi dapat dilakukan dengan lebih efisien. Bagi pelajar yang bergantung kepada capaian masa nyata terhadap sumber pendidikan, perkara ini adalah sangat penting kerana kelewatan pemprosesan boleh menjejaskan keupayaan mereka untuk berhubung dengan internet secara berkesan.

Selain itu, kemajuan dalam teknologi semikonduktor telefon pintar telah memungkinkan pembangunan pemproses yang meningkatkan keupayaan keseluruhan telefon pintar. Kemajuan ini turut menyumbang kepada capaian internet yang lebih pantas dan keterhubungan yang lebih baik, yang amat penting bagi pengguna akademik yang bergantung kepada akses maklumat yang pantas semasa kuliah dan sesi pembelajaran.

Ciri-ciri produk merupakan salah satu faktor penting yang mempengaruhi keputusan pembelian dalam kalangan pengguna, khususnya pelajar institusi pengajian tinggi. Dalam konteks ini, kajian oleh Maliza et al., 2024 mendapati bahawa ciri-ciri produk memberi pengaruh yang signifikan terhadap keputusan

pembelian telefon pintar dalam kalangan pelajar Universiti Teknologi MARA (UiTM). Kajian tersebut menunjukkan bahawa pelajar lebih cenderung memilih telefon pintar yang menawarkan ciri moden dan pelbagai, yang selari dengan keperluan serta keutamaan mereka yang semakin berkembang.

Dua kategori utama ciri-ciri yang dikenal pasti adalah atribut dalaman, seperti prestasi perisian dan keupayaan pemprosesan, serta atribut luaran, seperti reka bentuk, saiz dan berat peranti. Kedua-dua jenis atribut ini menjadi pertimbangan utama dalam membuat keputusan pembelian. Analisis statistik dalam kajian tersebut turut menunjukkan bahawa terdapat hubungan yang kuat antara ciri-ciri produk dengan niat pembelian**,** yang mencerminkan bahawa pelajar memberi penekanan terhadap telefon pintar yang mempunyai ciri-ciri canggih dan selaras dengan perkembangan teknologi semasa.

3 METODOLOGI

Telefon pintar memainkan peranan penting dalam menyokong proses pembelajaran digital masa kini, terutama apabila digabungkan dengan akses internet yang pantas dan stabil. Dalam konteks pendidikan tinggi, pelajar semakin bergantung kepada telefon pintar untuk mengakses nota kuliah, menghadiri kelas dalam talian, menyertai perbincangan interaktif, serta mendapatkan sumber pendidikan secara maya.

Kajian ini akan menggunakan pendekatan kuantitatif dengan reka bentuk tinjauan. Borang soal selidik dibangunkan untuk mengumpul data mengenai penggunaan internet, kelajuan sambungan, dan kepuasan pelajar terhadap kedua-dua system (Razali & Azman, 2021). Soal selidik ini diedarkan kepada pelajar Kolej Poly-Tech MARA Batu Pahat untuk mendapatkan pandangan mereka mengenai pemilihan spesifikasi telefon pintarmempengaruhi prestasi kelajuan capaian internet.

Kajian ini juga menggunakan pendekatan kualitatif di mana penyelidik kualitatif melaporkan saiz sampel antara 5 hingga 30 peserta, bergantung kepada fokus kajian dan tahap penyelidikan yang diperlukan. Kajian kualitatif biasanya mendapat manfaat daripada sampel yang lebih kecil dan lebih tertumpu, yang membolehkan penerokaan mendalam terhadap pengalaman peserta (Robinson, 2013). Penemuan ini selari dengan dapatan Cleary et al. (2014) yang menyatakan bahawa walaupun saiz sampel yang besar dapat menawarkan keluasan maklumat, ia berisiko mengorbankan kedalaman pemahaman dalam penyelidikan kualitatif.

Populasi kajian ini terdiri daripada pelajar Kolej Poly-Tech MARA Batu Pahat. Sampel dipilih secara rawak mudah, melibatkan pelajar dari pelbagai program pengajian yang terdiri daripada program “Diploma in Computer System & Networking”, “Diploma in Information Technology”, “Diploma in Graphic Design”, dan “Diploma in Human Resource” untuk memastikan representasi yang seimbang. Mengikut jadual Krejcie & Morgan (1970), seramai 319 orang pelajar dari 1818 pelajar yang aktif di Kolej Poly-Tech MARA Batu Pahat telah memberikan data yang mencukupi untuk analisis kajian ini. Seramai 30 orang pelajar telah dipilih sebagai peserta kajian ini melalui kaedah pensampelan bertujuan. Pemilihan ini dilakukan berdasarkan kesesuaian mereka dengan kriteria kajian, iaitu pelajar yang menggunakan telefon pintar semasa pembelajaran dalam talian. Sampel ini digunakan bagi tujuan pemerhatian untuk menilai hubungan antara spesifikasi telefon pintar dan kelajuan capaian internet semasa tugasan pembelajaran dilaksanakan.

Data yang diperoleh akan dianalisis menggunakan perisian Microsoft Excel dan SPSS bagi mendapatkan statistik deksriptif untuk mengetahui pemilihan pelajar terhadap spesifikasi telefon pintar terhadap kelajuan internet.

3.1 Analisis Faktor Demografi Terpilih Responden

Kajian deskriptif pada soal selidik telah digunakan untuk mengkaji kebolehcapaian sambungan Internet di antara Wi-Fi atau Hotspot dikalangan pelajar Kolej Poly-Tech MARA Batu Pahat. Responden kajian ini melibatkan 319 orang pelajar dengan menggunakan teknik bola salji dalam penggumpulan data. Kajian ini terbahagi kepada tiga bahagian iaitu Bahagian A berkenaan dengan analisa latar belakang responden yang terdiri daripada jantina, umur, program, semester, dan kursus. Bahagian B, analisa berkaitan dengan telefon pintar seperti pelantar telefon pintar, jenama telefon pintar, harga, saiz memori dan kapasiti storan telefon pintar. Bahagian C pula berkenaan dengan analisa sambungan internet dari segi jenis sambungan internet yang digunakan, sebab mengapa memilih jenis sambungan tersebut, jenama perkhidmatan internet, dan tahap kelajuan internet. Kaedah kekerapan dan peratusan digunakan untuk menganalisis latar belakang responden. Analisis data latar belakang responden adalah seperti yang ditunjukkan dalam Jadual 1.

Jadual 1: Analisa taburan bilangan dan peratusan responden mengikut Umur

Umur	Bilangan	Peratus
17	6	1.9%
18	123	38.6%
19	122	38.2%
20	53	16.6%
21	8	2.5%
22	4	1.3%
23	2	0.6%
24	1	0.3%
Jumlah	**319**	**100.0%**

Jadual 1 menunjukkan taburan bilangan dan peratusan responden mengikut umur. Jumlah bilangan responden adalah 319 orang. Dari jumlah ini seramai 6 orang (1.9%) berumur 17 tahun, 123 orang (38.6%) berumur 18 tahun, 122 orang (38.2%) berumur 19 tahun, 53 orang (16.6%) berumur 20 tahun, 8 orang (2.5%) berumur 21 tahun, 4 orang (1.3%) berumur 22 tahun, 2 orang (0.6%) berumur 23 dan 1 orang (0.3%) berumur 24 tahun Oleh itu, jumlah umur responden yang menjawab kaji selidik ini berumur di antara 18 dan 19 tahun.

Jadual 2: Analisa taburan bilangan dan peratusan responden mengikut Jantina

Jantina	Bilangan	Peratus
Lelaki	149	46.7%
Perempuan	170	53.3%
Jumlah	**319**	**100%**

Jadual 2 menunjukkan taburan bilangan dan peratusan responden mengikut jantina. Daripada kaji selidik yang dijalankan, responden perempuan paling ramai 170 orang (53.3%) diikuti dengan responden lelaki 149 orang (46.7%). Jumlah responden yang menjawab kaji selidik ini seramai 319 orang pelajar.

Jadual 3: Analisa taburan bilangan dan peratusan responden mengikut Program

Program	Bilangan	Peratus
AB107	97	30.4%
CC103	45	14.1%
CT103	109	34.2%
CT108	68	21.3%
Jumlah	**319**	**100.0%**

Jadual 3 menunjukkan taburan bilangan dan peratusan responden mengikut program di Kolej Poly-Tech MARA Batu Pahat. Seramai 319 orang pelajar menjawab kaji selidik yang terdiri daripada pelajar program CT103 paling ramai iaitu 109 pelajar (34.2%) diikuti program AB107 97 orang pelajar (30.4%), CT108 68 orang pelajar (21.3%) dan paling rendah daripada program CC103 iaitu 45 orang pelajar.

Jadual 4: Analisa taburan bilangan dan peratusan responden mengikut Semester

Semester	Bilangan	Peratus
1	142	44.5%
3	2	0.6%
4	142	44.5%
6	33	10.3%
Jumlah	**319**	**100%**

Jadual 4 menunjukkan taburan bilangan dan peratusan responden mengikut program di Kolej Poly-Tech MARA Batu Pahat. Seramai 319 orang pelajar menjawab kaji selidik yang terdiri daripada pelajar semester 1,3, 4 dan 6. Bilangan responden paling ramai iaitu 142 pelajar (44.5%) dalam semester 1 dan 4, diikuti semester 6 33 orang (10.3%) dan paling sedikit dikuti oleh pelajar semester 3 iaitu 2 orang (0.6%).

Jadual 5: Analisa taburan bilangan dan peratusan responden mengikut Jenis telefon pintar dan pelantar telefon pintar.

Jenis Telefon pintar/ Pelantar Telefon pintar	Android	Peratus	iOS	Peratus2	Jumlah telefon pintar	Peratus 3
Honor	10	3.1%	0	0.0%	10	3.1%
Huawei	1	0.3%	0	0.0%	1	0.3%
iPhone	0	0.0%	153	48.0%	153	48.0%
Lain-lain	25	7.8%	0	0.0%	25	7.8%
Oppo	21	6.6%	0	0.0%	21	6.6%
Realme	21	6.6%	0	0.0%	21	6.6%
Samsung	37	11.6%	0	0.0%	37	11.6%
Sony	3	0.9%	0	0.0%	3	0.9%
Vivo	21	6.6%	0	0.0%	21	6.6%
Xiaomi	27	8.5%	0	0.0%	27	8.5%
Jumlah	**166**	**52.0%**	**153**	**48%**	**319**	**100.0%**
Minimum	**1**	**0.3%**	**0**	**0**	**1**	**0.3%**
Maksimum	**37**	**11.6%**	**153**	**0.5**	**190**	**59.6%**
Purata	**18.4**	**5.8%**	**15.3**	**0.0**	**33.7**	**10.6%**
Sisihan Piawai	**11.7**	**3.7%**	**48.4**	**15.2%**		

Jadual 5 menunjukkan taburan bilangan dan peratusan responden mengikut jenis telefon dan pelantar telefon pintar yang di miliki oleh pelajar di Kolej Poly-Tech MARA Batu Pahat. Daripada kaji selidik yang dijalankan jenama telefon pintar iPhone merupakan pilihan utama pelajar iaitu 153 orang (48.0 %) yang menggunakan pelantar iOS, diikuti oleh telefon pintar jenama Samsung yang menggunakan pelantar Andriod iaitu 37 orang (11.6%). Selain itu, pelantar android juga menjadi pilihan bagi jenama Xiaomi 27 orang (8.5%), lain-lain jenama 25 orang (7.8%), Oppo, Vivo dan Realme 21 orang (6.6%), diikuti oleh jenama Honor 10 orang (3.1%) dan jenama telefon pintar Sony 3 orang (0.9%). Purata penggunaan pelantar android di Kolej Poly-Tech MARA Batu Pahat sebanyak 18.4 (5.8%) dan pelantar iOS adalah 15.3 (0%) ini kerana iOS hanya ada pada jenama iPhone. Sisihan piawai menunjukkan di Kolej PolyTech MARA Batu Pahat, pelantar iOS menjadi pilihan pelajar 48.4 (15.2%) diikuti oleh pelantar Android 11.7 (3.7%).

Jadual 6: Analisa taburan bilangan dan peratusan responden mengikut saiz memori telefon pintar

Saiz memori telefon pintar	Bilangan	Peratus
12 GB	25	7.8%
16 GB	32	10.0%
32 GB	13	4.1%
4 GB	80	25.1%
8 GB	92	28.8%
Lain-lain	77	24.1%
Jumlah	**319**	**100%**
Minimum	**13**	**4.1%**
Maksimum	**92**	**28.8%**

Jadual 6 menunjukan analisa saiz memori telefon pintar yang dimiliki oleh setiap pelajar. Didapati saiz memori yang paling banyak dimiliki oleh pelajar ialah 8 GB iaitu 92 orang (28.8%), diikuti oleh 4 GB saiz memori 80 (25.1%), lain-lain memori saiz 77 (24.1), 16 GB saiz memori 32 (4.1%), 12 GB memori saiz 25 (7.8%) dan 32 GB memori saiz 13 (4.1%). Ini menunjukkan setiap telefon pintar yang dimiliki oleh pelajar di Kolej Poly-Tech MARA Batu Pahat pasti akan mempunyai memori untuk prestasi dan pengalaman dalam penggunaan telefon pintar yang lebih efisien dan efektif.

Jadual 7: Analisa taburan bilangan dan peratusan responden mengikut ruang storan telefon pintar

Storan telefon pintar	Bilangan	Peratus
128 GB	134	42.0%
256 GB	130	40.8%
512 GB	14	4.4%
64 GB	35	11.0%
Lain-lain	6	1.9%
Jumlah	**319**	**100%**
Minimum	**6**	**1.9%**
Maksimum	**134**	**42.0%**

Jadual 7 menunjukkan analisa taburan storan telefon pintar bagi setiap responden mengikut bilangan dan peratus. Storan telefon pintar yang paling banyak ialah 128 GB iaitu 134 telefon pintar (42%), diikuti oleh 256 GB storan telefon pintar130 (40.8%), 64 GB iaitu 35 telefon pintar (11%), 512 GB iaitu 14 (4.4%) dan lain-lain saiz telefon pintar ialah 6 (1.9%). Storan telefon pintar yang besar mempengaruhi prestasi dan kapasiti dalam penyimpanan maklumat atau data di dalam telefon pintar.

Berdasarkan data yang diperolehi, didapati seramai 319 orang pelajar terlibat didalam kajian ini dengan peratusan jantina hampir seimbang iaitu 53.3% perempuan dan 46.7% lelaki, berumur 18 hingga 19 tahun. Pilihan utama telefon pintar yang digunakan oleh pelajar Kolej Poly-Tech MARA Batu Pahat ialah iPhone (48%), diikuti oleh jenama Samsung (11.6%). Kapasiti memori antara 8 GB hingga 12 GB, dan storan yang paling banyak adalah 128 GB.

4 OBJEKTIF KAJIAN

Berikut adalah objektif kajian ini;

4.1 Untuk menganalisis spesifikasi teknikal telefon pintar yang mempengaruhi prestasi kelajuan internet.
4.2 Untuk mengetahui faktor yang mempengaruhi pemilihan telefon pintar.
4.3 Untuk memberikan cadangan bagi memilih telefon pintar yang mengoptimumkan kelajuan internet

5 DAPATAN KAJIAN

Objektif 1: Untuk menganalisis spesifikasi teknikal telefon pintar yang mempengaruhi prestasi kelajuan internet.

H_0 : Tiada hubungan yang signifikan antara memori (RAM) telefon pintar dan kestabilan sambungan internet

Rajah 1: Hubungan antara RAM telefon pintardan kestabilan sambungan internet

Correlations

			RAM	Stabiliti_sambungan
Spearman's rho	RAM	Correlation Coefficient	1.000	.244
		Sig. (2-tailed)	.	.194
		N	30	30
	Stabiliti_sambungan	Correlation Coefficient	.244	1.000
		Sig. (2-tailed)	.194	.
		N	30	30

Bagi mencapai objektif ini, analisis korelasi Spearman telah digunakan bagi menilai hubungan antara RAM telefon pintar dan kestabilan sambungan internet. Ujian ini dipilih memandangkan data bersifat ordinal atau tidak menepati taburan normal, serta sesuai digunakan untuk saiz sampel kecil seperti dalam kajian ini (N = 30).

Hasil analisis menunjukkan bahawa nilai pekali korelasi Spearman bagi hubungan antara RAM dan kestabilan sambungan ialah r = 0.244. Ini menunjukkan hubungan yang lemah dan positif antara kedua-dua pemboleh ubah, di mana peningkatan dalam kapasiti RAM cenderung dikaitkan dengan peningkatan tahap kestabilan sambungan internet. Namun begitu, nilai signifikan (p = 0.194) adalah lebih besar daripada aras signifikan yang ditetapkan (α = 0.05). Ini bermaksud hubungan yang diperoleh adalah tidak signifikan secara statistik, dan tidak mencukupi bukti untuk menyokong bahawa kapasiti RAM memberi kesan secara langsung terhadap kestabilan sambungan internet dalam konteks kajian ini. Maka, hipostesis nol (H_0) diterima.

Dari sudut kualitatif kerana data dinilai dari pemerhatian, walaupun RAM sering dianggap sebagai elemen penting dalam prestasi telefon pintar, hasil kajian ini mencadangkan bahawa kestabilan sambungan internet lebih bergantung kepada faktor lain seperti spesifikasi modem dalaman, sokongan jalur frekuensi, atau kekuatan isyarat di kawasan setempat, berbanding kapasiti RAM semata-mata. Secara keseluruhannya, dapat disimpulkan bahawa RAM tidak menunjukkan hubungan yang signifikan dengan kestabilan sambungan internet, sekaligus menyarankan agar faktor lain turut dipertimbangkan dalam pemilihan telefon pintaruntuk tujuan pembelajaran yang memerlukan capaian internet yang stabil. Sebaliknya, analisis

hubungan antara kelajuan pemproses (processor speed) dan kestabilan sambungan internet menunjukkan dapatan yang lebih ketara.

H (1): Tiada hubungan yang signifikan antara kelajuan pemproses telefon pintardan kestabilan sambungan internet.

Rajah 2: Hubungan antara kelajuan pemproses telefon pintardan kestabilan sambungan internet

Correlations

			Stabiliti_sambungan	Processor_speed
Spearman's rho	Stabiliti_sambungan	Correlation Coefficient	1.000	.699**
		Sig. (2-tailed)	.	<.001
		N	30	30
	Processor_speed	Correlation Coefficient	.699**	1.000
		Sig. (2-tailed)	<.001	.
		N	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

Bagi menilai pengaruh spesifikasi teknikal terhadap prestasi kelajuan internet, analisis korelasi Spearman telah dijalankan lagi sekali bagi mengkaji hubungan antara kelajuan pemproses (processor speed) dan kestabilan sambungan internet. Ujian Spearman juga sesuai digunakan kerana data bersifat ordinal dan tidak semestinya menepati taburan normal.

Hasil dapatan menunjukkan nilai pekali korelasi Spearman (r) adalah 0.699, dengan nilai signifikan (p) = 0.000. Ini menunjukkan hubungan yang kuat dan positif antara kelajuan pemproses dan kestabilan sambungan internet. Lebih tinggi kelajuan pemproses, lebih stabil sambungan internet yang diperoleh. Tambahan pula, nilai p yang lebih rendah daripada aras signifikan 0.01 menunjukkan bahawa hubungan ini adalah sangat signifikan secara statistik. Maka hipotesis alternatif (H(1)) tidak diterima.

Penemuan ini menyokong anggapan bahawa kelajuan pemproses berperanan penting dalam memastikan prestasi internet yang baik pada telefon pintar. Pemproses yang lebih pantas membantu sistem peranti bertindak balas dengan lebih efisien terhadap permintaan data dan mampu mengurus trafik rangkaian dengan lebih baik. Ini sekali gus mengurangkan gangguan seperti lengah masa (lag) dan gangguan sambungan, menjadikan pengalaman pembelajaran dalam talian lebih lancar dan stabil.

Hasil dapatan ini selari dengan kajian oleh Dasari et al. (2018) menunjukkan bahawa prestasi pelayaran web lebih sensitif terhadap kelajuan pemproses berbanding kapasiti RAM. Ini kerana pelayaran web banyak dipengaruhi oleh frekuensi jam pemproses dan tidak menggunakan lebih daripada dua teras, menjadikan kelajuan pemproses faktor utama dalam prestasi internet.

Secara keseluruhannya, bukti empirikal menunjukkan bahawa kapasiti RAM bukanlah penentu utama dalam kelajuan atau kestabilan sambungan internet pada telefon pintar. Sebaliknya, kelajuan pemproses dan spesifikasi modem dalaman memainkan peranan yang lebih besar dalam menentukan prestasi sambungan internet. Penemuan ini memberi panduan penting dalam pemilihan telefon pintaruntuk tujuan pembelajaran dalam talian, di mana kelajuan pemproses harus dijadikan keutamaan bagi memastikan pengalaman pengguna yang lebih lancar dan stabil.

Objektif 2: Untuk mengetahui faktor yang mempengaruhi pemilihan telefon pintar

Rajah 3: Analisa faktor yang mempengaruhi pemilihan telefon pintar

FAKTOR YANG MEMPENGARUHI PEMILIHAN TELEFON PINTAR.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Harga (Price)	32	10.0	10.0	10.0
	Jenama (Brand)	40	12.5	12.5	22.6
	Spesifikasi pemproses (Processor Specification)	44	13.8	13.8	36.4
	Spesifikasi memori (Memory Specification)	52	16.3	16.3	52.7
	Spesifikasi kamera (Camera Specification)	41	12.9	12.9	65.5
	Spesifikasi Storan (Storage Specification)	50	15.7	15.7	81.2
	Spesifikasi pelantar (Platform Specification)	25	7.8	7.8	89.0
	Tren (Trend)	35	11.0	11.0	100.0
	Total	319	100.0	100.0	

Berdasarkan data tinjauan yang melibatkan seramai 319 responden, dapat dirumuskan bahawa faktor utama yang mempengaruhi pemilihan telefon pintar adalah aspek teknikal peranti. Antara faktor yang paling banyak dipilih ialah spesifikasi memori, dengan 52 responden atau 16.3% menyatakannya sebagai faktor utama. Ini diikuti rapat oleh spesifikasi storan sebanyak 50 responden (15.7%) dan spesifikasi pemproses sebanyak 44 responden (13.8%). Ketiga-tiga faktor ini berkait rapat dengan prestasi dalaman sesebuah telefon pintar, yang memberi kesan langsung terhadap kelancaran penggunaan, keupayaan menyimpan data, dan kepantasan pemprosesan maklumat.

Spesifikasi kamera pula berada di kedudukan keempat dengan 41 responden (12.9%), menunjukkan bahawa kualiti kamera juga merupakan salah satu pertimbangan penting bagi pengguna. Seterusnya, jenama dipilih oleh 40 responden (12.5%) dan trend semasa oleh 35 responden (11.0%), menunjukkan bahawa faktor-faktor ini lebih berkaitan dengan persepsi dan keutamaan gaya hidup pengguna, berbanding aspek prestasi sebenar peranti. Harga, walaupun sering dianggap penentu utama dalam pemilihan produk, hanya dipilih oleh 32 responden (10.0%), menjadikannya antara faktor paling rendah. Ini menunjukkan bahawa sebahagian besar pengguna kini lebih menitikberatkan prestasi dan nilai teknikal berbanding kos semata-mata.

Faktor yang paling kurang diberi perhatian adalah spesifikasi pelantar, iaitu sistem operasi dan *firmware*, yang hanya dipilih oleh 25 responden atau 7.8%. Walaupun faktor ini secara teknikal mempunyai pengaruh terhadap kestabilan sistem dan keupayaan sambungan rangkaian seperti 4G atau 5G, ia mungkin kurang difahami oleh pengguna biasa dan dianggap kurang signifikan dalam membuat keputusan pembelian.

Kesimpulannya, hasil analisis ini menunjukkan bahawa kebanyakan pengguna lebih cenderung memilih telefon pintar berdasarkan keupayaan teknikal seperti memori, storan dan pemproses. Faktor luaran seperti harga, jenama dan trend hanya memainkan peranan sokongan dalam proses pemilihan. Walaupun spesifikasi memori (RAM) mencatatkan peratusan tertinggi dalam pilihan responden, dari sudut teknikal, ia tidak mempunyai hubungan yang signifikan secara langsung dengan kelajuan internet. Sebaliknya, RAM lebih mempengaruhi kelancaran multitugas dan keupayaan menjalankan aplikasi. Begitu juga dengan spesifikasi pelantar atau sistem operasi, walaupun secara asasnya memainkan peranan dalam pengurusan rangkaian, hubungannya dengan kelajuan internet tidak begitu ketara berbanding spesifikasi pemproses yang mempunyai cip modem terbina untuk sambungan rangkaian.

Dapatan ini disokong oleh kajian yang dijalankan oleh Universiti Kuala Lumpur Business School (2021) yang mendapati bahawa pelajar lebih cenderung memilih telefon pintarberdasarkan prestasi teknikal seperti kelajuan pemproses, kapasiti storan dan kamera, serta jenama yang dipercayai (Alyia,2021). Ciri-ciri

inovatif seperti teknologi terkini, reka bentuk moden, dan fungsi pintar dikenal pasti sebagai aspek yang paling penting dalam menentukan keputusan pembelian (Safiek,2012).

Hasil dapatan ini juga mencerminkan tahap kesedaran pengguna terhadap prestasi dalaman telefon pintar yang semakin meningkat, khususnya dalam menyokong keperluan digital harian seperti penggunaan aplikasi, permainan dalam talian, penstriman media dan akses internet. Pemilihan yang berasaskan keupayaan teknikal menunjukkan pengguna semakin bijak membuat keputusan berdasarkan fungsi dan prestasi sebenar peranti, bukan semata-mata kepada faktor komersial atau kosmetik.

Objektif 3: Untuk memberikan cadangan bagi memilih telefon pintar yang mengoptimumkan kelajuan internet

Berdasarkan analisis data tinjauan dan pemahaman teknikal, dua faktor utama dikenal pasti sebagai paling berpengaruh terhadap kelajuan internet pada telefon pintar, iaitu spesifikasi pemproses dan spesifikasi pelantar. Spesifikasi pemproses merujuk kepada cip sistem (CPU/SoC) yang memainkan peranan penting dalam pengendalian data serta keupayaan sambungan rangkaian seperti 4G, 5G dan Wi-Fi. Cip pemproses moden biasanya dilengkapi dengan modem terbina yang lebih canggih dan pantas, seterusnya menyumbang kepada peningkatan kelajuan internet. Dalam tinjauan yang dijalankan, sebanyak 44 responden atau 13.8% memilih spesifikasi pemproses sebagai faktor utama yang mempengaruhi kelajuan internet.

Selain itu, spesifikasi pelantar yang merangkumi sistem operasi seperti Android atau iOS serta firmware yang digunakan turut memberi kesan kepada prestasi sambungan internet. Pelantar yang lebih baharu dan canggih lazimnya menyokong teknologi rangkaian yang lebih pantas, seperti 5G, dan mempunyai keupayaan pengurusan aplikasi dalam talian yang lebih baik. Walaupun hanya 25 responden atau 7.8% memilih spesifikasi pelantar sebagai faktor utama, ia tetap relevan dari segi teknikal.

Sebaliknya, faktor-faktor lain seperti harga, jenama, kamera, storan, memori, dan trend pengguna didapati kurang berkait secara langsung dengan kelajuan internet. Faktor-faktor ini lebih menjurus kepada keutamaan pengguna dari segi gaya, fungsi tambahan dan nilai komersial sesuatu peranti, berbanding pengaruh langsung terhadap prestasi sambungan internet. Walaupun sesetengah daripadanya mungkin berkorelasi dengan spesifikasi yang lebih baik, ia bukanlah penentu utama dalam menentukan kelajuan internet sesebuah telefon pintar.

Kesimpulannya, pelbagai kajian terdahulu menunjukkan bahawa pemilihan telefon pintar yang mengoptimumkan kelajuan internet amat bergantung kepada spesifikasi teknikal peranti tersebut, khususnya kelajuan pemproses dan sokongan terhadap teknologi rangkaian terkini seperti 4G LTE dan 5G. Kajian oleh Steiner dan Gao (2016), Finley et al. (2018), serta Martinez et al. (2016) secara kolektif menyokong dapatan bahawa prestasi pemproses, keupayaan modem dalaman, dan kestabilan sambungan rangkaian memainkan peranan utama dalam menentukan kelajuan serta kualiti pengalaman internet pengguna. Maka, pemilihan peranti dengan spesifikasi tinggi adalah kritikal untuk memenuhi keperluan pembelajaran dan penggunaan aplikasi dalam talian yang lancar. spesifikasi pemproses merupakan faktor paling relevan dan berpengaruh terhadap kelajuan internet telefon pintar, diikuti oleh spesifikasi pelantar.

6 KESIMPULAN

Dapatan kajian ini menunjukkan bahawa spesifikasi teknikal telefon pintar memainkan peranan utama dalam mempengaruhi kelajuan dan kestabilan sambungan internet, terutamanya dalam konteks penggunaan untuk pembelajaran dalam talian. Analisis korelasi menunjukkan bahawa kelajuan pemproses mempunyai hubungan yang kuat dan signifikan dengan kestabilan sambungan internet ($r = 0.699$, $p < 0.001$), menjadikannya faktor paling kritikal. Pemproses berprestasi tinggi bukan sahaja mempercepatkan pemprosesan data, tetapi juga dilengkapi dengan modem terbina yang mampu menyokong teknologi rangkaian terkini seperti 4G LTE dan 5G, sekaligus memastikan sambungan lebih stabil dan responsif.

Sebaliknya, kapasiti RAM walaupun sering dikaitkan dengan prestasi peranti, tidak menunjukkan hubungan signifikan dengan kestabilan sambungan internet ($r = 0.244$, $p = 0.194$), menunjukkan bahawa peningkatan RAM semata-mata tidak menjamin sambungan yang lebih baik. Berdasarkan nilai p yang melebihi aras signifikan ($\alpha = 0.05$), ini menunjukkan bahawa hipotesis nol (H_0) diterima dan hipotesis

alternatif (H_1) tidak diterima, sekali gus menolak andaian bahawa kapasiti RAM mempunyai pengaruh langsung terhadap kestabilan sambungan internet dalam konteks kajian ini.

Di samping itu, hasil tinjauan terhadap 319 responden menunjukkan bahawa kebanyakan pengguna lebih cenderung memilih telefon pintar berdasarkan aspek teknikal seperti memori, storan dan pemproses, berbanding faktor luaran seperti harga, jenama dan trend. Namun, dari sudut pengaruh terhadap kelajuan internet, pemproses dan pelantar dikenal pasti sebagai dua faktor utama yang memberikan kesan paling ketara. Pelantar yang terkini turut menyumbang kepada prestasi sambungan melalui pengurusan aplikasi dan sokongan sistem terhadap teknologi rangkaian moden, walaupun peranannya lebih sekunder berbanding pemproses.

Secara keseluruhannya, pemilihan telefon pintar untuk tujuan pembelajaran dan penggunaan digital intensif seharusnya memberi penekanan utama kepada kelajuan pemproses dan keserasian sistem pelantar, kerana kedua-dua faktor ini terbukti memberi kesan yang paling signifikan terhadap kelajuan serta kestabilan sambungan internet. Penemuan ini memberikan panduan yang jelas kepada pengguna dan pembuat dasar dalam memilih peranti yang sesuai, khususnya dalam konteks pendidikan digital dan persekitaran pembelajaran berasaskan internet.

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Harnessing Collaborative Learning in Higher Education: Addressing Challenges and Innovations in the 4th Industrial Revolution (4IR) Era

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ABSTRACT

Collaborative learning has become a key strategy for enhancing student success in higher education by promoting active engagement and nurturing essential 21st-century skills. However, the 4th Industrial Revolution (4IR) era presents notable challenges, including unequal access to technology, varying levels of digital proficiency, and difficulties sustaining engagement within virtual settings. This research examines the use of gamified digital tools such as Canva, Padlet, and Mentimeter to overcome these obstacles and improve collaborative learning outcomes. Adopting a mixed-methods approach, the study explores the impact of these tools on student participation, the creation of a supportive learning environment, and equitable access to collaborative opportunities. Data were collected through surveys and observational analyses involving students and educators in higher education contexts. The findings indicate that integrating gamification into digital collaboration enhances student motivation and engagement while enabling educators to foster inclusive and enjoyable learning experiences. This research underscores the transformative role of innovative tools in advancing educational excellence and offers practical recommendations for incorporating technology into collaborative teaching practices.

KEYWORDS: Collaborative learning, Higher Education, Student engagement, digital tools

1 INTRODUCTION

Collaborative learning has emerged as a fundamental approach to fostering student success in higher education by promoting active engagement and the development of essential 21st-century skills (Dillenbourg, 1999). However, the Fourth Industrial Revolution (4IR) presents significant challenges, including disparities in technological access, varying digital proficiency among students, and difficulties in maintaining engagement in virtual learning environments (Schwab, 2016). Given these obstacles, educators must explore innovative approaches to enhance collaborative learning experiences.

Essentially, the Fourth Industrial Revolution (4IR) has ushered in remarkable technological advancements that are reshaping various industries and profoundly influencing the global economy. This transformation is driven not only by emerging technologies but also by the rise of new business models and shifting value systems. In response, higher education institutions are compelled to evolve, facing mounting pressure to revise their curricula, teaching approaches, and organizational frameworks to equip students with the skills needed to thrive in the dynamic landscape of the 4IR (Pelletier et al., 2021; Smith, 2023).

The higher education sector is experiencing significant change as it adapts to the Fourth Industrial Revolution (4IR), driven by the integration of emerging technologies like artificial intelligence (AI), machine learning, and big data analytics. These innovations are reshaping teaching and learning methods within universities, opening new possibilities for personalized education, adaptive assessments, and data-informed decision-making processes (Grimus, 2020; Mhlanga, 2023). Despite the increasing integration of digital tools in higher education, challenges persist regarding student motivation, accessibility, and participation in collaborative learning. Research indicates that students often struggle with engagement in online settings, resulting in reduced interaction and lower learning outcomes (Bozkurt & Sharma, 2020). Furthermore, disparities in digital literacy and access to technological resources exacerbate these challenges, creating inequitable learning environments (Selwyn, 2016).

To adequately equip students for the challenges of the Fourth Industrial Revolution (4IR), higher education institutions must adopt innovative pedagogical strategies and teaching methods (Lubingan, Maramira, & Masiya, 2023). Approaches such as collaborative and experiential learning including project-based learning and flipped classrooms allow students to apply theoretical concepts to practical, real-world situations. Pedagogical frameworks serve as essential tools for educators, offering guiding principles and strategies to navigate the complexities of 4IR effectively (Mahaye, 2020). For instance, constructivism promotes active student engagement in building knowledge through hands-on activities and collaboration, fostering critical thinking, problem-solving, and creativity which are the key competencies in the digital era. Similarly, connectivism emphasizes the significance of forming connections and utilizing digital networks for learning. In the context of 4IR, this approach underscores the importance of digital literacy and the ability to manage the vast flow of information online. These and other pedagogical models provide a solid foundation for educators to adapt to the evolving educational landscape shaped by 4IR.

Considering the previously discussed challenges, this study explores the use of gamified digital tools such as Canva, Padlet, and Mentimeter, aiming to offer practical insights into their effectiveness in enhancing student engagement and promoting equitable access to collaborative learning opportunities. These tools are examined as more effective teaching resources for addressing the demands and obstacles posed by the Fourth Industrial Revolution (4IR).

2 LITERATURE REVIEW

Gamification has been widely recognized as a strategy to enhance student engagement by integrating game elements into educational contexts (Deterding et al., 2011). Studies show that gamified tools can improve motivation and cognitive retention, particularly in collaborative learning settings (Hamari et al., 2014). Digital tools like Canva, Padlet, and Mentimeter offer interactive features that encourage peer collaboration and creativity (Wang, 2021). Additionally, prior research highlights the importance of creating an inclusive digital learning environment, emphasizing the need for accessible and equitable technological interventions (Gee, 2013). By synthesizing existing literature, this study aims to validate the effectiveness of gamification in higher education.

2.1 Technology Advancement

The Fourth Industrial Revolution (4IR) is fundamentally driven by ongoing advancements in artificial intelligence, big data analytics, the Internet of Things, and robotics (Park & Park, 2021). These technological developments form a crucial theoretical foundation for 4IR, powering its transformative influence across various industries. As technology progresses, it unlocks new avenues for innovation, automation, and increased efficiency, thereby reshaping both economies and societies. For instance, breakthroughs in artificial intelligence have resulted in intelligent systems capable of making complex decisions, while the rapid expansion of data and sophisticated analytical methods enable organizations to extract valuable insights and make informed, data-driven choices. While these innovations enhance

productivity, they also introduce ethical dilemmas, privacy concerns, and potential workforce disruption issues that demand thoughtful responses and strategic adaptation. Overall, technological advancement underpins the integration and impact of 4IR technologies on a global scale.

Numerous studies (Foster et al., 2011; Washbon, 2012) have established a strong link between the use of digital tools and the academic success of 21st-century learners. According to Askar et al. (2006), integrating technology into teaching and learning is a multifaceted process that involves institutional culture, administrative practices, educators, students, families, and the curriculum. Akcil et al. (2021) argue that defining technology integration remains challenging due to the variety of models informed by different learning theories and the evolving nature of the relationship between education and technology.

At the higher education level, technology has significantly influenced instructional methods, compelling lecturers to thoughtfully select and implement digital tools in their teaching. Zechia (2017) emphasizes that such tools should be used purposefully and appropriately, ensuring they align with pedagogical goals and are accessible to students. While some platforms, such as learning management systems, serve basic functions like sharing class materials, others offer more interactive possibilities.

In this study, Canva, Padlet, and Mentimeter were employed to enhance student creativity and engagement. Canva, a web-based design platform (Bradley, 2015; Haake, 2021), enables students to produce visually compelling content such as posters, presentations, and infographics. It features a user-friendly drag-and-drop interface, making it accessible for both teachers and learners (Martin, 2016; Waring, 2021). Used during a student-led forum in this study, Canva allowed students to create interactive slides to demonstrate their understanding of course content. Arunachalam and Munisamy (2022) also highlight Canva's flexibility as a teaching tool. Mentimeter, on the other hand, functions as a student response system, enabling real-time feedback and interaction. It supports various question formats that keep students actively involved and can be used to gauge understanding at the beginning or end of a lesson.

Padlet (www.padlet.com) serves as a digital collaboration board, allowing real-time interaction between students and instructors. As noted by Fuchs (2014) and Zhi & Su (2015), Padlet is praised for its simplicity, compatibility across devices, and capacity for multimedia input. It facilitates instant collaboration, enabling learners to reflect on and share their thoughts openly. In this study, Padlet was used as a reflective platform, encouraging students to articulate their learning processes flexibly and asynchronously. This approach aligns with MacDonald’s (2003) view that effective use of educational technology should foster meaningful collaboration, as cooperative engagement enhances learning outcomes.

Overall, these digital tools contribute to sustained student engagement by making learning interactive, personalized, and enjoyable. According to contemporary learning theories, such external motivators are essential for maintaining long-term learner motivation. Technology, when appropriately integrated, can transform the classroom into a dynamic and participatory learning environment.

2.2 Constructivism Learning Theory

Vygotsky's Social Constructivism Theory emphasizes that learning is inherently a social process, in which knowledge is actively constructed through interaction with others in a given cultural and historical environment. Central to this theory is the belief that cognitive development arises from social interactions, especially those involving more knowledgeable others such as teachers, peers, or mentors (Vygotsky, 1978). Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which refers to the difference between what a learner can do independently and what they can achieve with guidance and support. In this zone, learning is most effective when it is temporarily scaffolded by more capable individuals until the learner can do it independently (Chaiklin, 2003).

Unlike cognitive theories that focus primarily on internal mental processes, Social Constructivism argues that knowledge acquisition is not simply about assimilating and accommodating new information but about becoming an active member of a learning community (Wertsch, 1991). In this view, language plays a crucial role as a cognitive tool and cultural artifact that facilitates the co-construction of meaning. Through dialogue and collaborative activities, students engage in socially shared experiences, gradually transforming

them into independent thinking (Daniels, 2001). Therefore, education should prioritize cooperative learning environments, where social interactions, cultural tools, and shared practices enable students to build deeper and contextually relevant understandings.

2.3 Connectivism Learning Theory

Connectivism, developed by George Siemens (2005) and further developed by Stephen Downes (2007), is a contemporary learning theory that addresses how learning occurs in the digital age. Unlike traditional learning theories such as behaviorism, cognitivism, and constructivism, which focus on internal cognitive processes or structured social interactions, connectivism emphasizes the role of digital networks, technology, and real-time information sharing in shaping how individuals acquire and manage knowledge.

At the heart of connectivism is the idea that knowledge exists across networks of connections and that learning consists of the ability to build and traverse those networks. According to Siemens (2005), learning is no longer a purely individual activity but a process of connecting specific nodes or sources of information. In this context, the capacity to know more becomes more critical than what is currently known, making skills such as digital literacy, pattern recognition, and network navigation essential for meaningful learning in the 21st century.

Connectivism acknowledges that learning can occur outside of individuals, in non-human devices and databases, such as artificial intelligence systems, online communities, and cloud-based platforms (Downes, 2007). It also emphasizes the importance of currency (updating) as the information landscape is constantly evolving. Therefore, students must cultivate the ability to distinguish between reliable sources, adapt to new information, and participate in collaborative and distributed learning environments.

This theory is particularly relevant in the era of the Fourth Industrial Revolution, where knowledge is rapidly expanding and digital technologies are deeply embedded in all aspects of education and society. It provides a theoretical foundation for online and blended learning environments, MOOCs (Massive Open Online Courses), and the use of social media and digital tools for lifelong learning.

3 METHODOLOGY

A mixed-methods approach was adopted to investigate the impact of gamified digital tools on collaborative learning. The study involved a survey distributed to 100 undergraduate students and observational in class towards educators who used gamified tools like Canva, Padlet, and Mentimeter in higher education institutions. Additionally, observational analyses of digital collaborative sessions using Canva, Padlet, and Mentimeter were conducted to assess engagement patterns. Quantitative data from survey responses were analyzed using descriptive statistics, while qualitative insights from observation sessions were examined through thematic analysis (Creswell & Plano Clark, 2018).

4 RESULTS AND DISCUSSION

This section explains the findings of the data for quantitative and descriptive analysis of the respondents. The demographic analysis of the students is in Table 1 below.

Table 1 Demographic Profile of the Respondents

Demographic Profile	Frequency	Percent (%)
Gender		
Male	33	33.3
Female	67	66.7
Semester		
≥ 3	74	74
≤ 3	26	26
College		

College A	52	51.8
College B	22	22.2
College C	15	14.8
College D	7	7.4
College E	4	3.7
Course Status		
Major	56	55.6
Minor	44	44.4

The table presents a breakdown of student demographics across gender, semester level, college affiliation, and course status. The dataset reflects a total of 100 respondents, allowing for a well-balanced observation of student characteristics. Based on the table above, most students are female (66.7%), while males make up 33.3% of the respondents. This indicates a notable gender gap, suggesting a higher female enrolment in the surveyed population. Meanwhile, for semester breakdown, students in their third semester or higher account for 74%, while 26% are in earlier semesters (≤ 3). The significant number of senior students could imply increase engagement from more experienced individuals or possibly a higher retention rate beyond the third semester. The distribution across colleges reveals that College A holds the largest proportion of students (51.8%), while College E has the fewest (3.7%). The numbers for College B (22.2%), College C (14.8%), and College D (7.4%) suggest varying levels of student enrolment, which may be influenced by factors such as college reputation, specialization, or student preference. The last data represented in Table 1 is about the course status (2 classes of Public Policy course) indicating that most students (55.6%) are pursuing their major, while 44.4% are enrolled in minor courses. This trend suggests that a considerable portion of students have committed to specialized coursework, potentially reflecting the growing interest in deeper academic engagement within their fields.

Overall, based on the survey, the findings indicate that integrating gamified digital tools significantly enhances student motivation and participation in collaborative learning environments. Survey results reveal that 85% of students reported increased engagement when using Canva, Padlet, or Mentimeter compared to traditional digital platforms. Some of the students' reflections through the survey indicated the finding in Table 2 below.

Table 2 Reflections on Digital Tools in Classroom Activities

Respondent	Tool Used	Reflection
Student A	**Canva**	*"Canva has been incredibly useful in creating visually appealing presentations and posters for class assignments. The vast library of templates and design elements makes it easy to produce high-quality graphics, even for those without design skills. It enhances creativity, allowing students to express ideas in a visually engaging way."*
Student B	**Padlet**	*"Padlet provides an interactive space where students can collaborate seamlessly. It fosters real-time sharing of ideas, reflections, and feedback, making discussions more dynamic. The ability to organize content visually helps in understanding complex topics while promoting engagement and participation."*
Student C	**Mentimeter**	*"Mentimeter is an excellent tool for engaging students during lectures and discussions. The interactive features, such as live polls, quizzes, and word clouds, encourage active participation. It makes learning more enjoyable and allows students to assess understanding instantly, fostering a more inclusive learning environment."*

De Kock, Sleegers, and Voeten (2004) suggest that students gain knowledge most effectively through active participation in classroom activities, where they build their understanding through experience and interaction. To deepen their comprehension, students are encouraged to analyze and reflect on their learning. Such strategies foster the development of higher-order thinking and deep learning skills. The data from this study further supports this notion, showing that students enrolled in the course constructed knowledge through both internal cognitive processes and external collaborative interactions. This finding is consistent with Vygotsky's Social Constructivism, which emphasizes the importance of social interaction in learning. Students expressed satisfaction with these interactive learning experiences, indicating that such approaches helped them better understand the course material by engaging in meaningful, socially driven activities.

Furthermore, incorporating digital tools such as Canva, Padlet, and Mentimeter into the classroom can significantly enhance student engagement and motivation by creating dynamic and interactive learning environments. These tools not only support the acquisition of course content but also encourage active participation and peer-to-peer collaboration, aligning well with the principles of Connectivism Learning Theory. According to Siemens (2005), connectivism emphasizes the role of digital networks in knowledge construction, where learning is distributed across a network of connections and facilitated by technology.

For instance, tools like Canva can foster healthy competition among students, stimulating extrinsic motivation as learners strive to produce creative and visually appealing work. Moreover, activities involving Padlet and Mentimeter are often perceived as enjoyable and stimulating, making learning more accessible and memorable. These platforms support real-time interaction and content sharing, allowing students to engage with information in diverse formats an essential aspect of connectivist learning, which values access to multiple perspectives and continuous information flow.

Ultimately, such digital tools contribute to creating a learning environment that not only makes complex theories and foundational concepts easier to grasp but also empowers students to take ownership of their learning through digital connectivity and active engagement.

Observational analyses further demonstrate improved peer interaction and a more supportive learning atmosphere facilitated by these tools. Educators also noted that gamification fostered inclusivity, allowing students with different levels of digital proficiency to engage meaningfully in collaborative activities. These findings align with previous research emphasizing the positive impact of gamification on student learning experiences (Landers, 2015). However, challenges such as technology accessibility and instructor training must be addressed to maximize effectiveness.

4 CONCLUSION

The findings of this study underscore the transformative potential of gamified digital tools namely Canva, Padlet, and Mentimeter in enhancing collaborative learning experiences in higher education, particularly in the context of the Fourth Industrial Revolution (4IR). These tools not only enriched classroom engagement but also addressed critical challenges related to student motivation, digital equity, and interactive participation. The integration of these tools created a dynamic, inclusive, and visually stimulating learning environment that fostered creativity, peer collaboration, and knowledge co-construction.

Anchored in the theoretical frameworks of Constructivism and Connectivism, the study validates that learning is most effective when students are actively involved in constructing their understanding through social interaction and digital connectivity. Vygotsky's concept of the Zone of Proximal Development was evident in how students supported one another through shared learning tasks, while Siemens' Connectivist perspective was reflected in students' ability to navigate and synthesize knowledge across digital networks.

The empirical evidence derived from student surveys and classroom observations demonstrated significant increases in engagement, motivation, and comprehension when gamified digital tools were used. These tools empowered students with different levels of digital proficiency to participate meaningfully, thereby reducing barriers to access and promoting educational inclusivity. Moreover, the use of real-time feedback mechanisms and collaborative digital boards helped reinforce deep learning and sustained attention in virtual and physical classrooms.

Nevertheless, this study also highlights ongoing challenges, particularly regarding technological access and the need for structured digital pedagogy training for educators. To fully harness the benefits of gamification and networked learning, institutions must invest in equitable access to digital infrastructure and upskill academic staff in technology-enhanced teaching practices.

In conclusion, the thoughtful integration of gamified digital tools guided by modern learning theories offers a practical and theoretically grounded approach to reimagining collaborative learning in the digital era. As higher education continues to navigate the complexities of 4IR, such innovations will be essential in preparing students with the critical, creative, and connected competencies needed for success in a rapidly evolving world.

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Cabaran dan Peluang dalam Integrasi Teknologi Digital dalam Pengajaran Perakaunan kepada Generasi Z : Kajian Literatur Sistematik

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ABSTRAK

Kemunculan Generasi Z di dalam dunia Pendidikan Tinggi, memberikan cabaran dan peluang yang baharu kepada para pendidik di dalam bidang Perakaunan. Di kenali sebagai Generasi digital natif, pelajar Generasi Z mempunyai keutamaan pembelajaran yang berbeza, di mana ia memerlukan pendekatan pengajaran yang inovatif dan didorong oleh teknologi. Kajian ini bertujuan untuk mengkaji literatur secara sistematik (SLR) mengenai cabaran dan peluang di dalam pengajaran perakaunan kepada Generasi Z. Ia meneroka strategi pedagogi yang berkesan dan peranan teknologi dalam meningkatkan pendidikan perakaunan. Kajian ini dijalankan dengan menggunakan pangkalan data seperti Scopus, Web of Science, dan Google Scholar. Artikel yang diterbitkan antara tahun 2015 hingga 2024 dianalisis berdasarkan kriteria kemasukan (inclusion) dan pengecualian (exclusion) yang telah ditetapkan. Kajian ini mengenalpasti bahawa Generasi Z cenderung kepada pembelajaran interaktif dan berasaskan teknologi kerana dapat meningkatkan penglibatan mereka di dalam pengajaran dan pembelajaran (PdP) dan ini menjadikan kaedah kuliah tradisional kurang berkesan. Namun terdapat juga cabaran yang dihadapi seperti kewujudan jurang digital. Pendidikan perakaunan perlu mengadaptasikan teknologi dan pendekatan inovatif bagi memenuhi keperluan pembelajaran Generasi Z. Kajian akan datang disarankan untuk meneroka bukti empirikal mengenai keberkesanan strategi ini.

Kata kunci : Pendidikan Perakaunan, Generasi Z, Pembelajaran Digital, Kaedah Pengajaran Inovatif, Teknologi Pendidikan Perakaunan

1 PENGENALAN

Pengintegrasian teknologi digital ke dalam pendidikan perakaunan memberikan peluang besar dan cabaran yang kompleks, terutamanya apabila dikaitkan dengan corak pembelajaran yang unik oleh Generasi Z. Generasi Z atau dikenali dengan "*digital natives*", adalah merupakan individu yang dilahirkan antara pertengahan 1990an hingga awal 2010an. Mereka ini membesar dalam persekitaran yang dipenuhi dengan teknologi digital. Pelajar perakaunan bagi Generasi Z, khususnya di dalam konteks pendidikan tinggi, menunjukkan kecenderungan terhadap penggunaan teknologi dalam proses pembelajaran mereka. Kajian oleh Alruthaya et al. (2021), menekankan bahawa Generasi Z mempunyai ciri-ciri pembelajaran yang unik, termasuk keutamaan terhadap pembelajaran interaktif dan penggunaan sumber digital yang dalam proses pembelajaran mereka.

Perkembangan pesat di dalam tekonologi memerlukan penilaian semula bagi kaedah pendidikan perakaunan traditional , untuk memastikan ia seiring dengan jangkaan dan gaya pembelajaran bagi Generasi

Z. Kebiasaan demografi yang wujud dengan alat dan platform digital ini menawarkan peluang kepada pendidik untuk mencipta pengalaman pembelajaran yang lebih menarik dan interaktif (Postolov et al., 2017). Untuk itu, memahami kehendak atau keperluan bagaimana teknologi digital mempengaruhi budaya pembelajaran pelajar Generasi Z, adalah penting untuk mengoptimumkan strategi pengajaran dan rekabentuk kurikulum. Namun begitu, persediaan dan penyesuaian diri pendidik dengan era digital, membolehkan pendidik menyediakan dan melahirkan pelajar yang memenuhi permintaan tenaga kerja yang lebih praktikal.

Integrasi teknologi digital dalam pendidikan perakaunan telah menjadi fokus utama dalam meningkatkan kualiti pengajaran dan pembelajaran. Penggunaan teknologi seperti perisian perakaunan berasaskan awan atau "*cloud-based accounting*", analitikal data dan kecerdasan buatan (AI), telah mengubah landskap pendidikan perakaunan. Terdapat juga pendidik perakaunan masih belum mengoptimumkan sepenuhnya penggunaan intergrasi teknologi abad ke 21 ini ke dalam pengajaran dan pembelajaran (Ridhuan et al., 2023).

Walaupun terdapat peningkatan dalam penggunaan teknologi digital dalam pendidikan perakaunan, terdapat kekurangan kajian komprehensif yang meneliti secara sistematik tentang peluang dan cabaran dalam integrasi teknologi ini, khususnya bagi pelajar Generasi Z. Kajian oleh Firdaus, M. I., & Furqorina, R. (2024), menyatakan keperluan untuk memahami kemahiran yang diperlukan oleh graduan perakaunan Generasi Z dalam era digital, namun kajian yang menyeluruh mengenai pendekatan pedagogi dan cabaran yang dihadapi, masih lagi terhad. Berdasarkan permasalahan yang telah dikenalpasti, persoalan kajian ini adalah "Apakah peluang dan cabaran dalam mengintegrasikan teknologi digital dalam pengajaran perakaunan bagi pelajar Generasi Z?".

Objektif utama kajian ini adalah untuk menjalankan tinjauan literatur sistematik bagi mengenalpasti dan menganalisa peluang serta cabaran dalam integrasi teknologi digital dalam pengajaran perakaunan untuk Generasi Z. Kajian ini bertujuan untuk menyediakan pemahaman yang mendalam mengenai pendekatan pedagogi yang berkesan dan halangan yang mungkin dihadapi dalam konteks ini. Tinjauan literatur traditional sering kali tidak mempunyai metodologi yang sistematik dan telus, yang boleh menyebabkan bias dalam pemilihan kajian dan interpretasi hasil. Kajian oleh Azmi et al. (2022) menunjukkan bahawa pendekatan tinjauan literatur traditional mungkin tidak mencukupi untuk menangani kompleksiti isu dalam pendidikan perakaunan digital.

Pendekatan tinjauan literatur sistematik menawarkan metodologi yang telus, berstruktur dan boleh diulang, yang membolehkan pengumpulan dan analisis data yang lebih objektif. Kajian literatur sistematik dapat membantu dalam mengenal pasti tema utama, jurang pengetahuan dan arah aliran dalam literatur yang berkaitan dengan pendidikan perakaunan dalam era digital (Pargmann et al., 2023). Kajian ini penting kerana ia menyediakan pemahaman yang komprehensif mengenai bagaimana teknologi digital dapat diintegrasikan secara berkesan dalam pengajaran perakaunan untuk pelajar Generasi Z. Hasil kajian ini dapat membantu pendidik, pembuat dasar dan institusi pendidikan dalam merancang kurikulum dan strategi pengajaran yang sesuai dengan keperluan dan ciri-ciri pelajar Generasi Z.

Walaupun terdapat beberapa kajian literatur sistematik yang membincangkan transformasi digital dalam pendidikan perakaunan atau penggunaan teknologi pendidikan secara umum, tetapi ianya sangat sedikit malah ia hanya memberi tumpuan secara khusus kepada gabungan pelajar Generasi Z dengan pengajaran perakaunan. Sebagai contoh kajian yang dibuat oleh Azmi et al. (2022), meneliti cabaran generasi atau keperluan pembelajaran dalam talian semasa pandemik, tetapi tidak mengambil kira ciri generasi atau keperluan pembelajaran spesifik kepada pelajar Generasi Z. Begitu juga dengan kajian literatur sistematik yang lain, yang hanya menyentuh teknologi pendidikan yang selalunya merangkumi pelajar daripada pelbagai peringkat umur atau menumpukan kepada pedagogi secara umum tanpa mengaitkannya secara khusus dengan bidang perakaunan. Oleh itu kajian ini memang diperlukan kerana menggabungkan tiga dimensi penting iaitu teknologi digital, pengajaran perakaunan dan pelajar Generasi Z. Kajian ini dapat menyediakan dapatan yang lebih relevan dan praktikal kepada pendidik khususnya.

2 METHODOLOGY

2.1 Review Protocol

Kajian ini menggunakan panduan PRISMA (Preferred reporing Items for Systematic Reviews and Meta-Analyses) sebagai sumber rujukan utama dalam membangunakan kajian sistematik literatur ini. PRISMA

telah dibangunkan oleh Moher et al. (2009) dan seterusnya ditambah baik oleh Page et al. (2021) untuk memastikan pelaksanaan kajian sistematik literatur dijalankan secara bersistematik, telus dan berkualiti tinggi. Meskipun PRISMA pada asalnya diperkenalkan dalam konteks penyelidikan bidang kesihatan dan perubatan, namun Page et al. (2021) menekankan bahawa panduan ini adalah fleksibel dan boleh disesuaikan penggunaanya dalam pelbagai bidang yang lain termasuk bidang sains sosial, pendidikan dan perakaunan. Dalam kajian ini, penggunaan PRISMA adalah penting kerana ia menyediakan satu kerangka metodologi yang menyeluruh, menekankan kepada pencarian literatur yang komprehensif, serta tapisan dan penilaian artikel yang berkualiti. Selaras dengan struktur PRISMA, proses kajian sistematik literatur ini dijalankan melalui empat langkah utama iaitu: (i) pembentukan persoalan kajian; (ii) pembangunan strategi pencarian yang sistematik; (iii) penilaian kualiti dan pemilihan artikel; dan (iv) proses pengekstrakan dan analisis data secara tematik. Pendekatan ini membolehkan penyelidikan dilaksanakan secara lebih tersusun, telus dan mampu menghasilkan dapatan yang lebih sahih dan boleh digunapakai dalam konteks pendidikan perakaunan bagi Generasi Z.

2.2 Pembentukan Persoalan Kajian

Dalam merangka kajian sistematik literatur ini, persoalan kajian telah dibina secara berstruktur dengan merujuk kepada dua garis panduan penting iaitu PRISMA dan PICo. PRISMA berfungsi sebagai kerangka pelaporan yang memastikan proses kajian sistematik literatur dijalankan secara sistematik, menyeluruh dan telus. Bagi membentuk persoalan kajian yang terfokus dan selari dengan objektif penyelidikan, pendekatan PICo digunakan sebagai alat konseptual. PICo merangkumi tiga elemen utama; (i) P (*Population*) : pelajar Generasi Z yang mengikut pendidikan perakaunan; (ii) I(*Interest*) : penggunaan teknologi digital dalam pengajaran perakaunan; dan (iii) Co (*Context*) : pelaksanaan pengajaran dan pembelajaran di institusi pendidikan tinggi. Oleh yang demikian, satu persoalan utama kajian ini dirumuskan sebagai "Apakah peluang dan cabaran dalam mengintegrasikan teknologi digital dalam pengajaran perakaunan kepada pelajar Generasi Z?". Penetapan persoalan ini bukan sahaja mengarahkan keseluruhan proses pencarian dan penialian artikel secara sistematik, malah juga memastikan kajian ini memenuhi keperluan metodologi teliti seperti yang disarankan di dalam PRISMA.

2.3 Strategi Pencarian Sistematik

Proses pencarian artikel di dalam kajian ini dirancang secara sistematik bagi memastikan hasil kajian adalah menyeluruh dan bebas daripada bias pemilihan. Strategi ini dibangunkan berdasarkan garis panduan PRISMA (Page et al., 2021) yang menekankan kepada pencarian yang telus dan komprehensif. Selain itu, pendekatan ROSES (*Reporting Standards for Systematic Evidence Syntheses*) turut dijadikan rujukan dalam merancang aliran pencarian, khususnya di dalam konteks penyelidikan bidang sains sosial dan pendidikan. Bagi memastikan proses pencarian secara komprehensif, tiga langkah utama dilalakukan dalam startegi pencarian secara sistematik, iaitu berdasarkan *identification*, *screening* dan *eligibility*.

2.3.1 *Identification*

Proses *identification* merupakan langkah awal dalam pencarian sistematik yang bertujuan untuk mengenalpasti artikel-artikel yang relevan berdasarkan persoalan kajian yang telah dibangunkan melalui pendekatan PICo. Dalam kajian ini, kata kunci yang telah dikenalpasti dan berkait langsung dengan focus kajian, iaitu "Pendidikan Perakaunan", "Generasi Z", "Pembelajaran Digital", "Kaedah Pengajaran Inovatif" dan Teknologi Pendidikan Perakaunan".

Bagi mengukuhkan lagi strategi pencarian, usaha memperluas dan mempelbagaikan kata kunci turut dilakukan dengan merujuk kepada pelbagai sumber, termasuk ChatGPT, *thesaurus* serta kajian lepas yang relevan. Melalui pendekatan ini, sinonim dan istilah berkaitan telah dikenalpasti bagi membentuk kombinasi kata kunci yang lebih luas dan inklusif. Seterusnya *search string* dibina dengan menggunakan teknik *Boolean Operators* (seperti AND, OR), *phrase searching* ("…"), *truncation* (*)*, wildcard dan field codes function.* Antara kombinasi carian yang digunakan termasuklah:

("Pendidikan Perakaunan" OR "Accounting Education") AND ("Generasi Z" OR "Gen Z" OR "Digital Natives") AND ("Teknologi Pendidikan" OR "Digital Learning" OR "ICT in Education") AND ("Kaedah Pengajaran Inovatif" OR "Innovative Teaching Methods")

Selain dari penggunaan teknik ini, pencarian manual dengan menggunakan kaedah *handpicking*, serta kaedah *snowballing* ke atas artikel yang telah dipilih telah digunapakai.

Kajian ini melibatkan pencarian artikel di dalam tiga pangkalan data yang relevan iaitu Scopus, Science Direct dan Google Scholar. Pemilihan pangkalan data ini adalah berdasarkan kemampuan pangkalan data ini menyediakan artikel jurnal akademik dalam bidang pendidikan, teknologi dan perakaunan. Hasil daripada strategi ini, sebanyak 66,900 artikel yang berpontensi telah dikenalpasti dan akan disaring dalam fasa seterusnya iaitu proses *screening*.

2.3.2 *Screening*

Proses kedua dalam strategi pencarian sistematik melibatkan proses *screening* dan pada proses ini, kajian telah menetapkan beberapa kriteria saringan awal bagi memastikan hanya artikel yang relevan dan memenuhi skop kajian sahaja yang akan dibawa ke peringkat proses seterusnya. Proses ini dijalankan selepas artikel-artikel yang berpontensi dikenalpasti dalam proses *identification*. Antara kriteria inklusi yang digunakan adalah seperti di Jadual 1.

Jadual 1 Kriteria inclusion dan exclusion yang digunakan.

Kriteria	**Inklusi**	**Eksklusi**
Tahun penerbitan	2015 - 2024	Sebelum tahun 2015
Jenis penerbitan	Artikel jurnal	Tesis, laporan teknikal, buku dan artikel bukan akademik
Bahasa	Bahasa Melayu dan Bahasa Inggeris	Bahasa selain daripada Bahasa Melayu dan Inggeris
Fokus dapatan	Penggunaan teknologi digital dalam pendidikan perakaunan untuk Generasi Z	Topik tidak berkaitan dengan teknologi digital, pendidikan perakaunan, atau Generasi Z

Artikel yang tidak memenuhi salah satu daripada kriteria di atas telah dikecualikan daripada analisis. Hasil daripada proses ini, sebanyak 17,400 artikel telah dikecualian dan hanya 556 artikel yang layak untuk diteruskan ke peringkat seterusnya iaitu proses *eligibility*.

2.3.3 *Eligibility*

Seterusnya, artikel sebanyak 556 artikel yang melepasi saringan awal akan melalui proses *eligibity*. Pada peringkat ini, penyelidik telah membaca keseluruhan kandungan artikel untuk memastikan kesesuaian yang tepat dengan objektif kajian. Antara kriteria yang digunakan dalam proses ini adalah artikel mestilah mempunyai kandungan yang relevan dengan persoalan kajian iaitu menyentuh secara langsung aspek integrasi teknologi digital dalam pendidikan perakaunan kepada Generasi Z. Selain itu, penyelidik juga menilai kualiti metodologi kajian asal yang digunakan dalam artikel tersebut serta tahap kesahan dan kebolehpercayaan dapatan. Hanya artikel yang membincangkan peluang atau cabaran dalam penggunaaan teknologi dalam konteks pendidikan perakaunan sahaja yang dipilih. Artikel yang hanya menyentuh teknologi secara umum tanpa kaitan yang jelas dengan konteks pengajaran atau Generasi Z telah dikecualikan. Hasil daripada proses ini, sebanyak 82 artikel telah dikenalpasti sebagai memenuhi kriteria dan seterusnya dimasukkan ke dalam penilaian kualiti artikel.

2.4 Penilaian Kualiti Artikel

Seterusnya, kesemua artikel yang dipilih selepas proses *eligibility* telah dinilai kualitinya berdasarkan kriteria utama seperti yang disarankan oleh Abouzahra et al. (2020). Penilaian ini penting bagi memastikan hanya artikel yang benar-benar berkualiti dan relevan sahaja dianalisis dalam kajian ini. Kriteria yang digunakan adalah seperti di Jadual 2.

Jadual 2 Senarai Semak Penilaian Kualiti

No. soalan	Bentuk soalan
QA1	Adakah tujuan kajian dinyatakan dengan jelas?
QA2	Adakah kajian dibentangkan dengan jelas?
QA3	Adakah metodologi kajian diterangkan dengan jelas?
QA4	Adakah konsep pendekatan ditakrifkan dengan jelas?
QA5	Adakah kajian dibandingkan dan diukur dengan kerja lain yang serupa?
QA6	Adakah limitasi kajian yang disebut dengan jelas?

Prosedur pemarkahan yang digunakan untuk menilai setiap penilaian kualiti iaitu Ya (Y) = 1 markah; Sebahagiannya/Tidak Sepenuhnya (P) = 0.5 markah; dan Tidak/Tidak Pasti (N) = 0 markah. Artikel dianggap berkualiti dan disertakan dalam kajian ini, sekiranya markah keseluruhan artikel tersebut melebihi 3.0 atau 50%. Proses penilaian ini telah dilakukan oleh penyelidik dan disemak semula secara oleh dua orang pakar bidang untuk memastikan ketepatan dan kebolehpercayaan skor yang diberikan. Melalui proses ini, sebanyak 26 artikel telah dikenalpasti melepasi tahap penilaian kualiti dan seterusnya dimasukkan ke dalam peringkat akhir kajian iaitu proses pengekstrakan data dan analisis. Pengektrakan data dalam kajian ini telah dipandu oleh soalan kajian dan objektif kajian. Penyelidik telah membaca secara mendalam setiap artikel di bahagian "hasil kajian" dan "perbincangan" bagi mengenalpasti maklumat penting yang berkaitan.

Data yang diperoleh telah disusun dalam bentuk jadual untuk menjadikan proses analissi lebih sistematik dan teratur. Bagi tujuan analisis, pendekatan analisa tema (*Thematic Analysis*) secara deduktif telah digunakan. Analisa tema deduktif melibatkan penentuan tema utama terlebih dahulu berdasarkan sumber-sumber seperti objektif kajian, teori atau model yang berkaitan dan sorotan literatur terdahulu. Proses ini adalah selari dengan kaedah yang dicadangkan oleh Braun & Clarke (2006) yang melibatkan empat langkah utama: (i) penentuan tema dan sub-tema, (ii) pengesahan dan pemurnian tema, (iii) pengekstrakan data berdasarkan tema , dan (iv) pelaporan tema dan analisis dalam penulisan akhir.

Hasil dari analisis ini telah menghasilkan lima tema utama yang mewakili dapatan utama dalam kajian ini. Tema-tema ini disertai dengan sub-tema khusus bagi membantu untuk memberikan gambaran yang lebih terperinci tentang aspek yang dikaji (Jadual 3).

Jadual 3 Tema dan Sub-tema

Tajuk kajian	Pendidikan Digital			Pengajaran inovatif			Penglibatan Gen Z			Kemahiran Digital			Kesan teknologi		
	PD	AP	ON	GM	PR	CL	TC	AT	CB	DS	AI	TR	TM	CC	IT
Holmes & Douglass, (2022)											/	/	/		/
Herbert et al., (2021)									/	/				/	
Al-Htaybat et al., (2018)	/					/	/	/	/	/			/	/	
Jackson & Meek, (2020)					/	/	/	/		/		/		/	
Tsiligiris & Bowyer, (2021)									/	/	/	/	/	/	/
Novak et al., (2021)	/	/	/	/			/					/	/	/	/
Seemiller & (Grace, 2017)				/			/	/	/						
Abidin et al., (2022)				/		/		/		/					
M. Zabidey, (2022)				/				/							

Mohamad et al., (2023)	/		/					/	/						
Imjai et al., (2024)								/		/					
Meesook et al., (2025)								/		/	/	/			
Apostolou et al., (2023)	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Buayai et al., (2025)					/	/		/	/	/					
Januszewski et al., (2024)		/					/	/		/		/	/		
Mukul & Büyüközkan, (2023)	/	/	/							/		/	/	/	/
Handoyo, (2024)	/	/	/				/			/		/	/	/	/
Bădicu et al., n.d.)								/	/	/					
Firdaus & Furqorina, (2024)						/	/	/	/	/	/	/			
Alruthaya et al., (2021)	/	/				/	/	/		/					/
Handoyo & Anas, (2019)	/		/						/	/		/	/	/	/
Azmi et al., (2022)	/		/					/	/						
Pargmann et al., (2023)	/	/	/				/	/		/	/	/	/	/	
Reschiwati, R. (2022)							/	/	/						
Tandiono, R. (2021)	/	/			/	/	/	/		/		/	/	/	
Pan & Seow, (2016)	/	/		/			/	/					/		

PD = penggunaan platform digital dalam pengajaran
AP = pengajaran perakaunan melalui aplikasi dan perisian
ON = Kesan pembelajaran dalam talian terhadap pelajar perakaunan
GM = pengguaan gamifikasi dalam pengajaran perakaunan
PR = pembelajaran berasaskan projek
CL = kaedah pembelajaran berpusatkan pelajar
TC = penggunaan teknologi untuk meningkatkan penglibatan pelajar
AT = sikap dan keutamaan Generasi Z dalam pembelajaran
CB = cabaran dalam mendidik Generasi Z alam bidang perakaunan
DS = keperluan Kemahiran teknikal dalam dunia akauntan moden
AI = pengaruh automasi dan AI terhadap profesion perakaunan
TR = Latihan dan Pembangunan Kemahiran digital dalam kurikulum
TM = transformasi kaedah pengajaran dengan penggunaan teknologi
CC = perubahan kandungan kurikulum perakaunan
IT = impak teknologi terhadap prestasi dan hasil pembelajaran pelajar

Penemuan ini membantu menyusunkan serta mengenalpasti pola dan trend utama dalam pendidikan perakaunan yang berkaitan dengan penggunaan digital khususnya dalam kalangan Generasi Z. Analisa tematik ini juga memberi peluang untuk memahami bagaimana pengajaran dan pembelajaran perakaunan boleh terus dipertingkatkan selaras dengan perkembangan teknologi semasa.

3 Hasil Kajian

Sebelum mengulas dapatan utama, bahagian ini akan memberikan fokus kepada latar belakang artikel yang di pilih dalam kajian ini. Daripada 26 artikel yang dipilih ini, artikel ini terdiri daripada kajian kuantitatif, kualitatif dan campuran (*mixed-methods*), serta merangkumi pelbagai negara seperti Malaysian, Indonesia, Thailand, Australia, US dan negara-negara Eropah seperti UK, Jerman, Sepanyol, Arab Saudi dan Belanda (Rajah 1). Ini secara langsung memberikan gambaran yang jelas tentang perubahan landskap pendidikan perakaunan pada peringkat global. Kajian yang dipilih meliputi pelbagai aspek pendidikan perakaunan dalam era digital, khususnya yang berkaitan dengan keperluan pembelajaran Generasi Z. Antara tema besar yang dikenalpasti termasuk penggunaan digital dalam pengajaran, pendekatan inovatif dalam pedagogi perakaunan, penglibatan pelajar Generasi Z, kemahiran digital dan kesan teknologi terhadap prestasi pelajar.



Rajah 1 Peta Kawasan Kajian

Setiap artikel telah dianalisis mengikut tema yang telah ditentukan secara deduktif berdasarkan objektif kajian. Antara tema utama adalah pendidikan perakaunan digital. Pendidikan digital ini merujuk kepada penggunaan platform pembelajaran atas talian, aplikasi serta sumber digital lain dalam pengajaran perakaunan. Buayai et al. (2025); Pargmann et al. (2023); dan Reschiwati, R. (2022), membuktikan bahawa terdapat keperluan integrasi teknologi dalam kandungan kurikulum dan amalan pengajaran. Dapatan menunjukkan bahawa penggunaan platform digital bukan sahaja mempercepatkan proses penyampaian ilmu, malah memudahkan akses kepada sumber maklumat. Penggunaan teknologi turut menyokong pembelajaran kendiri, seperti yang dijelaskan oleh Imjai et al. (2024) dan Apos olou et al. (2023), di mana pelajar memperlihatkan tahap kebergantungan yang tinggi terhadap platform digital dalam membangunkan analitikal dan pembelajaaran sepanjang hayat. Kajian juga menunjukkan peningkatan kebergantungan terhadap teknologi dalam menyampaikan kandungan dan latihan kepada pelajar. Holmes & Doudglass (2022) dan Januszewski et al. (2024) membincangkan kesan AI dan pembelajaran secara maya terhadap struktur pendidikan perakaunan. Selain itu, Mohamad et al. (2023) turut menunjukkan keberkesanan pembelajaran terbuka dan jarak jauh terhadap pelajar bukan perakaunan.

Kaedah pengajaran inovatif seperti gamifikasi, pembelajaran berasaskan projek dan pembelajaran kendiri ditekankan dalam beberapa kajian dengan meluas. Kajian oleh Pan & Seow (2016); M,Zabidey (2022) dan Abidin et al. (2022), telah membuktikan bagaimana elemen permainan atau pendekatan yang lebih bersifat interaktif, boleh meningkatkan minat dan penglibatan pelajar walaupun motivasi dan minat terhadap subjek perakaunan yang selalunya dianggap teknikal dan membosankan.

Beberapa artikel membincangkan sikap, keutamaan dan gaya pembelajaran Generasi Z dalam kontek penglibatan pelajar Generasi Z dalam pendidikan perakaunan. Antara kajian seperti Novak et al. (2021), Seemiller & Grace (2017) dan Tandiono, R. (2021) menyatakan bahawa sikap dan gaya belajar

mempengaruhi jangkaan pelajar terhadap peranan pendidik. Generasi Z secara umunya mengutamakan fleksibeiliti, pembelajaran kendri dan pembelajaran berasakan minat, di mana mereka lebih terlibat dalam suasana pembelajaran yang bersifat interaktif dan relevan ddengan kehidupan harian mereka. Ini turut disokokng oleh dapatan dari Holmes & Douglass, (2022) , yang menekankan keperluan untuk menyediakan suassana pembelajaran yang selari dengan perkembangan teknologi semasa dan keperluan individu. Selain itu, Seemiller & Grace, (2017) dan Tandiono, R. (2021), menjelaskan cabaran dan strategi untuk menyesuaikan kaedah pengajaran dengan keperluan unik Generasi Z.

Kemahiran digital kini menjadi satu keperluan penting dalam pendidikan perakaunan. Buayai et al. (2015) dan Januszewski et al. (2024) mengetengahkan kepentingan membangunkan kemahiran teknikal serta keupayaan pembelajaran kendiri dalam kalangan pelajar perakaunan. Penekanan keperluan kemahiran teknikal seperti penguasaan data analitik, perisian perakaunan dan penggunaan AI, amat penting dalam proses pembelajaran (Handoyo, 2024; Al-Htaybat et al., 2018; Tsiligiris & Bowyer, 2021). Perubahan landskap kerja turut memerlukan pelajar untuk mengusai kemahiran insaniah, kecekapan kendiri dan keupayaan membuat keputusan secara kritikal. Dalam konteks ini Herbert et al. (2021) mencadangkan bahawa perubahan paradigma pengajaran perlu dilakukan agar pelajar lebih bersedia menghadapi cabaran kerjaya perakaunan yang kian kompleks.

Akhir sekali, iaitu tema kesan teknologi terhadap pendidikan perakaunan merujuk kepada bagaimana digitalisasi telah mempengaruhi bukan sahaja pada corak pembelajaran, tetapi juga hasil pembelajaran itu sendiri. Hasil kajian Mukul & Büyüközkan (2023), Jackson & Meek (2020) dan Januszewski et al. (2024) menyokong pandangan bahawa transformasi digital telah mengubah pendekatan pedagogi daripada pasif kepada lebih dinamik dan berpusatkan pelajar. Pelajar kini lebih cenderung kepada model pembelajaran berasaskan masalah dan pembelajaran kendiri, di mana keberkesanan pengajaran diukur melalui hasil pembelajaran dan kecekapan yang dibina secara praktikal.

Daripada analisa dan pengekstrakan, terdapat beberapa dapatan bersama yang telah dikenalpasti. Yang pertama, teknologi dan platform digital telah mengubah secara menyeluruh pendekatan pengajaran dalam pendidikan perakaunan. Kedua, kaedah pengajaran konvensional semakin kurang relevan dengan keperluan Generasi Z yang lebih gemar pembelajaran visual, interaktif dan fleksibel. Ketiga, peranan pendidik telah berkembang daripada penyampai maklumat kepada fasilitator pembelajaran digital. Seterusnya, kemahiran seperti literasi AI, digital literasi dan keupayaan pembelajaran kendiri semakin mendapat perhatian dalam kurikulum. Dan terakhir, terdapat juga kebimbangan terhadap jurang digital serta cabaran dalam melatih tenaga pengajar.

Secara keseluruhannya, kesemua dapatan ini menunjukkan satu aliran jelas bahawa pendidikan perakaunan sedang mengalami perubahan signifikan dan kajian-kajian yang dikaji memberikan gambaran menyeluruh tentang keperluan mendesak untuk menyesuaikan sistem pengajaran dengan keperluan dan karakteristik pelajar Generasi Z. Dalam konteks ini, pendekatan pedagogi perlu besifat fleksibel, teknologi perlu dimanfaatkan secara optimum dan kandungan pengajaran perlu dikemaskini secara berkala bagi memastikan kesesuainan dengan perubahan industri perakaunan yang global.

4 PERBINCANGAN

Pendidikan perakaunan bagi Generasi Z memerlukan pendekatan pedagogi yang inovatif dan berteraskan teknologi. Namun begitu, penerapan teknologi dalam Pendidikan perakaunan juga mewujudkan beberapa cabaran yang perlu diberi perhatian. Salah satu isu utama adalah keperluan terhadap digital yang tinggi dalam kalangan pelajar perakaunan. Al-Htaybat et al. (2018) menekankan bahawa revolusi digital telah mengubah langskap pendidikan perakaunan, memerlukan pelajar menguasai kemahiran teknologi terkini seperti analitik data perisian perakaunan moden. Namun begitu, penerapan teknologi ini juga menimbulkan risiko peningkatan jurang digital, terutama di negara membangun seperti Malaysia dan Thailand, di mana infrastruktur dan latihan tidak semestinya menyokong keperluan digital tersebut. Kajian oleh Iyiner (2024) menyatakan bahawa walaupun teknologi digital meningkatkan akses dan aktiviti dalam pendidikan perakaunan, cabaran seperti jurang digital dan keperluan penyesuaian berterusan masih wujud.

Dalam konteks pengajaran inovatif, pendekatan seperti gamifikasi telah menunjukkan potensi dalam meningkatkan penglibatan dan motivasi pelajar. Creel et al. (2021) menujukkan bahawa penggunaan platform seperti Kahoot! di dalam kelas perakaunan dapat meningkatkan keseronokan dan pemahaman pelajar terhadap kandungan kursus. Begitu juga dengan Chen (2024) mendapati bahawa penggunaan

permainan papan dalam pengajaran perakaunan dapat meningkatkan motivasi intrinsik pelajar dan memperbaiki pengalaman pembelajaran mereka. Namun, perlu diingat bahawa keberkesanan pendekatan ini bergantung kebada pelaksanaan yang sesuai dengan konteks budaya dan tahap kematangan pelajar.

Penggunaan gamifikasi dalam pengajaran perakaunan dapat membantu pelajar bukan perakaunan memahami konsep perakaunan dengan lebih baik serta meningkatan kognitif meraka (Tandiono et al., 2022; Tandiono et al., 2021). Namun beberapa pelajar masih menganggap pembelajaran kendiri dan kuliah traditional sebagai lebih penting dalam pendekatan inovatif dan ia perlu dilaksanakan secara seimbang dengan kaedah pengajaran tradisional bagi mencapai keberkesanan yang maksimum.

Dalam memperluaskan skop perbincangan, satu kajian oleh Alruthaya et al. (2021) menekankan bahsawa Generasi Z mempunyai ciri-ciri pembelajaran yang unik, termasuk kebergantungan tinggi terhadap teknologi digital dan keperluan unutk pembelajaran yang fleksibel dan interaktif. Oleh itu, institusi pendidikan perlu menyesuaikan pendekatan pengajaran mereka untuk memenuhi keperluan dan jangkaan pelajar generasi ini.

Walaupun terdapat pelbagai inisiatif dan inovasi dalam pendidikan perakaunan, kejayaan pelaksanaannya sangat bergantung kepada kebolehsesuian pelajar, kemahiran pensyarah dan sokongan institusi. Maka infrastuktur, serta kesediaan insitusi dan pensyarah itu sendiri.

Secara keseluruhan, perubahan landskap pendidika perakaunan akibat kemajuan teknologi memberi implikasi besar kepada pelajar, pendidik dan institusi pengajian. Dari sudut pelajar Generasi Z secara umumnya bersifat lebih responsif terhadap penggunaan tekonologi dalam pembelajaran (Novak et al., 2021; Handoyo & Anas, 2019). Ia menekankan keperluan kepada kaedah pembelajan fleksibel, pantas dan bersifat dua hala. Tambahan pula, pelajar Generasi Z ini lebih menghargai pengalaman pembelajaran bersifat praktikal dan berasaskan aplikasi teknologi, berbanding pendekatan teori semata-mata. Namun begitu kajian Tandionoet et al. (2024) menunjukkan masih terdapat kelompok pelajar yang memilih pembelajaran kendiri dan lebih konvensional dan ini menandakan terdapat keperluan kepada pendekatan bersifat hibrib.

Jika dilihat dari konteks pensyarah, keupayaan mereka menyesuaikan diri dengan teknologi baharu menjadi faktor kritikal dalam kejayaan transformasi pendidikan perakaunan. Azmi et al. (2022) dan Alruthaya et al. (2021) menyatakan bahawa ramai pendidik perakaunan menghadapi cabaran untuk mengintegrasikan teknologi secara efektif dalam bilik kuliah, terutamanya berkaitan dengan latihan, perubahan silibus dan penyesuaian bahan pengajaran. Di sinilah perlunya pembangunan profesional berterusan dan sokongan institusi untuk membantu pensyarah mengikuti perubahan teknologi terkini.

Kajian ini juga memberi perhatian kepada isu kebolehcapaian teknologi, terutamanya di negara membangun. Ketidaksamaan sumber teknologi ini boleh menjejaskan keberkesanan proses pengajaran dan pembelajaran serta melebarkan lagi jurang pencapaian akademik. Tetapi jika dilihat dari segi kurikulum, ia semakin jelas bahawa pendidikan perakaunan tidak lagi bersifat statik. Buayai et al. (2025) menekankan pentingnya silibus perakaunan disemak semula untuk memasukkan elemen seperti analitik data, teknologi maklumat, automasi dan kemahiran insaniah yang relevan. Perubahan ini harus seiring bukan sahaja oleh Institusi Pendidikan, malah disokong juga oleh polisi kerajaan dan kehendak badan professional seperti Malaysian Institute of Accountant (MIA) dan ACCA.

Akhir sekali, Kesan jangka panjang terhadap profesion perakaunan turut perlu diberi perhatian. Seiring dengan kemunculan teknologi seperti automasi dan kecerdasan buatan (AI), sesetengah peranan tradisional dalam bidang perakaunan dijangka akan diganti. Holmes & Douglass, (2022) dan Kokina et al. (2021) menyatakan bahawa walaupun AI membawa kemudahan dan kecekapan, ia juga menggesa agar graduan perakaunan masa kini lebih bersedia dari segi kemahiran analitik, penyelesaian masalah dan pemikiran kritis. Jesteru, transformasi pendidikan perlu menyokong peralihan ini agar pelajar bukan sahaja menjadi celik teknologi tetapi juga berdaya saing dan relevan dalam pasaran kerja masa hadapan.

5 RUMUSAN

Pemahaman secara mendalam berkaitan cabaran dan peluang dalam pengajaran perakaunan kepada Generasi Z banyak telah dihuraikan di dalam kajian ini. Generasi Z, sebagai generasi digital mempunyai pendekatan pembelajaran yang berbeza dan memerlukan kaedah pengajaran yang lebih fleksibel, inovatif dan berorientasikan teknologi. Hasil kajian menunjukkan bahawa penggunaan teknologi digital seperti platform pembelajaran atas talian, gamifikasi dan aplikasi pembelajaran memberi kesan positif terhadap minat dan penglibatan pelajar (Herbert et al., 2021; Abidin et al., 2022; Imjai et al., 2024; Firdaus &

Furqorina, 2024). Walau bagaimanapun, cabaran seperti tahap literasi digital yang tidak seimbang (Meesook et al., 2025; Januszewski et al., 2024), kekangan infrastuktur dan keperluan latihan pensyarah untuk menyesuaikan diri dengan kaedah baru turut dikenalpasti. Di samping itu, dapatan turut menunjukkan bahawa pendekatan berasaskan pelajar, pembelajaran berasakan kerja (*Work-Based Learning*) dan pengemaskinian kurikulum sejajar dengan kehendak pasaran kerja digital menjadi keperluan mendesak dalam pendidikan perakaunan masa kini (Jackson & Meek, (2020); Mukul & Büyüközkan, (2023); Handoyo & Anas, (2019); Tandiono, R. (2021)).

Skop kajian ini hanya tertumpu kepada tempoh masa dan kriteria tertentu sahaja, serta keterbatasan analisis terhadap kesan sebenar pelaksanaan teknologi dalam bilik darjah sebenar kerana hanya bergantung sepenuhnya kepada kajian sekunder. Tambahan lagi, tidak semua artikel memberi fokus kepada konteks negara membangun seperti Malaysia.

Dicadangkan, satu kajian empirikal bagi mengesahkan dapatan kajian ini, terutamanya di peringkat institusi pengajian tinggi di negara membangun. Kajian juga dicadangkan untuk meneroka secara lebih mendalam kesan keberkesanan penggunaan teknologi tertentu sperti penggunaan kecerdasan buatan (AI) terhadap prestasi pelajar perakaunan Generasi Z ini. Selain itu, kajian perbandingan antara pendekatan pengajaran di negara maju dan negara membangun juga boleh memberikan perspektif yang lebih luas dan membantu merangka dasar pendidikan perakaunan yang inklusif dan futuristik.

Akhir sekali, kajian ini menyumbang kepada pemahaman yang lebih holistik tentang transformasi dalam pendidikan perakaunan selari dengan era digital. Ia memberi implikasi penting kepada penggubal dasar, pendidik serta institusi pengajian tinggi untuk menyesuaikan kurikulum dan pendekatan pengajaran agar lebih relevan, responsif dan berkesan dalam mendidik henerasi akauntan masa hadapan.

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Penggunaan Kecerdasan Buatan (AI) dalam Kursus Integriti dan Anti Rasuah: Satu Kajian Terhadap Pelajar Kolej Poly-Tech MARA Alor Setar

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ABSTRAK

Kajian ini bertujuan untuk meneroka potensi penggunaan kecerdasan buatan (AI) dalam kursus Integriti dan Anti Rasuah di Kolej Poly-Tech MARA (KPTM) Alor Setar. Seiring dengan perkembangan teknologi, AI semakin diterapkan dalam pendidikan bagi meningkatkan kefahaman pelajar serta memperkasakan pendekatan pembelajaran. Namun, keberkesanan AI dalam menyampaikan konsep integriti dan anti rasuah masih belum diterokai secara mendalam. Oleh itu, kajian ini dijalankan untuk menilai sejauh mana AI dapat membantu pelajar memahami konsep tersebut dan mengenal pasti cabaran dalam penggunaannya. Kajian ini menggunakan metodologi kuantitatif melalui soal selidik diedarkan kepada pelajar yang mengambil kursus ini. Soal selidik ini menilai tahap kesedaran, kefahaman, cabaran dan penerimaan pelajar terhadap penggunaan AI sebagai alat pembelajaran dalam bidang integriti dan anti rasuah. Data yang diperoleh akan dianalisis bagi mengenal pasti corak penggunaan AI serta faktor yang mempengaruhi keberkesanannya dalam proses pembelajaran. Hasil kajian ini diharapkan dapat memberikan gambaran awal tentang potensi AI dalam meningkatkan kefahaman pelajar terhadap nilai integriti dan usaha memerangi rasuah. Selain itu, dapatan kajian ini boleh dijadikan rujukan bagi institusi pendidikan dalam merangka strategi yang lebih efektif untuk mengintegrasikan AI dalam kursus-kursus yang berkaitan dengan etika dan integriti.

KATA KUNCI: Kecerdasan Buatan (AI), Integriti dan Anti Rasuah, Pengajaran dan Pembelajaran

1 PENGENALAN

Kemajuan teknologi digital telah membuka ruang inovasi dalam pendidikan, termasuk penggunaan kecerdasan buatan (AI) sebagai alat bantu pembelajaran. AI berupaya menyediakan akses kepada maklumat dengan lebih cepat, meningkatkan kefahaman konsep secara interaktif, dan menyokong pembelajaran kendiri. Namun, dalam konteks kursus yang menekankan nilai dan etika seperti Integriti dan Anti Rasuah, masih kurang kajian yang mendalam mengenai keberkesananAI.

Kajian ini dijalankan di Kolej Poly-Tech MARA (KPTM) Alor Setar untuk menilai sejauh mana AI menyumbang kepada kefahaman pelajar dalam kursus Integriti dan Anti Rasuah serta untuk mengenal pasti cabaran dan persepsi pelajar terhadap AI dalam konteks ini.

2 OBJEKTIF KAJIAN

Penyelidikan ini dilaksanakan untuk mengukur secara komprehensif tahap pengamalan dan kekerapan penggunaan teknologi kecerdasan buatan (AI) oleh pelajar yang mengikuti kursus ini, dengan penekanan khusus untuk menganalisis secara mendalam sejauh mana implementasi alat dan aplikasi berasaskan AI berupaya memperkukuh kefahaman pelajar terhadap prinsip-prinsip integriti dan konsep anti rasuah yang diajarkan. Selain itu, kajian ini juga bertujuan untuk mengidentifikasi secara sistematik pelbagai cabaran yang dihadapi oleh pelajar dalam mengintegrasikan AI ke dalam proses pembelajaran mereka, serta mengumpulkan cadangan konstruktif daripada perspektif pelajar untuk mengoptimalkan pemanfaatan AI di masa hadapan. Akhir sekali, penyelidikan ini akan meneliti secara kritis persepsi dan pandangan pelajar mengenai potensi jangka panjang AI, khususnya dalam konteks sama ada teknologi ini dilihat berpotensi untuk menggantikan sebahagian atau keseluruhan peranan tradisional pensyarah, atau sebaliknya, berfungsi sebagai alat pelengkap yang berharga dalam memperkaya pengalaman pengajaran dan pembelajaran dalam kursus ini.

3 METODOLOGI

Reka bentuk kajian ini mengaplikasikan pendekatan kuantitatif berbentuk tinjauan bagi mendapatkan gambaran yang terstruktur mengenai pandangan dan pengalaman pelajar. Data primer dikumpulkan melalui instrumen soal selidik yang direka bentuk dan dibangunkan secara digital menggunakan platform Google Forms. Proses pengumpulan data melibatkan pengedaran pautan kepada soal selidik tersebut secara dalam talian kepada keseluruhan populasi pelajar yang sedang mengikuti kursus integriti dan anti rasuah. Kaedah ini dipilih untuk memastikan capaian yang luas dan memudahkan pelajar memberikan respons pada masa dan tempat yang sesuai bagi mereka, sekaligus membolehkan penganalisisan data secara statistik untuk mengenal pasti kecenderungan dan hubungan yang signifikan.

4 DAPATAN KAJIAN

Hasil dapatan menunjukkan majoriti pelajar yang terlibat dalam kajian ini terdiri daripada golongan perempuan berumur antara 18 hingga 21 tahun. Hampir kesemua pelajar telah mempunyai kesedaran awal tentang konsep integriti dan rasuah sebelum mengikuti kursus, tetapi tahap kefahaman mereka kebanyakannya berada pada tahap sederhana. Selepas penggunaan AI, ramai pelajar melaporkan peningkatan dalam pemahaman mereka terhadap konsep-konsep tersebut, menunjukkan kesan positif terhadap proses pembelajaran.

Penggunaan AI dalam kalangan pelajar didapati agak meluas, dengan aplikasi seperti ChatGPT dan QuillBot menjadi antara yang paling popular. AI digunakan untuk menjana idea, menyediakan ringkasan, menjawab soalan berkaitan tugasan, dan membantu memahami konsep yang kompleks. Sebahagian besar pelajar menggunakan AI secara berkala, iaitu beberapa kali seminggu, manakala sebilangan kecil menggunakan AI setiap hari.

Walau bagaimanapun, terdapat pelbagai cabaran yang dihadapi pelajar. Antara yang paling kerap dilaporkan ialah maklumat yang diberikan AI tidak tepat atau kurang kontekstual, khususnya dalam menjawab soalan berbentuk tempatan dan berkaitan dengan konteks Malaysia. Isu teknikal lain seperti keterbatasan AI memahami bahasa Melayu, serta kesamaran dalam memberikan jawapan juga menjadi kekangan. Beberapa pelajar juga melaporkan bahawa penggunaan AI yang terlalu kerap menyebabkan mereka kurang berfikir secara kritis dan terlalu bergantung kepada teknologi.

Isu etika turut menjadi perhatian dalam kajian ini. Majoriti pelajar bersetuju bahawa penggunaan AI yang tidak dikawal boleh menggalakkan sikap tidak jujur dalam kalangan pelajar, khususnya dalam menyiapkan tugasan. Oleh itu, ramai yang mencadangkan supaya pihak institusi memperkenalkan

panduan etika penggunaan AI dalam semua kursus akademik.

5 PERBINCANGAN

Dapatan kajian ini menunjukkan bahawa penggunaan AI dapat meningkatkan kefahaman pelajar terhadap konsep yang kompleks dalam kursus Integriti dan Anti Rasuah**.** Menurut kajian oleh Luckin et al. (2016), AI dapat menyokong pembelajaran yang diperibadikan, di mana pelajar dapat mengakses maklumat dan sumber yang relevan dengan keperluan pembelajaran mereka. Ini membolehkan pelajar untuk belajar pada kadar mereka sendiri dan mendapatkan bantuan segera mengenai topik-topik yang memerlukan penjelasan lebih mendalam.

Walaupun penggunaan AI membawa manfaat, terdapat kebimbangan yang wujud mengenai ketepatan maklumat yang diberikan oleh teknologi ini. Isu ini adalah konsisten dengan kajian yang dilakukan oleh Yusoff et al. (2025), yang mencatatkan bahawa pelajar sering menghadapi masalah ketidaktepatan dalam jawapan AI, terutamanya dalam konteks yang lebih spesifik dan tempatan. Dalam konteks Malaysia, penggunaan bahasa Melayu dalam soal selidik dan tugasan mungkin menghadapi masalah apabila AI digunakan, kerana kecenderungan sistem AI untuk mengutamakan bahasa Inggeris dan kesukaran dalam memahami konteks tempatan.

Selain itu, kajian ini juga mendapati bahawa ketergantungan berlebihan terhadap AI boleh menjejaskan kemahiran berfikir kritis pelajar. Oleh itu, adalah penting untuk mendidik pelajar supaya menggunakan AI dengan bijak dan menggunakannya sebagai alat tambahan dalam proses pembelajaran mereka, bukannya menggantikannya sepenuhnya. Dalam hal ini, penggubalan dasar yang jelas dan latihan untuk pelajar dan pensyarah adalah penting bagi memastikan penggunaan AI yang beretika dan berkesan. Pendekatan ini juga dapat mengelakkan pelajar daripada terlalu bergantung pada teknologi, dan memastikan bahawa mereka tetap mengembangkan kemahiran berfikir secara kritis serta pengambilan keputusan yang lebih baik.

6 KESIMPULAN

Secara keseluruhannya, kajian ini membuktikan bahawa AI mempunyai potensi besar dalam membantu pelajar memahami dan menghayati konsep integriti dan anti rasuah. Penggunaannya dalam kalangan pelajar di KPTM Alor Setar dilihat memberi kesan positif terhadap kefahaman dan minat terhadap kursus tersebut. Namun begitu, untuk memastikan AI digunakan secara beretika dan berkesan, institusi pendidikan perlu memperkenalkan dasar dan panduan penggunaan AI dalam pengajaran dan pembelajaran.

Pihak pengurusan institusi juga disaran untuk melaksanakan bengkel latihan AI kepada pelajar dan pensyarah, serta memperkenalkan kursus literasi digital dan etika teknologi. Kajian lanjutan disarankan bagi menilai kesan jangka panjang penggunaan AI terhadap prestasi akademik pelajar dalam bidang yang bersifat nilai dan sahsiah.

Kajian ini mencadangkan supaya institusi pendidikan mengadakan latihan bagi pensyarah dan pelajar dalam penggunaan AI yang beretika dan bertanggungjawab. Selanjutnya, kajian lanjutan perlu dilakukan untuk menilai impak jangka panjang penggunaan AI dalam pembelajaran dan untuk memastikan bahawa penggunaan teknologi ini mematuhi nilai akademik dan etika yang tinggi.

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Artificial Intelligence in Education: Impact on Student Learning and Academic Performance

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ABSTRACT

Artificial Intelligence (AI) is revolutionizing education by enhancing student learning and academic performance. AI-powered tools personalize learning experiences, adapt to individual student needs, and provide instant feedback, fostering deeper engagement and improved comprehension. Intelligent tutoring systems, predictive analytics, and AI-driven assessments help educators identify learning gaps and tailor instructional strategies accordingly. Additionally, AI automates administrative tasks, allowing educators to focus on interactive and creative teaching methods. The integration of AI in education also raises concerns regarding data privacy, ethical considerations, and the digital divide, which may impact equitable access to AI-driven learning tools. While AI has the potential to enhance learning outcomes by offering adaptive content and interactive simulations, its effectiveness depends on proper implementation, educators training, and student readiness. This paper explores the impact of AI on student learning, analyzing its benefits and challenges in fostering academic success. By reviewing current AI applications in education, it aims to provide insights into how AI can be leveraged to improve educational quality while addressing ethical and accessibility concerns. The findings suggest that when AI is effectively integrated, it can complement traditional teaching methods, enhance personalized learning, and contribute to better academic performance in shaping the future of education.

KEYWORDS: *Artificial Intelligence, Enhance Student Learning, Academic Performance, Benefits and Challenges*

1 INTRODUCTION

1.1 Background of the Study

The integration of Artificial Intelligence (AI) into educational systems has ushered in a transformative era, redefining traditional pedagogical approaches and learning environments. AI technologies, encompassing intelligent tutoring systems, adaptive learning platforms, and automated assessment tools, have been increasingly adopted to enhance personalized learning experiences and improve academic outcomes. These tools analyze vast amounts of data to tailor educational content to individual student needs, thereby fostering a more engaging and effective learning process (Shahzad et al., 2024).

The role of AI in education has been widely examined, particularly in relation to its potential to improve teaching and learning practices. However, its specific effect on academic performance within Open and Distance Learning (ODL) environments remains under-researched. While numerous studies have highlighted key success factors and challenges in integrating AI into education, they frequently fall short of providing a critical analysis of how AI directly impacts academic outcomes in ODL contexts (Bressane et al., 2024).

However, the rapid adoption of AI in education also presents challenges. For example, the concerns regarding data privacy, algorithmic bias, and the digital divide have emerged, highlighting the need for ethical considerations and equitable access to AI-driven educational tools. Furthermore, the reliance on AI may inadvertently impact critical thinking skills and academic integrity if not implemented thoughtfully (Pitts, Marcus & Motamedi, 2025).

In Malaysia, the Ministry of Education has recognized the potential of AI to revolutionize the educational landscape, aligning with global trends to integrate technology into teaching and learning processes. As the nation strives to enhance its educational quality and accessibility, understanding the implications of AI integration becomes imperative.

1.2 Problem Statement

While AI offers promising avenues to enhance student learning and academic performance, its integration into educational systems is tense with complexities. The primary concern lies in the lack of comprehensive understanding of how AI impacts various facets of education, including pedagogical effectiveness, student engagement, and equity.

Despite the availability of AI tools, there is a lack of empirical research examining their actual impact on student learning outcomes within the Malaysian context. Educators often face challenges in selecting appropriate AI applications, integrating them into curricula, and ensuring that these tools align with learning objectives. Moreover, disparities in access to technology exacerbate the digital divide, potentially marginalizing students from underprivileged backgrounds (Saleem et al., 2025).

Ethical considerations further complicate the integration of AI in education. Issues related to data privacy, consent, and algorithmic transparency raise questions about the responsible use of AI technologies (Sargiotis, 2024). Additionally, the potential for AI to unintentionally perpetuate existing biases necessitates a critical examination of its deployment in educational settings.

Therefore, this study seeks to explore the multifaceted impact of AI on student learning and academic performance, addressing the benefits, challenges, and ethical implications of its integration into education.

1.3 Significance of the Study

This study holds significant relevance for various stakeholders in the educational sector. For educators, understanding the capabilities and limitations of AI tools can inform instructional strategies, enabling more effective and personalized teaching approaches. Insights from this research can guide the development of professional development programs focused on AI literacy, ensuring that educators are equipped to leverage technology to enhance learning outcomes.

Policymakers can benefit from the findings by formulating evidence-based policies that promote the ethical and equitable integration of AI in education (Noor et al., 2025). Addressing concerns related to data privacy, accessibility, and algorithmic fairness is crucial to ensure that AI serves as a tool for inclusion rather than exclusion. By establishing clear guidelines and standards, policymakers can foster a conducive environment for the responsible use of AI in educational settings.

As for the students, this study aims to shed light on how AI can be harnessed to support diverse learning needs, enhance engagement, and improve academic performance. By identifying best practices and potential pitfalls, this research can contribute to creating learning environments that are both technologically advanced and pedagogically sound (Ellikkal & Rajamohan, 2024).

Furthermore, this study contributes to the broader academic discourse on the intersection of technology and education. By providing empirical evidence on the impact of AI, it adds to the existing body of knowledge and serves as a foundation for future research in this domain.

In the Malaysian context, where educational transformation is a national priority, this study aligns with efforts to integrate technology into education to enhance quality and accessibility. By addressing the challenges and opportunities presented by AI, this research supports the nation's goal of developing a resilient and comprehensive educational system.

2 LITERATURE REVIEW

2.1 Artificial Intelligence in Education

Artificial Intelligence (AI) is rapidly transforming the educational landscape, impacting how institutions operate, how teachers instruct, and how students learn. Research highlights a broad range of AI applications in education, from personalized learning and intelligent tutoring to administrative automation and ethical considerations. AI facilitates customized teaching by examining student data, detecting learning trends, and adjusting materials to suit each learner's needs, thereby enhancing engagement and academic performance (Chen et al., 2020). AI-powered tools like chatbots and intelligent tutoring systems offer instant feedback, handle automated grading, and assist students beyond regular classroom hours (Wang et al., 2024). AI technologies simplify administrative duties such as reviewing assignments, grading, and creating student profiles, enabling educators to dedicate more time to teaching. According to Hamal et al. (2022), the use of AI in education is rooted in fields like computer science, psychology, neuroscience, and others, promoting interdisciplinary research. AI in education investigates a variety of applications, such as adaptive learning, customized tutoring, intelligent evaluation, student profiling, and predictive analytics, while also addressing challenges related to technical design and implementation (Wang et al., 2024). AI in education has progressed significantly in developed nations, yet ethical concerns and various challenges persist, highlighting the need for future research to tackle these issues (Tahiru, 2021).

Moreover, chatbots such as ChatGPT hold the potential to transform education, but their effective integration and responsible use require addressing both ethical and practical challenges. The discussion includes chatbots and related algorithms capable of imitating human interactions and producing human-like text in response to natural language input (Adiguzel et al., 2023). Although AI brings numerous benefits, its implementation must be approached with caution to uphold ethical standards, protect data privacy, and promote inclusivity. Educators need to harmonize AI integration with human-centered teaching to preserve the vital role of teachers in nurturing critical thinking, creativity, and social-emotional development. The collaboration between AI and human intelligence can improve both learning and teaching by working together in real time, supporting human decision-making, and increasing efficiency within educational environments (Ifenthaler et al.,2023). AI is transforming education through personalized learning, automation of administrative duties, and support for varied learning environments. Despite its significant advantages, issues related to ethics, privacy, and proper implementation persist. Continuous research and careful regulation are crucial to fully harness AI's benefits in the educational sector.

2.2 Academic Performance

Artificial Intelligence (AI) tools are being increasingly applied in education to forecast, assess, and improve academic performance. Studies examine not only the predictive strength of AI models but also how AI-driven educational tools directly influence student performance across different levels and learning environments. The use of generative AI (Gen-AI) tools greatly enhances college students' academic performance, with the most significant improvements observed in independent learning and the creation of text-based content (Sun & Zhou, 2024). AI facilitates customized and adaptive learning, more effective content delivery, and improved support, all of which contribute to better academic results. By analyzing student behavior and performance data, AI can identify learning gaps and provide targeted resources to address them. Additionally, AI-powered platforms can offer real-time feedback and interactive learning experiences, keeping students engaged and motivated (Zakaria et al., 2024). Artificial neural networks are capable of accurately predicting academic performance in higher education, enhancing decision-making in areas such as planning, student advising, and progress monitoring (Fayoumi & Hajjar, 2020). Machine learning, collaborative filtering, recommender systems, and artificial neural networks are powerful techniques for forecasting student performance in educational settings. These methods analyze large datasets to identify patterns and provide personalized recommendations that support student learning (Rastrollo-Guerrero, 2020).

AI-driven writing tools have a beneficial effect on academic writing by improving students' skills, boosting their confidence, and increasing their awareness of academic integrity. However, it is

important to integrate these tools thoughtfully to maintain human creativity and critical thinking (Malik at al., 2023). AI tools in higher education have the potential to boost student performance, engagement, and success, but their responsible use depends on well-planned implementation, proper teacher training, and careful attention to ethical issues (Abbas et al., 2023). AI systems examine each student's data to customize learning materials and pace, catering to their unique needs and challenges. This personalized approach enables students to grasp difficult concepts more effectively and advance at a comfortable rate, resulting in better academic performance (Mallillin, 2024). Besides, AI provides intelligent, context-sensitive content and improved assistance via virtual assistants or chatbots. These tools offer instant feedback, respond to inquiries, and assist students with assignments, minimizing frustration and encouraging ongoing learning. In conclusion, AI enhances academic achievement by customizing learning experiences, increasing student motivation, providing intelligent content, facilitating early support, and promoting effective study habits. Educational institutions are encouraged to adopt AI-driven tools to support improved academic results and overall student success (Treve, 2024). AI tools prove effective in forecasting and boosting academic performance across various educational environments. Additionally, AI-driven educational technologies enhance student motivation, learning attitudes, and overall achievement.

2.3 Impact on Student Learning

In today's fast-paced world, technology is transforming almost every aspect of our lives, including how we learn. The rapid development of intelligent machines and emerging technologies is reshaping higher education in remarkable ways. AI-driven applications have become part of our everyday routines, making technology more important than ever in education (Rodríguez-Hernández et al., 2021). In recent years, countless AI-powered educational tools have surfaced, bringing both exciting opportunities and new challenges to teaching and learning. These innovations are not just enhancing how students interact with educational content but also transforming how institutions operate. As technology becomes more integrated into the educational landscape, it is reshaping how students engage with their studies.

One of the most notable changes is the evolution of online and web-based education. Previously, these platforms mainly provided downloadable resources and assignments for students. Now, they have evolved into intelligent, adaptive systems that learn from both teachers' and students' interactions. These smart systems continuously adjust to meet individual learning needs, creating a more personalized and effective educational experience. Consequently, AI is increasingly used not only for teaching and learning but also for managing educational processes efficiently. AI-powered tutoring systems, for example, are making a significant difference in modern education. Brown and Lee (2023) highlight how these systems provide immediate, customized feedback, allowing students to address their knowledge gaps in real time. By adapting to individual learning patterns, these tools create a more supportive and responsive learning environment.

Moreover, integrating AI into educational practices helps students develop essential skills that are highly valued in the modern workplace, such as critical thinking and data analysis. Smith and Parker (2024) point out that by using AI-driven tools, students not only enhance their academic performance but also build competencies that prepare them for the demands of a technology-driven future. Overall, it is clear that AI is revolutionizing higher education by making learning more personalized, accessible, and skills-focused. As educational institutions continue to embrace these technologies, it is crucial to explore how best to balance innovation with the human aspects of teaching and learning.

3 RESEARCH METHODOLOGY

To achieve the objectives, a literature review was conducted using an archival research approach. Keywords such as "Artificial Intelligence," "Impact Online Learning," "Student Academic Performance," "ChatGPT," and "AI in Education" were used to gather academic studies from online platforms including Google Scholar, ResearchGate, Emerald Insight, and ProQuest. Consequently, research articles published between 2021 and 2025 focusing on Artificial Intelligence and its influence

on student learning were analyzed. This study aims to offer valuable insights into how AI developments affect students' academic performance.

4 DISCUSSION AND CONCLUSION

In today's world, shaped by the Industrial Revolution, technology has become an essential part of our daily lives. We have reached a point where almost everything we do relies on information technology (IT), making it much more than just a tool. It is now a vital component of modern living. The rapid development of IT has made life more convenient, but it has also created a strong dependence on technology to get things done (Rahmatullah et al., 2022).

As technology continues to evolve, today's generation is naturally more tech-savvy than those before. Growing up surrounded by digital devices and online platforms, they have developed a level of technological literacy that previous generations did not have. This growing comfort with technology, along with recent advancements, has led to a surge in its use within education, making tech-driven learning more common and accessible.

The integration of information technology (IT) in modern educational institutions, especially those aspiring to be world-class universities, has become essential. This is because delivering quality education as a public service requires good governance characterized by transparency, accountability, efficiency, and effectiveness. Due to the growing awareness of the importance of information and communication technology (ICT) as a fundamental pillar of modern civilization, educational management is increasingly committed to embedding ICT into all aspects of educational activities, ensuring its effective implementation (Rahmatullah et al., 2022). AI technology has a rich history and continues to progress over time. According to Ouyang and Jiao (2021), advancements in computing and information processing have significantly expanded the use of AI in education, presenting new opportunities and challenges for educational practices. AI technologies bring both benefits and drawbacks. Therefore, it is essential to focus on integrating AI into education effectively while developing strategies that address the needs and expectations of both teachers and students. Doing so will help achieve better academic outcomes.

In summary, the integration of AI in education holds the potential to transform student learning and academic performance significantly. The ability of AI-driven systems to deliver instant feedback, enable self-directed learning, and alleviate administrative tasks for educators further demonstrates its positive influence in higher education settings (Brown & Lee, 2023). To fully capitalize on these advantages, it is essential to address challenges related to data privacy, inclusivity, and technological accessibility. Collaboration between educators and policymakers is necessary to develop strategies that ensure AI is utilized to support diverse learning needs while maintaining a human-centred approach to teaching (Johnson & Kim, 2024). Moreover, ongoing research is crucial to examine the long-term impact of AI on education, particularly in understanding how these technologies shape critical thinking, problem-solving abilities, and overall academic success.

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Enhancing the Teaching of Electromagnetic Theory through Simulation-Based Instruction: A Case Study Using Antenna Parameters

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ABSTRACT

Teaching core concepts in Electromagnetic Theory (EMT), particularly in electrical engineering education, presents significant challenges due to the abstract and mathematically intensive nature of the subject. Traditional pedagogical tools—such as lectures and static presentations—often fall short in conveying the dynamic behavior of electromagnetic fields and antenna operations. This study explores the integration of simulation software as a pedagogical aid to enhance conceptual and procedural understanding in EMT. Focusing on antenna parameters as a representative topic, a microstrip patch antenna was modeled and analyzed using CST Microwave Studio (CST MWS) software. The simulation-based teaching method was evaluated against conventional approaches, including blackboard instruction and power point presentations. Comparative assessments were conducted through classroom implementation and student feedback. Findings indicate that software-assisted instruction offers substantial improvements in student engagement, visualization, and comprehension. The study highlights the educational potential of CST MWS and similar electromagnetic simulation tools, advocating their broader adoption in engineering curricula to bridge theoretical knowledge and practical understanding.

KEYWORDS: electromagnetic theory, engineering education, antenna simulation, CST MWS, teaching methods, microstrip patch antenna

1 INTRODUCTION

Electromagnetic Theory (EMT) forms a fundamental pillar in the education of electrical and electronics engineering students. It provides the theoretical framework for understanding wave propagation, antenna behavior, transmission lines, and microwave systems. Despite its importance, EMT is widely recognized as one of the most challenging subjects for students to grasp. This difficulty arises from its heavy reliance on advanced mathematics, abstract vector field concepts, and the lack of visible physical phenomena that can be easily demonstrated in a traditional classroom setting [1], [2].

The conventional teaching of EMT often involves blackboard derivations, mathematical formulations, and static diagrams in lecture slides. While these methods are essential for theoretical rigor, they frequently fail to convey the dynamic nature of electromagnetic interactions. As a result, students may struggle to form intuitive understandings of key concepts such as field distributions, wave propagation, and antenna radiation patterns. This gap between theory and intuition poses a significant obstacle to learning and application in later coursework and professional practice [3].

Visualization and interactivity have been identified as critical elements in enhancing student comprehension in STEM disciplines. In the context of EMT, the use of simulation tools offers a powerful means to make invisible electromagnetic phenomena accessible and understandable [4]. Simulations allow students to manipulate parameters, observe field behaviors in real-time, and directly correlate theoretical inputs with practical outcomes. These tools also support active learning and foster a deeper engagement with the subject matter by enabling exploration beyond textbook examples [5].

This study investigates the integration of simulation-based instruction into EMT teaching, with a focus on antenna parameters as a representative application. Specifically, a microstrip patch antenna is modeled and analyzed using CST Microwave Studio (CST MWS), a professional-grade electromagnetic simulation platform. The primary objective is to evaluate the effectiveness of simulation-assisted instruction in improving students' conceptual understanding, engagement, and ability to relate theory to real-world engineering problems. Through comparative classroom implementation and analysis of student feedback, this work aims to contribute to evidence-based pedagogical practices in engineering education.

2 LITERATURE REVIEW

The teaching of Electromagnetic Theory (EMT) has traditionally relied on lecture-based instruction, chalk-and-talk methods, and the use of textbook examples. These approaches prioritize mathematical rigor and formal derivations but often underrepresent physical intuition and real-world application [6]. While essential for foundational understanding, such methods are frequently criticized for their abstract nature, which can lead to cognitive overload and disengagement, particularly among undergraduate students encountering the subject for the first time.

To address these issues, researchers and educators have explored the integration of simulation-based learning in engineering education. Simulation tools provide interactive visualizations and allow learners to manipulate variables, observe outcomes, and engage in exploratory learning. Numerous studies report that such tools improve conceptual understanding, retention, and student motivation across various domains, including electromagnetics, signal processing, and control systems [7], [8]. For example, [9] demonstrated the effectiveness of using EMTP simulation tools to teach high-voltage power system concepts to electrical engineering students at Wuhan University. The study showed that students reported greater satisfaction with the simulation-based tasks compared to traditional instruction and found the approach more helpful for understanding theoretical concepts.

In the specific context of electromagnetic education, commercial electromagnetic simulation software such as CST Microwave Studio (CST MWS), ANSYS HFSS, and FEKO has gained traction in both academic and industrial settings. These tools offer high-fidelity modeling of electromagnetic fields, antenna structures, and wave propagation phenomena. Several case studies have incorporated CST MWS into undergraduate and postgraduate curricula, highlighting its effectiveness in bridging theoretical content with practical design skills [10]. Students exposed to CST-based labs and projects tend to show improved spatial understanding of field interactions and greater confidence in handling real-world electromagnetic problems.

The pedagogical benefits of simulation-based tools are supported by established learning theories. Cognitive Load Theory, for instance, suggests that multimedia learning environments can reduce extraneous cognitive burden by presenting information through multiple channels—visual and verbal—thereby enhancing processing efficiency [11]. Similarly, the Constructivist Learning Theory posits that learners construct new knowledge more effectively when engaged in active, experiential tasks rather than passive content consumption [12]. Mayer's Cognitive Theory of Multimedia Learning further reinforces the notion that combining animations with narration or text supports deeper understanding, particularly in conceptually dense subjects like EMT [13]. These frameworks provide a solid theoretical basis for the integration of simulation tools in engineering pedagogy.

In summary, existing research strongly supports the effectiveness of simulation-based learning in technical education, especially in enhancing conceptual understanding. This is particularly relevant in the field of electromagnetics, where visualizing field interactions is essential for student comprehension. Simulation tools such as CST Microwave Studio (CST MWS) have demonstrated significant educational benefits by making abstract electromagnetic phenomena more accessible and engaging. However, despite these advantages, there is a noticeable lack of empirical studies that assess the impact

of such tools in actual classroom environments, especially when focusing on specific topics like antenna parameters. This gap in the literature provides the rationale for the present study.

3 METHODOLOGY

3.1 Course Context and Participants

The study was conducted within the context of an undergraduate Electromagnetic Theory (EMT) course offered as part of the Electrical and Electronics Engineering program. The course, typically taken in the second year of the undergraduate curriculum, is designed to provide students with a foundational understanding of electromagnetic fields, wave propagation, transmission lines, and antenna theory. It is a core subject that prepares students for more advanced studies in communications, antenna design, and microwave engineering.

The course is structured to include both theoretical lectures and practical laboratory sessions, with a focus on mathematical models and problem-solving techniques. The students enrolled in the course have generally completed introductory courses in physics and calculus, and they possess basic knowledge of circuit theory and vector calculus, which are prerequisites for understanding the material presented in EMT.

For the study, a total of 60 students were selected from a single course offering. The participants were taught using both conventional lecture-based methods (blackboard instruction and PowerPoint presentations) and simulation-based teaching with CST Microwave Studio (CST MWS). The majority of participants were male (approximately 70%), with the remaining 30% being female. The age range of participants varied from 20 to 23 years, with most students having little prior exposure to electromagnetic simulation tools.

The participants were selected based on their enrollment in the course, and no specific criteria regarding prior academic performance or familiarity with simulation tools were applied. Students were informed about the purpose of the study and provided with a consent form to participate. The study ensured that the sample was representative of the larger student population in the course, allowing for a meaningful comparison of the effectiveness of traditional versus simulation-based teaching methods.

3.2 Conventional Instruction: Blackboard and Slides

In the conventional instructional approach, the students were taught key concepts related to antenna parameters—such as return loss, current distribution, radiation patterns (both 2D and 3D), and gain—using traditional methods, including blackboard explanations and PowerPoint presentations. These methods involved the instructor deriving mathematical formulas and explaining theoretical concepts step by step. For instance, the return loss of an antenna was discussed in terms of the reflection coefficient and the S-parameters, but students were limited to abstract mathematical expressions and static images of idealized antenna structures.

The current distribution was explained through simplified diagrams that showed general patterns of current flow, but these visualizations lacked the dynamic nature of actual current behavior in antennas. Similarly, the radiation pattern was depicted using static 2D polar plots, which, although useful for conveying general principles, did not provide students with a clear understanding of how the pattern evolves over different angles or how it changes with varying antenna dimensions and frequencies. For gain, students were shown theoretical equations and examples but lacked an interactive or visual method for understanding how changes in design affect an antenna's directional gain.

While these traditional methods allowed for the delivery of theoretical knowledge, the lack of real-time, dynamic visualization left students with a limited understanding of how the antenna's characteristics actually manifested in practice. Without the ability to directly manipulate design parameters and see their effects in real time, students often struggled to develop an intuitive grasp of complex concepts such as impedance matching, the relationship between current distribution and radiation efficiency, and the effect of antenna dimensions on radiation patterns and gain. This gap between theory and practical experience was a common limitation of the conventional approach.

3.2 Simulation-Enhanced Instruction: CST Microwave Studio (CST MWS) Demonstrations

In contrast, during the simulation-enhanced phase of instruction, students benefited from the integration of CST Microwave Studio (CST MWS), a professional electromagnetic simulation tool, into the teaching process. Using CST MWS, students had the opportunity to visualize and interact with the key antenna parameters—return loss, current distribution, radiation patterns (2D and 3D), and gain—in a dynamic, real-time environment.

For example, when explaining return loss, students were able to directly observe the S-parameters and reflection coefficient in the CST MWS simulation, instantly visualizing how changes in antenna design—such as altering the feed point or adjusting the antenna dimensions—affected the return loss. The software provided clear graphical representations of the impedance matching, allowing students to correlate the theoretical equations with actual simulation results. This hands-on experience gave them a far deeper understanding of how to optimize antenna performance and minimize signal reflection.

The current distribution was another parameter that was significantly enhanced through CST MWS. Rather than relying on static diagrams, students could visualize real-time current flow across the antenna structure. As they adjusted parameters such as frequency or material properties, they could directly observe how these changes affected the current distribution, giving them an intuitive understanding of how electromagnetic fields interact within the antenna.

When it came to radiation patterns, the simulation provided both 2D and 3D views, offering students a comprehensive perspective of the antenna's radiation characteristics. In the traditional approach, students were typically shown 2D polar plots, which depicted the radiation pattern from a single angle. However, CST MWS allowed them to rotate and zoom into the 3D radiation pattern, visualizing how the antenna radiates energy across different angles and frequencies. This dynamic visualization helped students better understand directional radiation, beamwidth, and the effects of antenna design modifications on radiation efficiency.

Gain was similarly explored in a more interactive manner through the simulation. Students could manipulate antenna dimensions, materials, and operating frequencies while observing the immediate effect on the antenna's gain. The real-time feedback provided by CST MWS made it easier for students to grasp how factors like antenna size and shape contribute to the overall efficiency of radiation in a specific direction. By directly linking theory to practice, students gained a more robust understanding of how to maximize antenna performance.

The simulation-based approach fostered active learning by providing students with the opportunity to experiment with various designs, analyze the results, and refine their understanding of the relationship between theory and application. This hands-on experience significantly enhanced student comprehension, as they were able to visualize how theoretical concepts such as impedance, radiation patterns, and gain were not only mathematically derived but also manifested in real-world antenna designs.

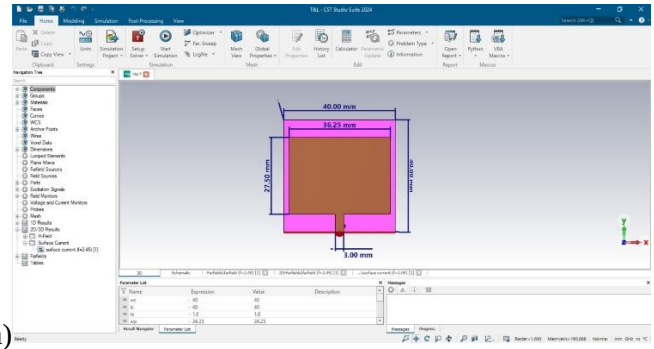
3.3 Simulation Setup

Microstrip Patch Antenna Design in CST MWS

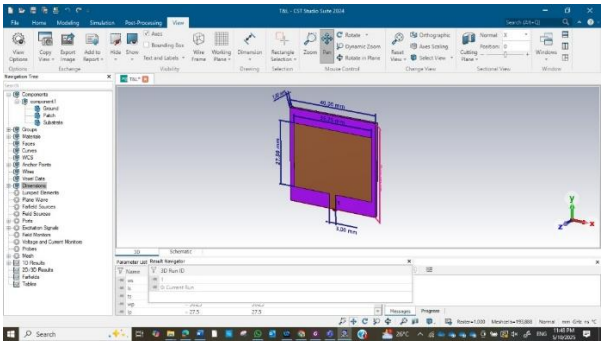
To implement the simulation-enhanced teaching approach, a rectangular microstrip patch antenna was modeled using CST Microwave Studio (CST MWS). The choice of a microstrip patch antenna was intentional, as it is commonly used in educational contexts to demonstrate core electromagnetic concepts due to its planar structure, ease of fabrication, and rich theoretical background. The antenna was designed to operate at a resonant frequency of 2.45 GHz, commonly used in ISM band applications, making the simulation relatable and practically meaningful for students.

The antenna structure as depicted in Figure 1 was built on an FR-4 substrate with a dielectric constant of $\varepsilon r = 4.4$, a thickness of 1.6 mm, and dimensions optimized for resonance at the target frequency. An inset feed was employed to excite the patch, enabling students to understand the role of feeding techniques in impedance matching and return loss behavior. The simulation domain was enclosed in an open boundary (PML) to minimize reflections and emulate free-space conditions.

(a)



(b)



(c)

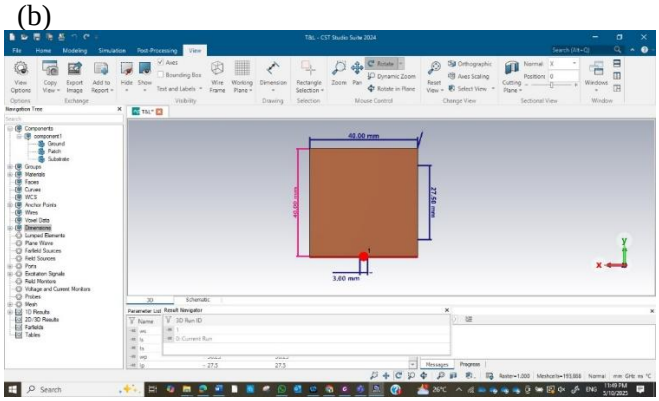


Figure 1: Geometry of the microstrip patch antenna in CST MWS. (a) Front view (b) Perspective view (b) Bottom view. The model includes the rectangular patch, dielectric substrate (FR-4), ground plane, and inset feed. This visualization helps students understand the physical structure and simulation setup.

Key Parameters Analyzed

Several key performance parameters were extracted and used as the instructional focus during the simulation sessions:

1. **Return Loss (S_{11}):** Return loss was analysed over a frequency sweep to determine the antenna's resonant behaviour and impedance matching. As shown in Figure 2, the simulated S_{11} curve exhibits a pronounced dip at 2.45 GHz, indicating good impedance matching and efficient power transfer. The -10 dB bandwidth can be observed around the resonant frequency, and its width provides insight into the operational frequency range of the antenna. The return loss was analysed over a frequency sweep to determine the resonance frequency and impedance matching of the antenna. Students were taught to interpret S_{11} plots and identify the -10 dB bandwidth, a critical metric in antenna design.

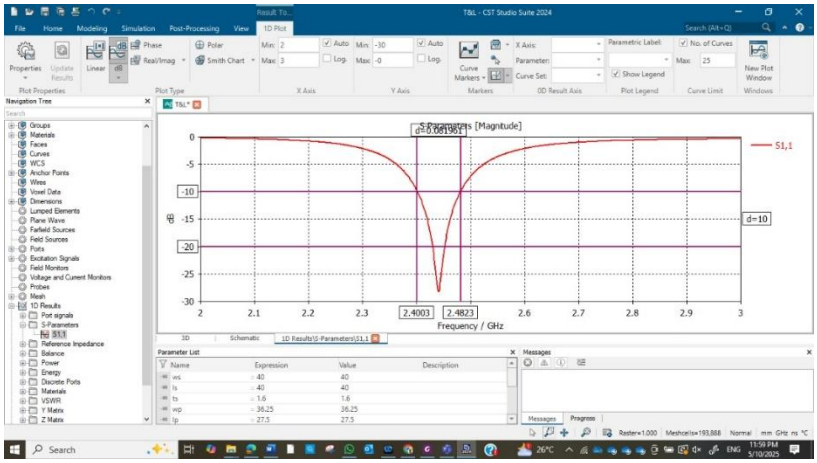


Figure 2**:** Simulated return loss (S_{11}) versus frequency for the microstrip patch antenna. The dip at 2.45 GHz indicates the resonant frequency.

2. **Voltage Standing Wave Ratio (VSWR):** In addition to return loss, the Voltage Standing Wave Ratio (VSWR) was examined to further assess impedance matching quality. As illustrated in Figure 3, the VSWR drops below the threshold of 2 at the resonant frequency, confirming effective impedance matching. This reinforces the interpretation of the S_{11} plot and provides a complementary perspective on antenna performance.

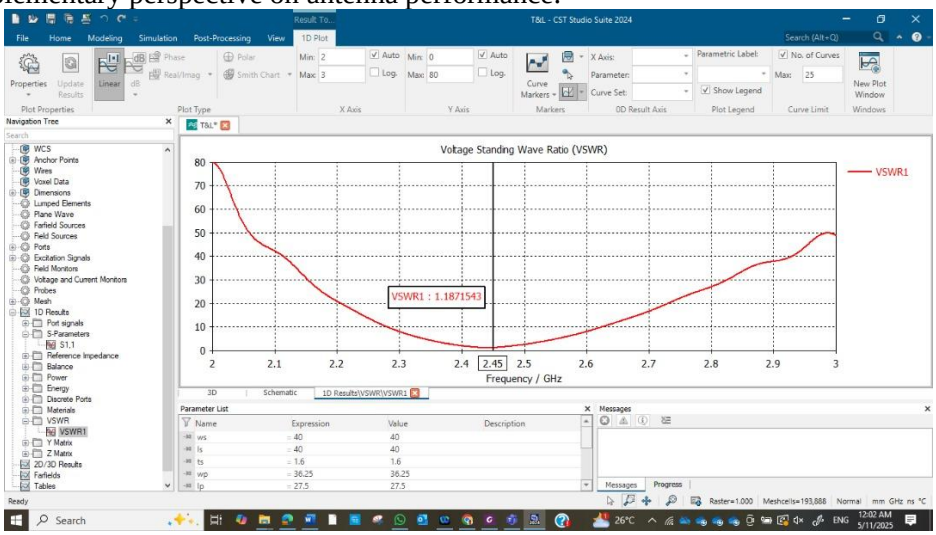
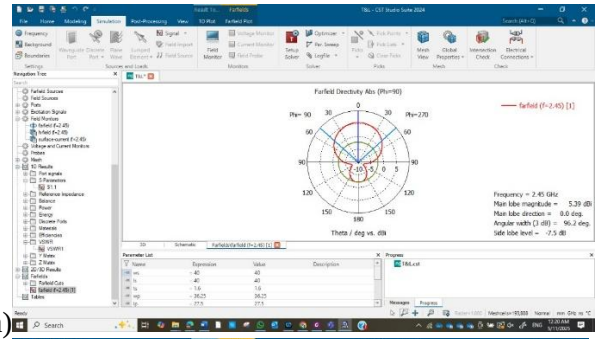


Figure 3**:** Simulated VSWR versus frequency for the microstrip patch antenna. A VSWR value below 2 around 2.45 GHz indicates good impedance matching, consistent with the return loss results.

3. **Radiation Pattern (2D and 3D):** The antenna's directional characteristics were examined using 2D polar plots. Figure 4 shows the radiation patterns in both the E-plane and H-plane, allowing students to identify main lobes, side lobes, and beamwidth. These visualizations directly supported their understanding of directivity and spatial power distribution.

(a)



(b)

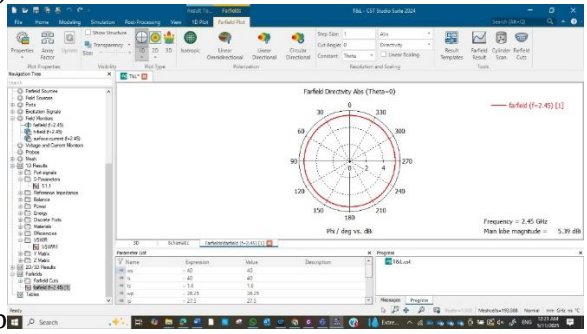


Figure 4: 2D radiation patterns of the antenna in the (a) E-plane and (b) H-plane. The plots highlight the main lobe direction and beamwidth, essential for analysing antenna directivity.

For a more intuitive understanding of spatial radiation, a 3D far-field plot was generated. As illustrated in Figure 5, the plot provides a comprehensive visualization of the antenna's gain lobes, enabling students to appreciate how electromagnetic energy is distributed in space.

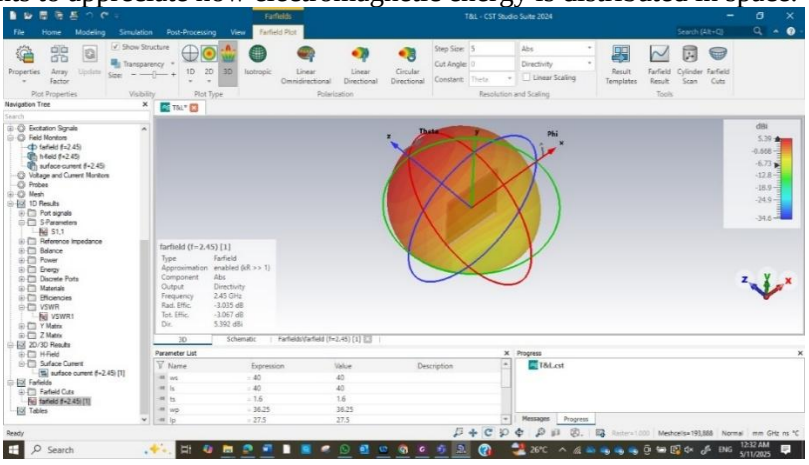


Figure 5: 3D far-field radiation pattern of the patch antenna at 2.45 GHz. The plot highlights directional gain and overall spatial coverage.

4. **Surface Current Distribution:** To help students understand how current flow leads to radiation, the surface current distribution was visualized at the resonant frequency. As shown in Figure 6, the current forms standing wave patterns with clear nodes and antinodes, corresponding to the theoretical half-wavelength resonance mode of the patch.

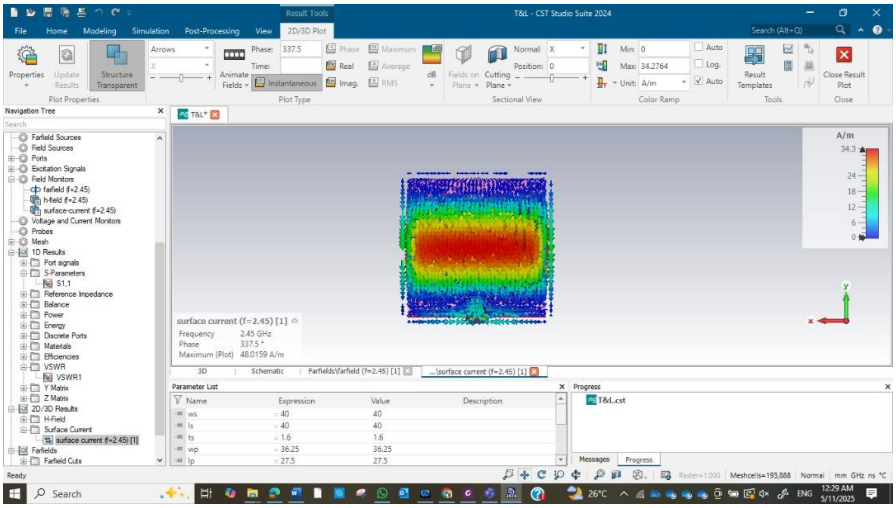


Figure 6: Surface current distribution on the microstrip patch antenna at 2.45 GHz. The colour map illustrates areas of high and low current density, revealing the standing wave pattern essential for radiation.

These parameters were not only presented but also manipulated interactively in real-time during lectures. For example, students could observe how changing the feed position or patch dimensions altered the return loss and radiation pattern, reinforcing the theory with practical insight.

Classroom Integration Strategy

The simulation setup was fully integrated into the classroom environment to support active, inquiry-based learning. The experimental group participated in a structured three-phase simulation-enhanced instruction process:

1. **Pre-simulation Lecture:** Students were first introduced to the theoretical concepts using brief conventional instruction (e.g., equations for resonance, radiation pattern theory, and impedance matching principles). This established a baseline understanding.

2. **Live Simulation Demonstration:** During class, the instructor conducted live demonstrations using CST MWS. Each simulation was aligned with the lecture content, allowing students to immediately see the practical realization of the theory. Students were encouraged to ask questions, make parameter suggestions, and predict simulation outcomes before running them.

3. **Hands-on Simulation Sessions:** After demonstrations, students accessed simplified CST projects in lab settings where they could modify design variables (e.g., patch width, feed location) and analyse how changes impacted antenna performance. These sessions promoted self-directed learning and critical thinking.

Throughout the semester, simulation assignments were incorporated into coursework and assessments. Students submitted lab reports discussing the interpretation of S-parameters, radiation characteristics, and gain plots, thereby reinforcing their conceptual and procedural understanding.

This integrated simulation approach not only improved engagement and comprehension but also familiarized students with industry-standard tools, preparing them for future professional applications in RF and antenna engineering.

3.4 Data Collection

To evaluate the impact of both instructional methods on student learning, feedback was collected after each phase—conventional instruction and simulation-based instruction. Students were asked to rate the relative influence of various factors on their learning experience. The key dimensions

considered were: clarity of instruction, assessment relevance, depth of conceptual understanding, interactivity of learning resources, motivation to explore beyond the syllabus, and time spent on independent study.

Responses were compiled and analysed separately for the two instructional methods to identify the most influential aspects contributing to student learning. The distribution of student responses for the conventional instruction phase is shown in Figure 7(a), and that for the simulation-based instruction phase is presented in Figure 7(b).

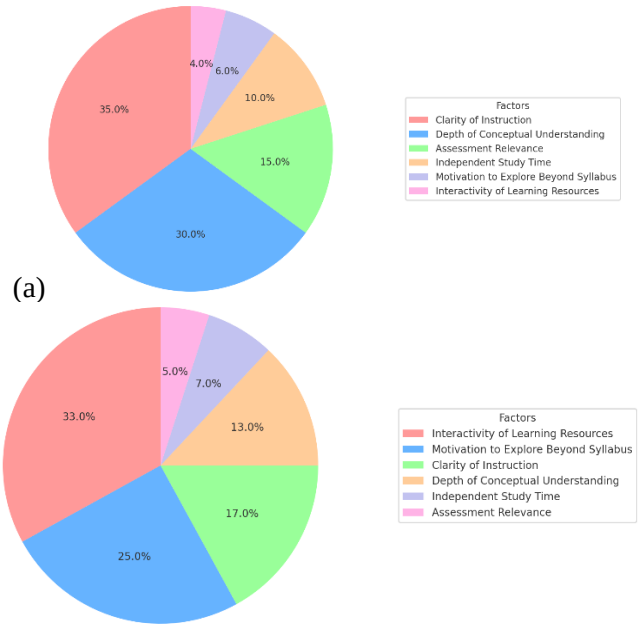


Figure 7**:** Distribution of contributing factors to student learning in (a) Conventional Instruction Phase and (b) Simulation-Based Instruction Phase.

In the conventional phase Figure 7(a), clarity of instruction (35%) and depth of conceptual understanding (30%) were rated as the primary contributors to learning. These were followed by assessment relevance (15%), independent study time (10%), motivation to explore beyond the syllabus (6%), and interactivity of learning resources (4%)—the last reflecting the static nature of the teaching materials used.

In contrast, during the simulation-based instruction phase Figure 7(b), interactivity of learning resources (33%) and motivation to explore beyond the syllabus (25%) emerged as the most significant drivers of student engagement and learning. Other contributing factors included clarity of instruction (17%), depth of conceptual understanding (13%), independent study time (7%), and assessment relevance (5%). Similarly, as shown in Figure 8, the bar chart presents the distribution of contributing factors to student learning in both the conventional and simulation-based instruction phases. The findings from the bar chart align with the previous pie charts. In the conventional phase (represented by the dark blue bars), clarity of instruction and conceptual understanding are the primary contributors, which match the 35% and 30% observed in the pie charts. On the other hand, in the simulation-based phase (represented by the light blue bars), interactivity of learning tools and motivation to explore beyond the syllabus emerge as the most significant factors, consistent with their higher percentages in the pie chart. This bar chart provides a clear visual comparison of the key learning factors across both instructional methods. The results demonstrate the positive impact of CST MWS on enhancing student interest and engagement by facilitating dynamic, visual, and exploratory learning experiences. The interactive nature of the CST Microwave Studio (MWS) environment allows students to visualize electromagnetic field distributions, simulate real-world scenarios, and immediately observe the effects of parameter changes. This hands-on, feedback-driven approach fosters deeper conceptual understanding and motivates learners by connecting abstract theoretical principles with tangible, observable phenomena. Consequently, students are more likely to remain engaged, ask insightful

questions, and pursue further inquiry, leading to improved learning outcomes and greater enthusiasm for the subject matter.

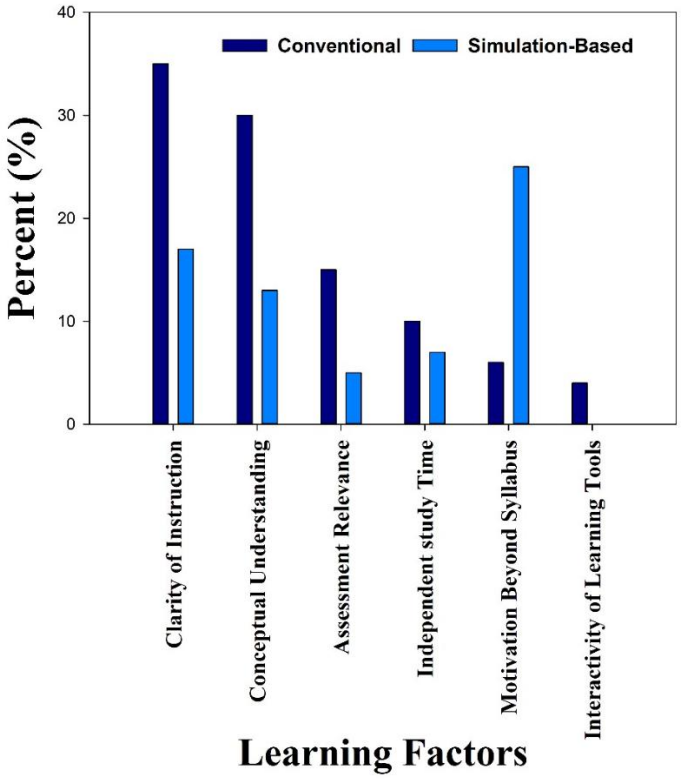


Figure 8: Analysis of student feedback questionnaire. The bar chart shows the proportion of students who identified each factor as significantly contributing to their learning experience during the EMT course.

4 CONCLUSION

This study explored the effectiveness of simulation-based instruction using CST Microwave Studio (CST MWS) in enhancing the teaching and learning of Electromagnetic Theory (EMT), with a focus on antenna parameters. By integrating real-time simulations into classroom instruction—particularly on topics such as return loss, current distribution, radiation patterns, and gain—students were able to visualize complex electromagnetic phenomena that are otherwise difficult to grasp through conventional methods alone.

The comparative experience between traditional instruction (blackboard and slide-based teaching) and simulation-enhanced learning revealed significant pedagogical benefits. Simulation tools allowed students to observe dynamic behaviours, interact with antenna models, and relate theoretical concepts to visual outcomes—providing a deeper and more intuitive understanding of key principles.

Student feedback further reinforced these findings. In simulation-based learning environments, learners identified interactivity of tools and motivation to explore beyond the syllabus as the most influential factors—highlighting the role of visual and hands-on learning in fostering engagement and improved conceptual clarity.

These outcomes support the argument that simulation tools such as CST MWS serve as effective pedagogical aids in engineering education. They not only bridge the gap between theoretical abstraction and practical application but also promote active learning and sustained interest in complex subjects. The findings advocate for the broader integration of electromagnetic simulation platforms into undergraduate curricula to improve both the quality of instruction and student engagement in technical courses.

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The Impact of Food Review Writing in Food App as An Authentic Writing Activity for ESL Students

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ABSTRACT

Writing an essay is often considered as the hardest skill for language learners to be proficient in, especially if the language that they are learning is their second language. This language skill requires tons of guidance and a lot of practice from its learners. Considering most Malaysians are learning English as their second language, a lot of practice needs to be done in order for them to master the language. This situation can be witnessed when teachers conduct writing lessons in the classroom. Students will usually procrastinate a lot as they are unable to understand or follow the writing lesson. This could be caused by students' inability to really understand the importance of having good writing skills. Therefore, there is a need for teachers to have the students participate actively during writing class. One of the ways is to incorporate the use of authentic writing activity in the ESL classroom. This study aims to examine the effects of the structured food review writing technique on food apps towards students' writing skills. A quasi-experimental research design was conducted for the pilot study involving both an experimental group and a control group, with pre-tests and post-tests administered to measure the effects of the intervention. The findings have shown that there are positive improvements to students' writing skills when using the structure's food review as an authentic writing activity in the English language classroom.

KEYWORDS: authentic writing activity, second language learner, language skill, writing review, food app

1 INTRODUCTION

Even with years of learning the English language in Malaysia, many still shy away when needing to write essays in the target language (Jasman et al., 2023; Kamaruddin et al., 2021; Juin et al., 2021). As a result, many English as a Second Language (ESL) students in Malaysia often feel reluctant to participate in such language activities in the classroom (Jasman et al., 2023; Juin et al., 2021; Kamaruddin et al., 2021) especially when the activity requires writing as a part of the lesson. This will negatively affect students' language skills if it is not being controlled because language needs practice (Sajid & Anwar, 2022: Khanal & Sharma, 2021). This situation needs to be communicated to ensure speakers are able to thrive and flourish in their language skills. Interestingly, that same group of students who were reluctant to participate in the classroom writing activities are able to demonstrate their thoughts in English language through their social media posts. Many students have stated that they are comfortable to write their posts extensively in the English language and prefer that over their native language (Al Murshidi et al., 2024; Rusli et al., 2019; Suswati & Saleh, 2019) without concern for grammatical accuracy or structural correctness. This behavior suggests students are more inclined to

participate in writing activity when it is carried out in an authentic and personal context (Al Murshidi et al., 2024; Rusli et al., 2019; Suswati & Saleh, 2019). In that sense, teachers should incorporate authentic writing activities in the ESL classrooms in Malaysia as a practical outlet to practice the target language (Orooq, 2022; Handayani, 2020; Setyowati, 2019). In addition to giving learning a greater sense of purpose, these kinds of exercises assist students in seeing how applicable writing abilities are in the actual world.

The methods to learn language have evolved significantly in recent years especially when it comes to using the language in practical and real world situations (Yan, Zhang & Fan, 2022; Sukma et al., 2021). Therefore, language learning that incorporates authentic materials has the potential to make the process more engaging for the students. Food review writing, in particular, presents a unique opportunity for language learners to practice their language, especially writing skills. However, despite the growing interest in language learning through authentic materials (Mukhtarova, 2024; Mohammed, 2023; Domogen, 2023; Cao & Bui, 2023), there is a lack of exploring the impact of using food application as an authentic writing activity that targets English as a Second Language (ESL) students, especially in Malaysia. While several studies do focus on the use of authentic materials in language learning, there is no research examining how engaging with food application in writing activities might improve students' writing skills. This research gap has shown that there is a need to find practical and engaging methods to improve ESL students' writing skills. In order to bridge the gap between formal classroom instruction and real-world language use, it is important to address the lack of effective and engaging writing activities for ESL students. Traditional writing activities such as structured writings in the general English language classroom learning often fail to encourage students to participate during lessons. Without practical and real-world context, students could be lacking in the necessary skills to express themselves in the English language. This study aims to examine the effects of the structured food review writing technique on food application towards students' writing skills. This research seeks to answer the following research questions:

1. Does the experimental group perform better in the food review writing than the control group in the post-test after the intervention?
2. Does the food review writing performance of students in the experimental group improve after the intervention?

2 AUTHENTIC WRITING ACTIVITIES FOR ESL STUDENTS

Zhang and Zou (2020) and Manara (2020) stated that incorporating authentic learning activities can enhance students' writing skills as they feel more confident and engaged in the lesson. The students also exhibit better writing performance where they are able to use more vivid vocabulary and expressions.

2.1 Learning Language Through Authentic Materials and its impact on ESL students

Authentic learning materials are referring to materials that can easily be available in our daily lives, that are used and expressed by language users. For example, newspapers, pamphlets, brochures, signboards and podcasts. These materials present the target language in its natural forms and context which helps language learners to understand the language naturally. Thus, its integration in the classroom is needed to help the students to be involved and engaged in the lesson since they can witness the language purpose explicitly (Mitrulescu & Negoescu, 2024; Ryandani & Nurkamto, 2024; Handayani & Dewi, 2022) Past studies have discovered that language students are able to improve their vocabulary acquisition, cultural awareness and comprehension when engaging in authentic learning materials (Albiladi & El-Atawy, 2020). The finding is also supported by Chamba, Reinoso and Rengifo (2021) who found that the materials can enhance students' creativity, coherence and cohesion in expressing the language. Ramasamy et al. (2023) stated that the students' grammar and vocabulary are enhanced when engaging in essay writing whenever authentic materials are used in the classroom. In a study by Yavani (2022), the researcher highlighted that when authentic materials were used for students' writing activity, it was found that it benefited them with exposure to diverse language structures and rhetorical conventions. Despite these positive attributes, challenges remain in

implementing authentic materials. For teachers, they have difficulties defining what is considered authentic material and how to really carry it out in the classroom thus needing professional training to develop the lesson effectively. Students with lower proficiency level are more likely to struggle with their comprehension of the authentic learning materials, particularly its context, complex vocabulary, idiomatic expressions, and cultural nuances (Kaitarinne, 2025; Orooq & Abdel Razeq, 2022; Wulandari, 2019). Consequently, teaching techniques like scaffolding should be implemented by the teachers (adapting the texts, supporting the context of the text of the authentic material as well as during pre-teaching (Handayani & Dewi, 2020; Wulandari, 2018; Geisa, 2022). Eldydamouny (2022) highlighted that utilizing authentic materials in the classroom can also increase students' motivation during writing activities.

Interestingly, Khoiriyah (2021) and Nguyen and Khau (2020) authentic materials are reported to be contributing to ESL students' cognitive development. Activities with authentic materials often require the students to actively and constantly analyze, synthesize, and evaluate the information before they are able to produce the language output. This is thereby forcing the students to also engage in higher order thinking skills. Students are able to reflect on their opinions, connecting ideas and constructing arguments based on the real-world context. As observed by Kharisma and Wardhani (2021), students who engage in authentic materials for writing activities showed improved critical thinking and problem-solving skills compared to the students who only learn through conventional exercises. Moreover, the students who engage in authentic materials are more likely able to construct arguments with clarity and respond to counterpoints more effectively including with expressing it eloquently in their essays (Yulitriana, Imran, & Khaerunnisa, 2023). In conclusion, authentic materials are a useful tool in creating authentic and real-world learning experiences for the students that encourage the students to engage and participate in the lesson. It is beneficial in enhancing ESL students' language proficiency because it allows them to engage and motivate them in the context of practical application of language skills. Incorporating authentic materials

3 METHODOLOGY

The current study is carried out using the quasi-experimental design with pre-test and post-test to measure the impact of food review writing in a food app as an authentic writing activity for ESL students. The participants were segregated into an experimental group and control group where only the former received the treatment. Due to practical constraints, this pilot study applied a small sample size of participants that were chosen through a convenient sampling method. The participants consisted of six ESL lower secondary school students that were divided into experimental and control groups. Both groups have similar levels of language proficiency to ensure the differences of their writing performances are due to the treatment.

3.1 Data Collection Procedure

A pre-test was administered to both control and experimental groups before the first writing activity (Figure 1). The pre-test required the student to write an essay on the topic of "Describe your favourite dish" to gather the baseline writing skill of the participants. The essays were marked using the school-based assessments (Pentaksiran Bilik Darjah, PBD) marking scheme that was adapted from the Common European Framework of Reference for Languages (CEFR) writing scales. The components of the writing scales are content, style and tone, organisation and language. The experimental group received the treatment over two weeks comprising 4 authentic writing activities. Each writing activity was constructed for 45 minutes where the students used GrabFood application as sources and prompts for the authentic writing activities. Lesson plans have been constructed by the researcher to teach the writing activities that instructed the students to complete food writing review. The post-test was then conducted to both groups to evaluate any improvement made from the authentic writing activities.

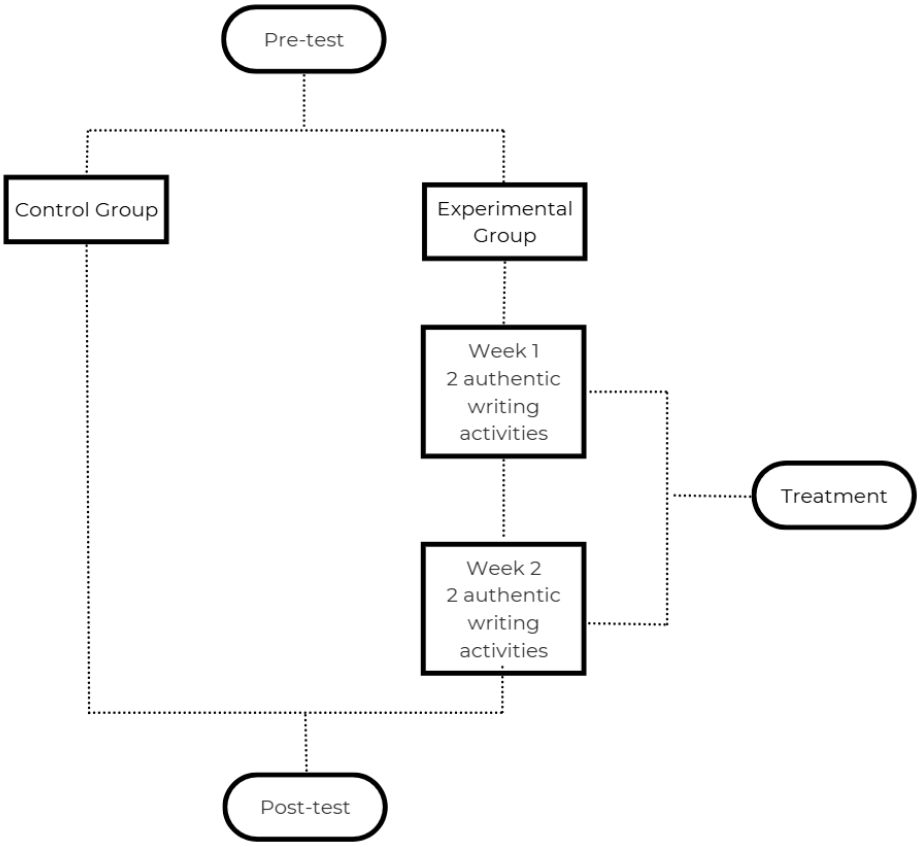


Figure 1: Data Collection Procedure

3.2 Data Analysis

To analyze the effectiveness of the treatment, the pre-test and post-test score of both the experimental and control groups were analyzed. Descriptive statistics of the mean and standard deviation of the writing test scores were compared accordingly. The current study conducted a paired sample t-test to determine whether there are significant improvements made by the experimental group after receiving the treatment and independent sample t-test to compare the writing performances between the experimental and control groups.

4 FINDINGS

The pre-test scores of the experimental group ranged from 56 to 71, with the mean score of 65.33 and a standard deviation (SD) of 8.14 (Table 1). After the treatment was administered, the post-test scores remained the same for two students while another one improved, resulting in the mean score of 68.67 and a standard deviation of 2.52. The pre-test scores of the control group ranged from 61 to 72, with the mean score of 64.67 and a standard deviation of 6.35. The post-test scores showed minimal changes, with a mean of 65.33 and a standard deviation of 5.86. To answer Q1, the results of the descriptive analysis indicates that there is a slightly greater difference in the experimental group compared to the control group. However, further analysis of the scores should be carried out to determine its impact on ESL students' language learning.

Table 1 Descriptive analysis of test scores

Group	Test	Mean Score	Standard Deviation (SD)
Experimental	Pre-test	65.33	8.14
	Post-test	68.67	2.52
Control	Pre-test	64.67	6.35
	Post-test	65.33	5.86

4.1 Inferential Analysis

An independent sample t-test was carried out (Table 2) using the post-test score of both groups to compare the impact of the treatment. The mean post-test score for the control group was 65.33, while for the experimental group was 68.67. The difference of 3.34 points favored the experimental group. However, the result of the independent sample t-test is not significant with $t(4) = 0.790$, $p = 0.470$. This means the difference between the results cannot be confidently classified as a true effect of the treatment due to the sample size and potential variability.

Table 2 Independent sample t-test

Test	Group	t	df	Sig. (2-tailed)	Mean Difference
Independent Sample T-Test	Experimental vs Control (Post-test)	0.790	4	0.470	3.33

Based on the previous analysis, the post-test scores of the experimental group (M=68.67) was slightly higher than the pre-test scores (M=65.33) with a mean increase of 3.34 points. The increase suggests that authentic materials have positive effects on students' writing performance. However, the paired sample t-test (Table 3) showed that the treatment was not statistically significant, $t(2) = 1.000$, $p = 0.422$. Despite having the observable increase in the test scores, the results of the t-test could be influenced by the small sample size and the variability in students' writing performances. For the control group, there was only a minimal increase in the mean scores between both tests, the group yielded a non-significant result of $t(2) = 1.000$, $p = 0.422$, which indicates non changes of the writing performances for the group. To answer Q2, the findings suggest that the slightly greater improvements between the tests' scores have limited the ability to detect their significant differences due to the small sample size.

Table 3 Paired sample t-test

Group	Test Pair	Mean Difference	t	df	Sig. (2-tailed)
Experimental	Pre-test vs Post-test	3.33	1.000	2	0.422
Control	Pre-test vs Post-test	0.67	1.000	2	0.422

5 CONCLUSION

In conclusion, the slightly better improvement of the results cannot be interpreted as the impact of the food writing review in the food application as an authentic writing activity for ESL students. Due to the small number of students in each group, the results of the analysis were very limited, resulting in the difficulty to detect any significant differences in the tests. However, the findings should not be

disregarded because of the limitation of the sample size. This is because, in a real classroom environment, slight improvement of students' writing performance can be meaningful, especially when the activity is able to increase students' engagement, class participation, and confidence in writing. Moreover, the use of food application for authentic writing activity of the food review can be a practical and innovative source for the teachers to be used in their classroom. Despite the missing significant differences in the statistical evidence, there are positive improvements observed in the descriptive analysis. The potential that the food review writing in the food application has, deserves future study where the sample size of the students should be larger to increase the result of statistical analysis.

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Kelulut Sparkling: A STEM-Based Experiential Learning Module on Functional Beverage Innovation

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ABSTRACT

Innovative approaches in education are essential to connect scientific learning with sustainability, health, and real-world relevance. This STEM-based experiential learning module addresses 4IR challenges by fostering critical thinking, interdisciplinary innovation, and real-world problem-solving, aligning with the era's push toward educational excellence through sustainable, health-conscious, and technology-integrated learning. This paper presents a STEM-based experiential learning module centered on the formulation of a functional beverage, Kelulut sparkling, using stingless bee honey as a core ingredient. This module helps students learn through hands-on activities that combine science with health and sustainability, focusing on food chemistry, biotechnology, and creating new products from Kelulut. Driven by the rise of non-communicable diseases (NCDs) linked to high sugar intake, this project introduces Kelulut honey as a healthier natural sweetener with a low glycemic index, rich in antioxidants and trehalulose. Honey from three stingless bee species i.e., *Geniotrigona thoracica, Heterotrigona itama,* and *Tetragonula laeviceps*, was tested for pH, viscosity, phenolic content, and antioxidant activity. Students created five honey-based sparkling drink variants, evaluated for taste and storage quality, with the top choice receiving an overall score of 4.7 out of 5. This hands-on, cross-disciplinary project not only built students' scientific and critical thinking skills, but also exposed them to sustainable food innovation and entrepreneurship. Supporting SDGs 3, 4, and 12, the module offers a practical and adaptable approach to enhance school curricula and engage communities.

KEYWORDS: STEM education; Stingless bee honey; Functional beverage; Experiential learning; Food science; Sustainable development

1 INTRODUCTION

Contemporary science education must evolve beyond textbook-based instruction to address complex, real-world challenges faced by society today. In this light, STEM (Science, Technology, Engineering, and Mathematics) education plays a vital role in cultivating interdisciplinary thinking, scientific literacy, and practical problem-solving skills among students (Bybee, 2013; National Research Council, 2012).

One such issue is the rising burden of non-communicable diseases (NCDs) in Malaysia and globally, particularly obesity, type 2 diabetes, and cardiovascular diseases linked to lifestyle factors including poor nutrition, high sugar intake, and lack of dietary awareness. Alarmingly, Malaysia has one of the highest rates of diabetes in Southeast Asia, with increasing prevalence among younger populations (Institute for Public Health Malaysia, 2020; Ismail et al., 2002). This calls for not only health interventions but also innovative educational initiatives that empower youth to critically evaluate

food systems and understand the relationship between diet, disease, and sustainability (Norliza, Norfadhilah, & Zalilah, 2019).

Global movements such as the United Nations Sustainable Development Goals (SDGs) have emphasized the need for sustainable food innovation, responsible consumption, and the valorization of local bioresources. SDG 3 (Good Health and Well-being) and SDG 12 (Responsible Consumption and Production) both highlight the urgent need for food products that are both health-promoting and environmentally responsible. Within the Malaysian context, stingless bee honey, locally known as 'madu kelulut', offers significant potential in this regard. Derived from native bee species such as *Geniotrigona thoracica, Heterotrigona itama, and Tetragonula laeviceps*, kelulut honey is prized not only for its unique taste but also for its functional bioactive profile. It contains trehalulose, a rare disaccharide with a low glycemic index and promising anti-diabetic, antioxidant, and antimicrobial properties (Chuttong et al., 2016).

This paper presents the development and implementation of an interdisciplinary STEM-based learning module titled Kelulut Sparkling, which centers around the formulation of a functional carbonated beverage using stingless bee honey. The module is designed to foster scientific literacy, creativity, and entrepreneurship among secondary school students and community learners. Through classroom-based experiments, students explore the physicochemical properties of different honey samples, engage in formulation trials using natural herbs and fruits, perform sensory evaluations, and learn food safety and product stability testing. The initiative serves as a platform to promote health education, introduce concepts of local resource utilization, and cultivate socio-scientific responsibility through a culturally relevant and community-embedded approach. In doing so, it showcases how food innovation can serve as a transformative educational tool aligned with national policy and global sustainability priorities.

2 MATERIALS AND METHODS

2.1 Module Framework and Target Audience

The Kelulut Sparkling module was implemented with participants/students as shown in Figure 1. Activities were designed to develop critical thinking, analytical testing, and product innovation skills. The module included laboratory-based experiments, group discussions, and a market survey. Instruction was guided by experiential learning cycles, students observed, conceptualized, experimented, and reflected on their learning through scaffolded instruction and peer collaboration.

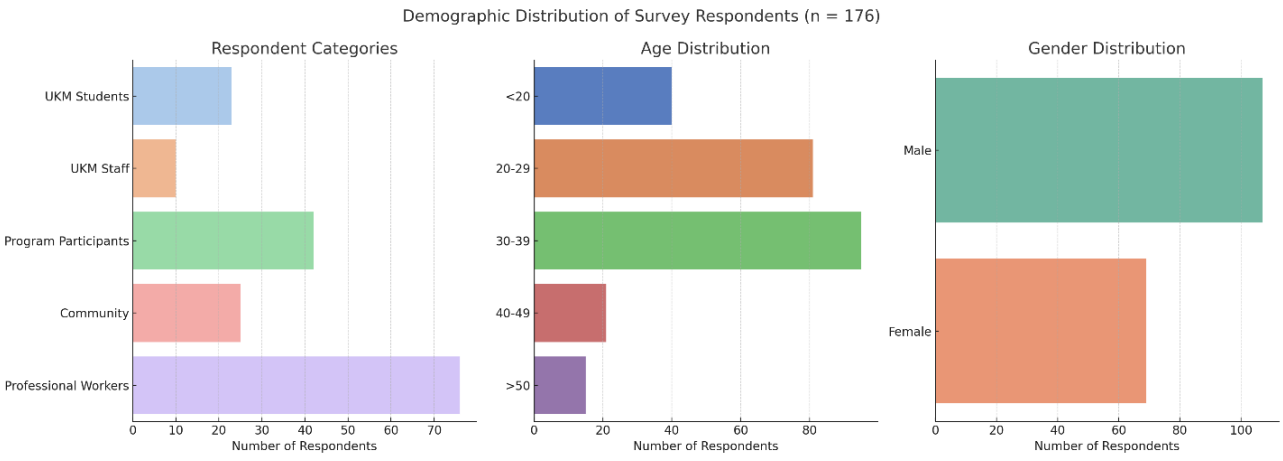


Figure 1. Demographic distribution of survey respondents (n = 176).

2.2 Honey Sourcing and Analysis

Raw stingless bee honey from *Geniotrigona thoracica*, *Heterotrigona itama*, and *Tetragonula laeviceps* was procured from certified Malaysian beekeepers. Samples were analyzed for pH using a digital pH meter, viscosity using a Brookfield viscometer, total phenolic content using the Folin-Ciocalteu assay, antioxidant activity measured as percentage DPPH inhibition, and trehalulose content using high-performance liquid chromatography (HPLC).

2.3 Beverage Formulation

Five sparkling drink prototypes were developed by students using a standardized base composed of 15% (w/v) kelulut honey, 5–8% lemon or lime juice, selected herbs such as mint, roselle, or strawberry, apple and carbonated water. Citric acid was used to stabilize the pH within the range of 3.2 to 3.8. Carbonation was achieved using manual CO_2 infusion bottles. All samples were stored at 4°C and monitored for visual appearance, aroma, and carbonation stability over a seven-day period.

2.4 Preliminary Sensory Testing

A preliminary sensory evaluation was conducted with 30 participants aged 13–40 from a community-based intervention program. Each formulation was rated for color, aroma, taste, and overall acceptability using a five-point hedonic scale. Food safety protocols were followed, including microbial swab tests and hygiene checklists.

2.5 Consumer Survey

A broader survey was conducted to assess consumer flavor preferences and price expectations (n = 176). Respondents included students, university staff, professionals, and members of the community. Each respondent tasted six variants: Herbal & Fruit, Mint & Lemon, Peach & Passionfruit, Apple, Roselle, and Strawberry. Flavors were rated on a five-point Likert scale. At the final stage of the module, participants created new products using kelulut honey and were asked to suggest a suitable price for a 200 mL bottle, choosing from options below RM10 to above RM20.

3 RESULTS AND DISCUSSION

3.1 Physicochemical Characterization of Stingless Bee Honey

The physicochemical properties of honey from three stingless bee species are summarized in Table 1. Among the samples, *G. thoracica* exhibited superior bioactive properties, including the highest trehalulose content (26.3%) and antioxidant activity (66.8% DPPH inhibition). All three species displayed acidic pH values (3.3–3.7), which are consistent with antimicrobial stability and characteristic of stingless bee honey (Chuttong et al., 2016; Biluca et al., 2016). Viscosity varied from 360 to 480 cP, influenced by floral sources and moisture content.

Notably, the phenolic content ranged between 47.1 and 58.2 mg GAE/100g, highlighting the honey's strong antioxidant potential, especially for *G. thoracica*. These findings support the integration of kelulut honey as a functional ingredient in beverage applications, particularly for health-conscious and diabetic-friendly product lines due to the presence of trehalulose, a rare sugar with a low glycemic index (Bragagnolo et al., 2021), and antioxidant properties (Ferreira et al., 2018). Figure 2 shows the antioxidant and phenolic content of stingless bee honey.

Table 1. Physicochemical properties of stingless bee honey

Species	pH	Viscosity (cP)	Trehalulose (%)	Phenolic (mg GAE/100g)	Antioxidant (% DPPH)
Geniotrigona thoracica	3.3	480	26.3	58.2	66.8
Heterotrigona itama	3.5	410	24.1	51.6	58.3
Tetragonula laeviceps	3.7	360	20.9	47.5	49.3

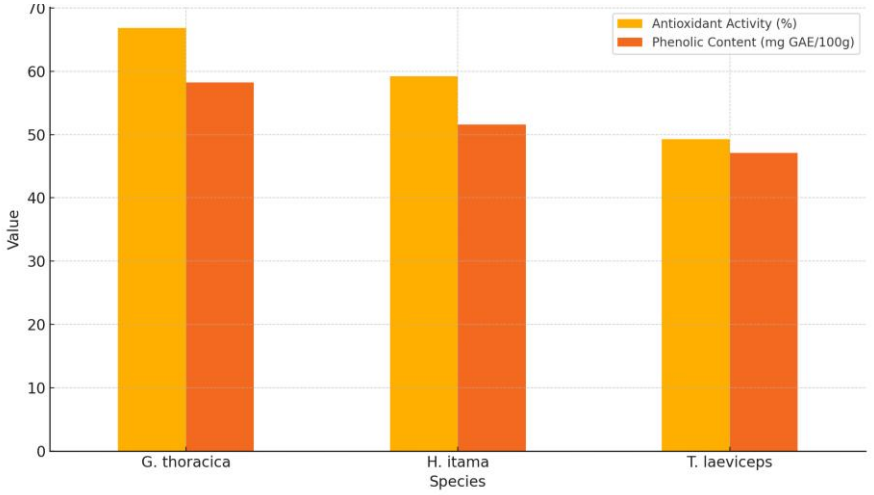


Figure 2. Antioxidant and phenolic content of stingless bee honey from three species.

3.2 Beverage Sensory Evaluation and Product Optimization

Among five student-formulated variants, the lime-mint-honey blend emerged as the most acceptable, receiving a high hedonic score of 4.7/5 for flavor, aroma, and overall palatability. The combination of citrus acidity and mint freshness was particularly well-received, suggesting that flavor balance is a key driver of consumer liking in beverage design (Spence, 2015). All beverages showed stability over a 7-day refrigerated storage period, retaining carbonation, clarity, and aroma, indicating suitability for local-scale distribution or school-based microenterprise ventures (KPM, 2021). Table 2 summarizes the 7-day stability and sensory acceptance of five honey-based beverage prototypes, formulated using stingless bee honey with added herbs and fruit extracts.

Table 2. Sensory evaluation summary of student-formulated kelulut sparkling beverage variants

Formulation	Flavor	Aroma	Overall Acceptability
Lime + Mint + Honey	+++	+++	+++
Roselle + Honey	++	++	++
Peach + Passionfruit + Honey	++	++	++
Lime + Ginger + Honey	+	+	+
Cucumber + Mint + Honey	+	+	+

"+++" indicates excellent or highly favorable response, "++" indicates moderate, and "+" indicates minimal but acceptable scores.

3.3 Consumer Preference Survey

Figure 3 presents the flavor preferences for six variants of Kelulut Sparkling Drink based on responses from 176 participants using a 5-point Likert scale. The vertical bars show the distribution of ratings across flavors from "1 (Dislike)" to "5 (Like Very Much)". Results from the broader consumer survey (n = 176) revealed that Peach & Passionfruit received the highest combined count of favorable ratings (scores 4 and 5), indicating it was the most liked flavor overall. This was followed closely by Roselle, which also showed strong positive perception. Herbs & Fruits and Strawberry recorded moderate acceptance, with a significant portion of neutral (score 3) responses, suggesting that they were generally well-received.

On the other hand, Mint & Lemon had the largest number of low ratings (scores 1 and 2), with over half of its responses falling into the "Slightly Dislike" and "Dislike" categories. Apple flavor was somewhat polarizing, with noticeable peaks in both high (4, 5) and low (2) ratings, indicating mixed opinions among respondents. This analysis reveals that flavors combining sweetness and acidity (e.g., peach & passionfruit, roselle) tend to be better received, while sharper or herbal blends may require further formulation adjustment to suit general consumer preferences (Lim & Othman, 2020; Tuorila & Monteleone, 2009).

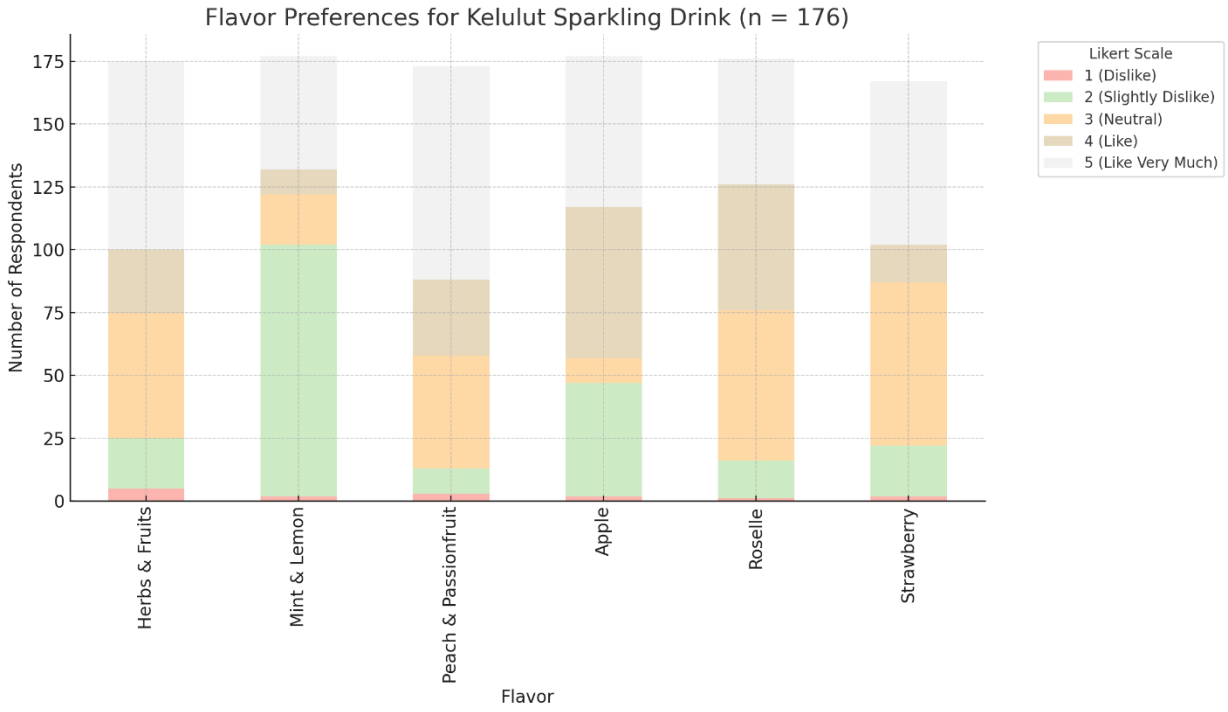


Figure 3. Respondents' preference for different Kelulut sparkling drink flavors based on a 5-point Likert scale (n = 176). Roselle and Peach & Passionfruit received the highest overall likability scores.

This highlights the importance of harmonizing herbal components during formulation. These results offer valuable insights into consumer behavior and can guide formulation decisions to enhance product appeal for broader market introduction.

3.4 STEM Learning Outcomes and Community Impact

Students and facilitators observed greater interest and involvement in STEM topics like fermentation, food safety, and basic lab analysis. The hands-on, cross-disciplinary approach sparked curiosity, encouraged teamwork, and inspired creative thinking, especially in exploring healthy food innovation (Honey et al., 2014). Learning about stingless bee farming and sustainable agriculture also

helped students connect science with real-life community values, making the Kelulut Sparkling module a useful model for education that combines science, health, and local wisdom (Bybee, 2013; UNESCO, 2020).

Table 1 shows the properties of kelulut honey from three species. *G. thoracica* had the highest trehalulose content (26.3%) and antioxidant activity (66.8%), followed by *H. itama* and *T. laeviceps*. All honeys had a low pH (3.3–3.7), which helps preserve freshness and prevent microbial growth. Viscosity varied between 360–480 cP depending on water content. The honey also showed good antioxidant strength, especially from *G. thoracica*. The presence of trehalulose, a natural low-glycemic sugar, makes this honey suitable for diabetic-friendly drinks.

Out of five beverage recipes, the lime-mint version scored highest in taste and aroma (4.7/5). Its balance of citrus and herbal notes was well liked. The drink stayed fresh, bubbly, and aromatic after 7 days in the fridge, showing good shelf stability for local use.

Figure 1 shows the antioxidant and phenolic levels of the honeys, while Figure 3 displays the taste ratings for six drink flavors from 176 respondents. Roselle and Peach & Passionfruit were top favorites, with many respondents giving high scores. Roselle's floral-tangy profile matched well with the natural tartness of kelulut honey. Peach & Passionfruit was also liked for its fruity, fragrant taste. In contrast, Mint & Lemon received mixed feedback, with many neutral or low scores, likely due to the strong mint flavor. Apple and Herbs & Fruits received moderate responses, showing they were acceptable but less popular.

These findings highlight how flavor balance affects consumer preference and provide useful guidance for improving the drink before market release. The overall project helped students learn about science and sustainability while creating real food products with future potential.

4 CONCLUSION

The Kelulut Sparkling module successfully integrates STEM education with hands-on learning, functional food innovation, and public health awareness. The use of locally sourced stingless bee honey, rich in trehalulose and antioxidants, offered students a real-world context to explore science and sustainability. The module enhanced scientific engagement, improved student understanding of food safety and product design, and introduced foundational skills in entrepreneurship. By aligning with SDGs 3, 4, and 12, the program demonstrates how experiential education can serve both academic and community objectives. Future work may explore scaling the module across schools and assessing long-term impacts on health knowledge and career interest in STEM.

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Exploring Lower Form ESL Students' Perceptions, Motivations, and Attitudes Towards English Literature as a Medium for Critical Thinking Through Writing Skills

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ABSTRACT

This study explores the perceptions, motivations, and attitudes of lower-form ESL students in Malaysia toward learning English Literature, focusing on its potential to enhance critical thinking through writing. The research highlights the role of literature in supporting second language acquisition and fostering analytical thought. Despite its value, outdated teaching methods continue to limit its effectiveness in ESL classrooms. Adopting a quantitative approach, data were collected via a Google Forms questionnaire administered to lower-form ESL students. The findings reveal that exposure to literary texts positively influences students' critical thinking and writing skills, promoting interpretation, reasoning, and reflection. The study supports the integration of literature into the ESL curriculum to strengthen both language proficiency and cognitive development. It recommends future research on incorporating diverse literary texts and learner-centred strategies to improve engagement and learning outcomes in ESL education.

KEYWORDS: English literature, critical thinking, secondary education, English as Second Language (ESL), ESL learners' English language learning, student attitudes

1 INTRODUCTION

The ability to think critically and express ideas effectively through writing is a crucial component of academic success, particularly for English as a Second Language (ESL) students. English Literature, as a pedagogical tool, offers unique opportunities to develop these competencies by encouraging learners to interpret texts, analyse themes, and engage with diverse cultural perspectives. In the Malaysian context, literature is an essential component of the English language curriculum, yet its implementation in lower secondary classrooms remains a challenge due to outdated pedagogical approaches and varying students' proficiencies.

According to Shahab (2020), English Literature comprises written works of artistic and cultural value that serve not only to entertain but also to cultivate reflective thinking. Literature instruction, when strategically designed, can enhance ESL learners' proficiency in reading and writing while fostering skills such as evaluation, interpretation, and empathy. This aligns with global shifts in education that emphasise cognitive development through student-centred learning. In Malaysia, Carter and Long's (1992) three models of teaching literature, comprising the cultural, language, and personal

growth models, are often employed to address different instructional needs. These models aim to improve students' grammatical and lexical knowledge, connect literary content to students' personal experiences, and broaden their cultural understanding.

Despite these frameworks, literature instruction in many classrooms remains teacher-centred and limited its ability to motivate critical thinking. To address this gap, the present study investigates how English Literature can serve as an effective medium for developing critical thinking through writing among lower secondary ESL students. The study also examines students' perceptions, motivations, and attitudes towards literature and identifies key challenges they face in literary engagement.

To achieve these objectives, a quantitative survey design was adopted, using a structured questionnaire distributed to 27 ESL students in Form One to Form Three at Sekolah Menengah Kebangsaan (SMK) Tumpat, Kelantan. The study is guided by Herzberg's Two-Factor Theory, which frames intrinsic and extrinsic motivations as central to student engagement and cognitive development.

2 LITERATURE REVIEW

2.1 English Literature and English as a Second Language (ESL)

English Literature refers to a body of written works in the English language known for their artistic merit and cultural significance across genres such as poetry, drama and fiction (Baba, 2022). The study of literature involves interpreting texts within historical, social, and cultural contexts (Shahab, 2020), fostering deeper engagement with language and meaning.

For ESL learners, English Literature serves dual purposes: improving language proficiency and enriching cognitive and emotional development. ESL, defined as the study and use of English by non-native speakers in primarily English-speaking environments, focuses on developing reading, writing, listening, and speaking skills (Nurishka, 2021). When incorporated into ESL instruction, literature becomes a dynamic tool to expose learners to authentic language, idiomatic expressions, and diverse worldviews. According to Zuhaimi and Abdullah (2023), literature supports language acquisition by promoting empathy, cultural sensitivity and reflective learning. These are the key attributes for holistic development.

2.2 Critical Thinking and Writing Skill

Critical thinking is broadly defined as the capacity to analyse, evaluate, and synthesise information to make reasoned judgments or solve problems (Mogea, 2022). It involves not only logical reasoning but also creative and reflective thought. Writing, on the other hand, is a productive skill that enables individuals to convey ideas clearly and coherently. It demands an understanding of purpose, audience, structure, and tone, which are essential for effective communication.

The process of writing encourages learners to externalise their thoughts, question assumptions, and build arguments based on evidence. Setiawan (2019) emphasises that writing is not merely a linguistic act but a cognitive one, prompting critical engagement with ideas. Furthermore, writing in response to literary texts sharpens interpretations, encourages analysis of moral and thematic elements, and fosters independent thinking (Ortiz, 2023). However, ESL students often face difficulties in writing due to limited vocabulary, grammatical challenges, and fear of making mistakes, which can inhibit both expression and confidence.

2.3 Advantages of English Literature

English Literature plays a significant role in enhancing ESL students' linguistic and cognitive competencies. Hashim and Abd Talib (2019) argue that literature provides meaningful context for language without isolating grammar instruction. Through narrative structure, literary texts expose students to vocabulary, syntax, and discourse in authentic settings. Additionally, literature fosters cultural awareness, empathy, and personal growth. Ling and Siew Eng (2016) note that engaging with literary texts allows learners to navigate diverse cultural perspectives and historical contexts, which can broaden their worldview and develop global competencies. Literature also cultivates self-awareness by encouraging learners to connect personal experiences with universal themes. In the context of 21st-century education, English Literature aligns with the development of Higher-Order Thinking Skills

(HOTS), offering opportunities for critical evaluation, creativity, and reflective thinking (Zuhaimi and Abdullah, 2023).

2.4 Challenges in Teaching English Literature to ESL students

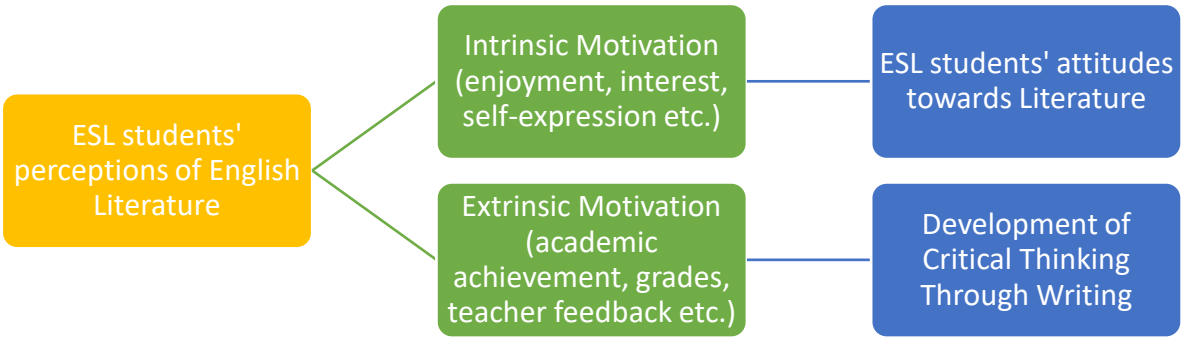
Despite its pedagogical benefits, several challenges hinder the effective use of English Literature in ESL classrooms. Many teachers report feeling unprepared to teach literature using interactive or student-centred approaches, often resorting to lecture-based methods that reduce student engagement (Zuhaimi and Abdullah, 2023). This lack of instructional innovation contributes to negative perceptions of literature among students, who may find it abstract, irrelevant, or linguistically inaccessible.

Low English proficiency remains a significant barrier. Literary texts frequently contain complex vocabulary, figurative language, and cultural references that ESL learners struggle to comprehend. Cultural disconnects, especially with Western texts, further impede students' ability to relate to characters or narratives, diminishing motivation and critical responses (Baba, 2022).These issues, combined with rigid curricula and limited class time, create a disengaging learning environment where the cognitive benefits of literature are not fully realised.

2.5 Theoretical Framework

This study adopts Herzberg's Two-Factor Theory of Motivation to explore how intrinsic and extrinsic motivational factors influence ESL students' engagement with English Literature and the development of critical thinking through writing.

Figure 2.5.1 Theoretical Framework



The framework is anchored on three guiding research questions:

1. What are lower secondary ESL students' perceptions, motivations, and attitudes towards English Literature as a tool for developing writing and critical thinking skills?
2. What are the challenges faced by lower-form students in engaging with English Literature?
3. How do students demonstrate critical thinking through writing tasks based on literary texts?

Herzberg's theory, originally developed to explain workplace motivation, distinguishes between hygiene factors (extrinsic) and motivators (intrinsic). In this educational context, extrinsic factors such as grades and teacher approval may prompt engagement, while intrinsic factors like enjoyment and personal connection with texts sustain deeper learning. This dual-layered motivational model helps explain the complex relationship between literature engagement and the development of critical writing and thinking skills among ESL students (Baba, 2022).

3 METHODOLOGY

This study adopted a quantitative survey research design to investigate the perceptions, motivations, and attitudes of lower-form ESL students towards learning English Literature as a means to develop critical thinking through writing. The research was conducted at Sekolah Menengah Kebangsaan (SMK) Tumpat, Kelantan, involving a sample of 27 students from Form One until Form Three, selected through simple random sampling to ensure fair representation. Data were collected using a structured online questionnaire distributed via Google Form over a 10-day period. The instrument consisted of 28 Likert-scale items grouped into four sections: students' perceptions of English Literature, motivational factors (intrinsic and extrinsic), attitudes towards literary learning and the development of critical thinking through writing activities. To complement the quantitative data, an additional set of eight open-ended questions was included to gather in-depth responses related to the challenges faced by students, particularly in relation to the second research question. These qualitative responses were thematically analysed, while descriptive statistics were used to interpret the quantitative data. The integration of both closed and open-ended items allowed for a more comprehensive understanding of students' engagement with literature and strengthened the validity of the findings. This methodological approach aligns with Budert-Waltz (2021), who emphasises the utility of survey research in identifying trends, exploring learner behaviour, and informing pedagogical interventions in educational contexts.

4 RESULTS AND DISCUSSIONS

Table 1 ESL students' perceptions towards English Literature

No.	Items	Mean	Strongly Agree Frequency / %	Agree Frequency / %	Neutral Frequency / %
	Learning English Literature:				
1	Helps me to improve my English Proficiency, particularly in writing	4.04	7 (25.9%)	14 (51.9%)	6 (22.2%)
2	Enhances my cultural awareness and understanding of multiple perspectives	3.85	2 (7.4%)	19 (70.4%)	6 (22.2%)
3	Improves my personal, intellectual, and emotional growth	3.78	7 (25.9%)	10 (37.0%)	7 (25.9%)

N = 27					

The findings of this study indicate that lower-form ESL students generally responded positively to the inclusion of English Literature as a tool for developing critical thinking through writing. A majority of respondents agreed that literature enhanced their cultural awareness (70.4%), improved their writing proficiency (70.4%), and supported their personal, intellectual and emotional growth (51.9%). These results underscore the role of literature in promoting self-reflection, multicultural understanding, and expressive clarity, which are the key components of higher-order thinking.

Table 2 ESL students' critical thinking development

No.	Items	Mean	Strongly Agree Frequency / %	Agree Frequency / %	Neutral Frequency / %
	English Literature class improves critical thinking when:				
1	I can analyse literary texts thoroughly and communicate my thoughts clearly in writing	3.60	3 (11.1%)	13 (48.1%)	8 (29.6%)
2	I understand the themes and moral values and reflect them in my writing	3.78	6 (22.2%)	11 (40.7%)	8 (29.6%)
N = 27					

Furthermore, 48.1% of students reported that they were able to analyse literary texts and express their thoughts clearly in writing. In comparison, 40.7% noted their ability to reflect on themes and moral values in written form, highlighting the cognitive benefits of literary engagement. These outcomes are consistent with the pedagogical approaches proposed by Ling and Siew Eng (2016), who advocate for literature-based teaching models that address cultural, linguistic, personal growth and moral development.

Despite these positive trends, the study also revealed five significant challenges that hinder students' deeper engagement with literary texts: limited English proficiency, cultural disconnects, lack of motivation, restrictive learning environments, and underdeveloped literary analytical skills. Many students struggled with complex vocabulary, archaic language, and unfamiliar historical or social references, often leading to disengagement.

Additionally, the passive, teacher-centred classroom environment and time constraints reduced opportunities for meaningful interaction with the texts. These barriers negatively impacted students' confidence and willingness to participate in discussions or express their interpretations. When considered through Herzberg's Two-Factor Theory, such as demotivating factors, especially language and cultural obstacles, were found to suppress intrinsic and extrinsic motivation, limiting the

development of critical thinking skills. As a result, while literature has proven potential to cultivate deeper thinking in ESL contexts, its effectiveness is contingent upon learner readiness, instructional approach and contextual support within the classroom.

5 RECOMMENDATIONS

The findings of this study underscore the importance of integrating English Literature into the ESL curriculum as a means to cultivate critical thinking and enhance writing skills. To optimise its impact, educators show adopt student-centred, inquiry-based approaches that move beyond traditional teacher-led methods. Incorporating a wider range of literary texts that reflect both local and global contexts can increase cultural relevance and foster greater student engagement. Reflective writing, creative responses, and analytical tasks should be embedded into lessons to promote deeper comprehension and expression. Additionally, professional development programs are necessary to support teachers in delivering literature instruction that is both accessible and intellectually enriching. Curriculum designers are encouraged to develop assessment frameworks that value interpretive insight and personal engagement, not just linguistic accuracy. Future research should examine the long-term effects of literature-based instruction on ESL learners' cognitive and linguistic development, particularly through targeted interventions addressing the specific challenges identified in the study.

6 CONCLUSION

This study successfully achieved its objectives by demonstrating that English Literature can serve as a valuable medium for enhancing critical thinking through writing among lower-form ESL students. The findings revealed that students generally held positive perceptions and attitudes towards literature, recognising its potential to improve their writing proficiency, cultural awareness, and cognitive engagement. However, the research also uncovered several barriers to effective literary learning, including language difficulties, cultural disconnection, low classroom engagement, and limited analytical skills. These challenges highlight the urgent need for instructional reforms prioritising learner-centred, culturally responsive approaches. Moreover, Herzberg's Two-Factor Theory offered insights into the motivational dynamics affecting ESL students, showing how extrinsic barriers and insufficient intrinsic stimulation can inhibit deeper learning outcomes. In light of these findings, educators and policymakers are encouraged to integrate diverse, relatable literary texts into ESL curricula and adopt pedagogical strategies that actively support critical thinking development. Future research could explore the longitudinal effects of literature-based instruction on writing proficiency and investigate the impact of targeted interventions that address the specific challenges identified in this study.

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The Smart Studio: Architectural Learning in The Digital Age

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ABSTRACT

The Smart Studio: Architecture Learning in the Digital Age explores the transformative role of Information and Communication Technology (ICT) in reshaping architectural education. As design pedagogy shifts toward digitally integrated environments, this study investigates how smart technologies, such as AI-assisted tools, Building Information Modelling (BIM), and immersive virtual platforms, enhance creativity, critical thinking, and collaborative learning. Drawing on case studies, student feedback, and expert interviews, the research identifies emerging digital competencies and evaluates their impact on studio-based learning experiences. The findings reveal that ICT integration not only improves design efficiency and visualization but also fosters inclusive adaptive, and future-ready architectural education. This research advocates for a pedagogical shift toward a “Smart Studio” model that bridges traditional design methods with advanced digital innovation, positioning future architects to meet to demands of a rapidly evolving built environment. The study contributes to the discourse on sustainable, technology-driven learning ecosystems in architectural education.

KEYWORDS: Smart Studio, Architectural Education, Digital Technology, Design Pedagogy, ICT Integration

1 INTRODUCTION

Architectural education is undergoing a significant transformation with the advent of digital technology. Traditionally reliant on studio-based, face-to-face interaction, the field is now embracing smart technologies to enhance pedagogy and design practice. The COVID-19 pandemic accelerated this shift, compelling educators and institutions to adopt virtual platforms and digital tools. The concept of the "Smart Studio," a technology-augmented learning space, has emerged as a central framework in this evolution. This paper aims to examine the integration of smart technologies within architectural education and explore their implications for pedagogy, student engagement, and future professional practice.

2 LITERATURE REVIEW

Malaysia's rapid urbanization demands innovative architectural solutions for sustainable development. The Smart Studio model aligns with emerging concepts like Ecological Intelligence Buildings (EIBs) (Aziz, S. et al., 2025) and Architectural Intelligence (ArcAI), which integrate nature, data, and AI to improve energy use, indoor health, and climate adaptation. These approaches, especially relevant in Malaysia's tropical context, foster smarter design thinking and environmental sensitivity in students. Incorporating ArcAI into design education equips future architects with tools for real-time decision-making and predictive planning essential for digital-age sustainable urbanism (Aziz, S. et al., 2024).

The integration of digital technologies in architectural education has been extensively documented in recent literature. Key technologies such as Building Information Modelling (BIM), virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) have redefined the learning environment.

For example, Chien & Wang (2021) highlight how BIM enhances collaboration and visualization in design studios. Similarly, Ahmad et al. (2022) emphasize the role of AI-assisted design tools in promoting critical thinking and design iteration. Furthermore, VR and AR technologies offer immersive experiences that simulate real-world environments, supporting experiential learning (Schnabel, 2020).

The table below presents a systematic literature review of 15 peer-reviewed articles published between 2020 and 2025 (Table 1).

Table 1 Systematic Review of ICT Integration in Architectural Education (2020-2025) (Salmiah Aziz, 2025)

No	Author(s) & Year	Title	Focus Area	Findings
1	Chien & Wang (2021)	BIM in Design Education	BIM, Collaboration	Improves collaborative design and visualization
2	Ahmad et al. (2022)	AI in Architecture	AI, Creative Thinking	AI tools support iterative design processes
3	Schnabel (2020)	Virtual Design Studios	VR, AR	Enhances spatial understanding and realism
4	Lee et al. (2023)	Smart Learning Environments	ICT, Smart Studio	Increases engagement and interactivity
5	Hassan & Othman (2024)	Hybrid Studios Post-COVID	Online Studio Models	Combines physical and digital pedagogies
6	Alsharif et al. (2021)	Student Perceptions on ICT	Student Feedback	Positive attitudes toward ICT-enhanced learning
7	Rahmat & Fauzi (2020)	BIM and Sustainability	BIM, Sustainability	BIM supports environmental awareness
8	Tan et al. (2023)	Digital Competencies	Digital Literacy	Identifies core digital skills in architecture
9	Goh et al. (2022)	AI for Conceptual Design	AI, Design Tools	AI fosters conceptual innovation
10	Lim & Abdul Karim (2021)	Design Studio Culture	Smart Studio	Shift in studio dynamics with tech integration
11	Müller et al. (2024)	Extended Reality in Studios	XR, Engagement	XR increases immersion and learning retention
12	Nordin et al. (2020)	Remote Studio Challenges	Online Learning	Technological gaps affect equity in access
13	Tan & Aziz (2022)	Pedagogical Innovation	Blended Learning	Smart pedagogy improves learning outcomes
14	Chong et al. (2025)	Smart Studio Framework	Digital Integration	Proposes Smart Studio model
15	Yusof et al. (2021)	ICT Tools Evaluation	Tool Usability	Assesses effectiveness of various digital tools

3 METHODOLOGY

This study employed a mixed-methods approach to investigate the perceptions and recommendations of architecture students regarding the future of model-making and prototype construction in a digital learning environment, within the framework of the Smart Studio. A total of 110 students from the Faculty of Architecture and Ekistics comprising architecture, interior architecture,

and landscape architecture programs participated in an open-ended online survey (Figure 1). The qualitative component of the study was analysed using thematic analysis, a widely recognized method for identifying, analysing, and reporting patterns within qualitative data (Braun & Clarke, 2006).

Open-ended responses were coded inductively, enabling emergent themes to be grouped into broader categories reflecting students' needs, frustrations, and aspirations. The thematic analysis process followed six core steps: data familiarization, initial code generation, theme searching, theme reviewing, theme defining/naming, and final reporting (Nowell et al., 2017). The thematic technique ensures reliability and depth in interpreting open-response data, especially within educational contexts (Javadi & Zarea, 2016).

Quantitative responses were analysed using descriptive statistics, such as frequency and percentage distribution, to capture trends in student perceptions. This helped contextualize the qualitative themes and provided a broader understanding of architectural students' expectations in the digital era.

The combination of qualitative and quantitative data strengthens the credibility and applicability of the findings for developing a Smart Studio framework (Vaismoradi et al., 2016; Guest, MacQueen & Namey, 2012).

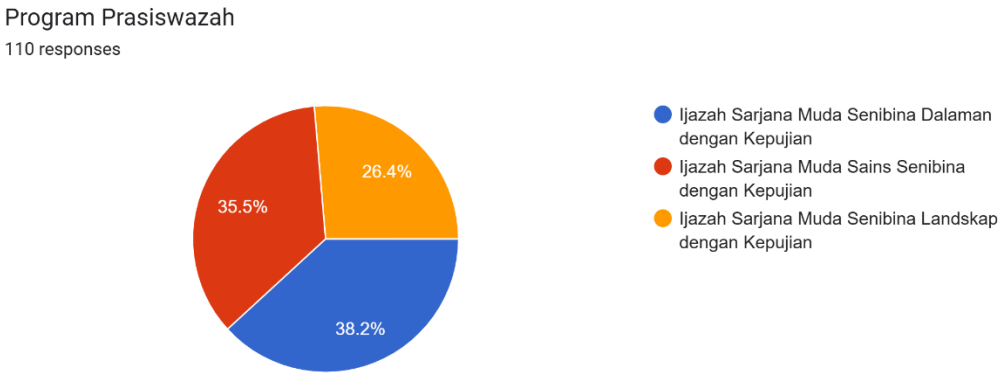


Figure 1: A Pie Chart of the Total 110 Student Respondents from The Faculty of Architecture and Ekistics (FSE), UMK Bachok

4 FINDINGS & DISCUSSIONS

This study gathered insights from 110 architecture-related students across the Faculty of Architecture and Ekistics, including architecture, interior architecture, and landscape architecture disciplines (Table 2). The findings highlight critical factors necessary to facilitate effective learning, model-making, and prototype development within a digitally enhanced architectural education environment, the envisioned "Smart Studio."

4.1 Infrastructure and Technological Facilities

Respondents strongly emphasized the need for well-equipped, technology-driven workshops incorporating 3D printing, laser cutting, and traditional fabrication spaces such as woodworking and metalworking studios. These facilities are considered essential for enabling students to realize complex design ideas with precision and efficiency, thereby bridging theoretical learning with practical execution. Additionally, the demand for extended access hours, including 24-hour studio availability, underscores the necessity for flexible learning environments that accommodate diverse student schedules and project demands. Comfort enhancements such as air conditioning were also noted as important to sustain focus and productivity in physically intensive activities.

4.1 Materials Accessibility and Cost Efficiency

A major theme cantered on the availability and affordability of materials critical to model-making and prototyping. Students proposed establishing a faculty-managed cooperative or dedicated store providing essential supplies at subsidized rates, which would alleviate financial burdens and streamline procurement processes. This aligns with the digital age's emphasis on optimizing resource access through centralized and possibly online platforms, reducing logistical barriers and time lost in sourcing materials.

4.3 Financial and Administrative Support

Given the high cost of model-making materials, students called for financial assistance mechanisms, including special funds or subsidies. Suggestions to limit the frequency of model construction tasks reflect a pragmatic approach to balancing educational rigor with cost and resource management. These findings highlight a critical intersection of pedagogy and resource sustainability in smart architectural education.

4.4 Digital Tools and Software Provisioning

Students also stressed the importance of reliable digital infrastructure, including well-maintained computer labs equipped with industry-standard software (e.g., AutoCAD, SketchUp, Photoshop). Ensuring access to these digital tools is fundamental for integrating digital design workflows into the Smart Studio concept, promoting efficient design iteration and collaborative learning.

4.5 Industry Engagement and Skill Enhancement

The call for increased collaboration with industry experts and practical workshops reveals students' desire for applied learning opportunities that keep pace with technological advancements. Integrating real-world expertise into the Smart Studio enhances relevance and prepares students for evolving professional demands.

4.6 Workflow Optimization and Learning Environment

Respondents recommended reducing unnecessary model-making requirements to optimize workload and resource allocation. Proposals for creating digital purchasing platforms and expanding faculty services (such as extended café hours) further illustrate the importance of a supportive, student-centric learning ecosystem that leverages technology to enhance convenience and well-being.

Table 2 Thematic Table Analysis From 110 Open-Ended Survey Responses

Main Theme	Sub-Themes / Specific Suggestions	Example Suggestions / Key Points	Frequency / Number of Responses
1. Provision of Infrastructure & Facilities	- Complete technology workshops (3D printing, laser cutting, woodworking, metal workshop)	"Provide technology workshops for model/prototype making." "Provide 3D printers, laser cutters, woodworking and metal workshops at faculty."	30
	- Comfortable model-making studio and 24-hour workspace	"Allow 24-hour studio access so students can work anytime."	15
	- Dedicated space/exhibition for models to inspire and motivate	"Provide a special room for displaying student models to boost motivation and creativity."	8
2. Supply of Materials & Dedicated Stores	- Establish a cooperative/store selling model materials at affordable prices	"Develop a cooperative for students to buy model-making materials cheaply." "Open a shop selling model materials within the faculty building."	35
	- Additional printing shops in faculty	"Add more printing shops because current ones get crowded during submission periods."	10
	- Collaboration with external parties to reduce laser cutting prices	"Collaborate with laser cutting businesses to get lower prices for students."	7
3. Financial Aid & Cost Management	- Financial aid or special funds for purchasing materials	"Provide financial assistance as model materials are quite expensive."	12

	- Limit number of model-making assignments to control costs	"Limit model-making tasks to 2-3 times over 4 years to save costs."	4
4. Tools & Equipment Support	- Provide complete tools and computer devices (software like AutoCAD, SketchUp, Photoshop)	"Provide software and computers that are fully equipped in the lab." "Repair broken computers to avoid disruptions."	10
	- Add facilities like air conditioning for a comfortable learning environment	"Install air conditioning in classrooms because it's very hot."	5
5. Industry Involvement & Skill Enhancement	- Invite industry experts to share experience in furniture making	"Arrange workshops with industry professionals."	6
	- Conduct training workshops on new technology (3D printing, laser cutting)	"Organize workshops on latest technologies for students to learn."	8
6. Management & Learning System	- Reduce unnecessary model-making requirements	"Reduce unnecessary model-making tasks."	6
	- Provide online/digital platforms for purchasing model materials	"Create online stores to facilitate easier purchase of model materials."	7
	- Open faculty café late for students working late	"Open the faculty café until late at night for student convenience."	3

The study highlights key student-driven recommendations to enhance Smart Studio learning and prototype development (Table 3). Students advocate for a Smart Cooperative Hub offering affordable materials, supported by upgraded digital tools like licensed software and 3D printers. A dedicated Model-Making Lab is needed to improve safety and efficiency. Financial assistance and subsidies are crucial to alleviate cost burdens. Students also emphasize the need for a comfortable and accessible studio environment, including 24/7 access and air-conditioning. A Model Showcase Space could promote peer learning, while industry engagement through expert workshops and mentoring would bridge academic and professional practice.

Table 3 Simplified Thematic Table Analysis: Facilitating Smart Studio Learning, Model Making and Prototype Construction (Salmiah Aziz, 2025)

Theme	Sub-Themes	Student Suggestions
1. Smart Cooperative & Supply Hub	- Cooperative store for students- Affordable material access	Establish a student-run cooperative or faculty shop selling model-making tools, boards, glue, and laser-cutting services at discounted prices within campus.
2. Digital Tools & Technological Access	- Computer lab upgrades- Licensed software- Digital fabrication tools	Provide access to updated computers, AutoCAD, SketchUp, Photoshop, Rhino, etc.; ensure software is available and PCs are functioning; add 3D printers and laser-cut.
3. Model-Making Workshop & Lab	- Dedicated making space- Tool sharing	Develop a centralized model-making lab with proper machinery (wood, metal, 3D tools); minimize clutter in studios and support safe, guided prototyping.
4. Financial Assistance & Subsidies	- Project material support- Cost-saving mechanisms	Offer financial support or bulk-purchase model kits to reduce student burdens; enable resource subsidies for large projects or final submissions.
5. Improved Learning Environment	- Comfortable studios- 24-hour access- Air-conditioning	Install air-conditioning in studios; allow 24/7 studio access; improve lighting and ergonomics for better learning outcomes and safe model-making at night.
6. Showcase & Reference Space	- Student model gallery- Idea exchange room	Create a permanent space to display student works; allow learning from previous models; foster peer inspiration and competitive creativity.
7. Industry Engagement & Exposure	- Expert-led workshops- Real-world prototyping	Invite skilled furniture makers and architecture professionals to conduct workshops; link students with industry mentors.

5 CONCLUSION

The "Smart Studio" concept represents a transformative shift in architectural education, particularly within the Faculty of Architecture and Ekistics, where students from architecture, interior design, and landscape architecture disciplines require a hybrid of digital literacy and hands-on model-making capabilities. Thematic analysis of 110 student responses reveals several core components that shape this future-ready learning ecosystem (Table 4).

5.1 Digital Design Infrastructure

The primary expectation is access to high-performance digital tools and design software. Students emphasized the need for licensed applications such as AutoCAD, SketchUp, Adobe Creative Suite, and Rhino, integrated into campus workstations. They also called for regular maintenance of computer labs and availability of digital tools that reflect real-world professional practice. These resources are foundational to bridging theoretical learning with applied architectural design processes.

5.2 Technological Fabrication Facilities

Another dominant theme is the demand for state-of-the-art prototyping tools. Students consistently suggested equipping the faculty with 3D printers, laser cutters, and CNC machinery. These tools allow for precision in producing physical models and prototypes, which are essential to translating digital designs into tangible outputs. A dedicated, well-ventilated fabrication lab would also prevent studio clutter and improve workflow efficiency.

5.3 Resources Accessibility Hub

Students proposed the creation of a cooperative store or kiosk within the faculty that sells affordable model-making materials. This "Architecture Supply Hub" would reduce dependency on costly external vendors and long commutes to urban centers. Bulk procurement by the faculty would lower costs and improve affordability for students, particularly those from low-income backgrounds. Many suggested this initiative be managed by students themselves as part of a cooperative education model.

5.4 Financial and Material Support

A significant number of students shared concerns about the cost of model-making, suggesting financial support schemes such as model-making subsidies or sponsorships. This reflects a wider issue of accessibility in architectural education and the financial burden associated with project submissions. Providing material kits or funding assistance would help ensure equal opportunities across the student body.

5.5 Smart Studio Environment

A smart learning space also addresses physical comfort and psychological well-being. Many students noted the absence of air-conditioning in studios and proposed 24-hour studio access. A conducive and ergonomic space, with secure storage and proper ventilation, was seen as essential to support long working hours, especially during submission periods.

5.6 Showcase and Knowledge-Sharing Platforms

Students advocated for dedicated spaces to exhibit past and current student work. A Model Gallery or Idea Bank would serve as a visual reference and stimulate creativity among peers. It would also instill a sense of pride and motivation in students to produce higher-quality models.

5.7 Industry Linkage and Collaborative Learning

Participants highlighted the need for exposure to real-world practices through workshops, guest lectures, and mentorship by industry professionals. Incorporating real-client projects and collaborative design sessions would bridge academic learning with industry expectations, improving employability.

Table 4 Smart Studio Framework (SSF) for Architectural Learning in The Digital Age (Salmiah Aziz, 2025)

Component	Description	Purpose/Outcome	Key Features/Tools
1. Digital Design Infrastructure	Integration of industry-standard software and hardware for design and modeling.	Ensures access to digital tools required for modern architectural workflows.	AutoCAD, SketchUp, Rhino, Adobe Suite, BIM tools; high-performance PCs or laptops

2. Technological Fabrication Facilities	Spaces equipped for physical prototyping using digital fabrication tools.	Bridges digital models with real-world prototyping and hands-on learning.	3D printers, Laser cutters, CNC machines, wood and metal workshops
3. Resource Accessibility Hub	A faculty-managed cooperative store or online system for material supply.	Reduces cost and effort in sourcing model-making materials.	On-campus store, online material ordering system, bulk purchasing mechanism
4. Financial & Material Support	Financial schemes and free/sponsored materials for project execution.	Alleviates students' financial burden and encourages equitable learning.	Model-making fund, subsidies, bursaries, free basic supply kits
5. Smart Studio Environment	Comfortable, flexible, and safe spaces designed for long working hours and creative work.	Promotes physical well-being and maximizes productivity.	24-hour studio access, air-conditioning, ergonomic furniture, safe storage, lighting
6. Integrated Learning Showcase Lab	Dedicated space to exhibit student work, foster collaboration, and peer learning.	Enhances motivation and provides a visual learning archive.	Model gallery, digital wall displays, AR/VR viewer, interactive peer-feedback station
7. Digital-Physical Workflow Optimization	Streamlined workflows combining digital design and physical output, with minimal redundancy.	Improves time management, encourages quality over quantity, and supports smart project planning.	Clear model requirements, digital mockup validations, feedback checkpoints
8. Industry Linkage & Capacity Building	Regular workshops, talks, and mentorship from industry professionals.	Ensures relevance of student learning and industry preparedness.	Guest lectures, hands-on workshops, real-client projects, collaborative design sprints
9. Academic-Administrative Integration	Faculty policies that align academic requirements with resource availability.	Creates a realistic, student-centered curriculum and reduces pressure.	Model limits per semester, flexibility in assessment, feedback loops
10. Sustainability & Green Studio Practices	Incorporation of eco-conscious principles in studio operations and materials.	Aligns with global sustainable design practices and climate goals.	Use of recycled materials, energy-efficient tools, waste segregation

The Smart Studio Framework (SSF) integrates digital tools, physical infrastructure, student support systems, and pedagogical innovation. By addressing technological, financial, and environmental needs, it lays the foundation for a sustainable, inclusive, and future-ready architectural education model.

In short, the SSF offers significant contributions to future research and architectural pedagogy by integrating digital tools, smart technologies, and adaptive learning environments. It provides a scalable model for hybrid and technology-driven design studios, fostering creativity, collaboration, and digital literacy. Future research may explore its long-term impact on student performance, interdisciplinary applications, and sustainability integration. This framework can inform curriculum innovation and institutional strategies in design education, particularly in preparing students for Industry 4.0. Its emphasis on immersive learning, accessibility, and equitable resource distribution contributes to a more inclusive, efficient, and forward-looking architectural education ecosystem.

6 ACKNOWLEDGEMENT

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Keberkesanan Penggunaan Aplikasi Interaktif dalam Mengukur Kefahaman Topik yang Diajar dalam Kalangan Pelajar di Kolej Poly-Tech MARA Alor Setar (KPTMAS)

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ABSTRAK

Perkembangan teknologi digital telah membawa revolusi dalam bidang pendidikan, khususnya melalui penggunaan aplikasi interaktif yang membantu meningkatkan penglibatan dan kefahaman pelajar. Kajian ini menilai persepsi pelajar terhadap keberkesanan aplikasi interaktif seperti Kahoot!, Quizizz, Google Form, Wordwall, dan Blooket dalam membantu proses pembelajaran di Kolej Poly-Tech MARA Alor Setar (KPTMAS). Melalui soal selidik dalam talian yang diedarkan kepada 153 pelajar, data dianalisis menggunakan Microsoft Excel untuk statistik deskriptif. Hasil kajian menunjukkan pelajar mempunyai persepsi positif terhadap aplikasi interaktif ini. Implikasi praktikal dan cadangan kajian lanjutan turut dibincangkan.

KATA KUNCI: Aplikasi Interaktif, Persepsi Pelajar, Teknologi Pendidikan, Motivasi Pelajar, Kolej Poly-Tech MARA

1 PENGENALAN

Perkembangan teknologi digital telah mengubah landskap pendidikan secara signifikan. Aplikasi interaktif kini menjadi alat bantu pengajaran yang popular kerana kemampuannya meningkatkan penglibatan pelajar serta menyediakan maklum balas segera terhadap tahap kefahaman mereka (Wulandari & Susanti, 2020).

Menurut Zaman dan Ahmad (2011), aplikasi interaktif adalah merujuk kepada perisian komputer yang membolehkan interaksi dua hala antara pengguna dan system. Aplikasi ini membolehkan pengguna bertindakbalas dengan sistem dengan cara menerima maklumat secara pasif, memberikan input atau arahan serta menerima maklum balas secara langsung daripada sistem berdasarkan tindak balas tersebut.

Terdapat beberapa aplikasi interaktif yang digunakan di dalam Pendidikan seperti Google Form, Quizziz. Kahoot, Blooket, WorldWall dan lain-lain.

Kajian terdahulu menunjukkan aplikasi seperti Kahoot! dan Quizizz berupaya menggalakkan pembelajaran yang lebih menarik dan kompetitif serta meningkatkan pencapaian pelajar (Smith, 2019; Lee & Lee, 2021). Plump dan LaRosa (2017) juga menegaskan bahawa aplikasi ini membantu pelajar mengenal pasti kelemahan dan memperbaiki prestasi secara berterusan.

Walaupun banyak kajian menyokong keberkesanan aplikasi interaktif, terdapat kekurangan kajian khusus dalam konteks pendidikan tinggi di Malaysia, khususnya di Kolej Poly-Tech MARA Alor Setar (KPTMAS). Justeru itu, kajian ini bertujuan untuk menilai persepsi pelajar terhadap keberkesanan aplikasi interaktif dalam pembelajaran serta mengenal pasti aplikasi yang paling kerap digunakan.

2 METODOLOGI

Kajian ini menggunakan pendekatan kuantitatif melalui soal selidik dalam talian yang terdiri daripada 11 soalan berkaitan demografi, pengalaman, dan persepsi pelajar terhadap aplikasi interaktif dengan menggunakan skala Likert 5 mata. Sampel terdiri daripada 153 pelajar Diploma di KPTMAS yang dipilih secara rawak mudah.

Soal selidik diedarkan selepas beberapa sesi pengajaran menggunakan aplikasi interaktif seperti Kahoot! dan Quizizz. Data yang dikumpul dianalisis menggunakan Microsoft Excel untuk statistik deskriptif, termasuk peratusan dan purata skor bagi setiap pernyataan.

3 HASIL DAN PERBINCANGAN

3.1 Maklumat Demografi

Jadual 3.1: Maklumat Demografi Responden

Program Pengajian	**Bilangan**	**Peratusan (%)**
Diploma in Accounting	4	2.6
Diploma in Business Management	30	19.6
Diploma in Office Management	26	17.0
Diploma in Tourism Management	59	38.6
Diploma in Computer Science	34	22.2
Jumlah	**153**	**100**

Jantina	**Bilangan**	**Peratusan (%)**
Lelaki	42	27.5
Perempuan	111	72.5
Jumlah	**153**	**100**

Komposisi responden merangkumi pelajar dari pelbagai program yang mewakili populasi KPTMAS secara menyeluruh. Dengan 72.5% responden adalah perempuan, kajian ini memberikan gambaran representasi jantina yang jelas.

3.2 Pengalaman Penggunaan Aplikasi Interaktif

Jadual 3.2: Penggunaan Aplikasi Interaktif oleh Pelajar

Aplikasi	**Bilangan Pelajar**	**Peratusan (%)**
Kahoot!	86	56.2
Quizizz	134	87.6
Google Form	143	93.5
Wordwall	15	9.8
Blooket	37	24.2
Lain-lain	16	10.5
Tidak Pernah Guna Mana-mana	1	0.7

Nota: Responden boleh memilih lebih daripada satu aplikasi.

Jadual 3.3: Kekerapan Penggunaan Aplikasi oleh Pensyarah

Kekerapan Penggunaan oleh Pensyarah	Bilangan	Peratusan (%)
Setiap kali selepas topik	56	36.6
Beberapa kali dalam semester	87	56.9
Jarang digunakan	9	5.9
Tidak pernah digunakan	1	0.7

Google Form merupakan aplikasi yang paling banyak digunakan oleh pelajar, diikuti Quizizz dan Kahoot!. Walaupun Wordwall dan Blooket kurang popular, penggunaannya masih signifikan. Kekerapan penggunaan aplikasi oleh pensyarah juga tinggi, menandakan penerimaan baik teknologi ini dalam pengajaran.

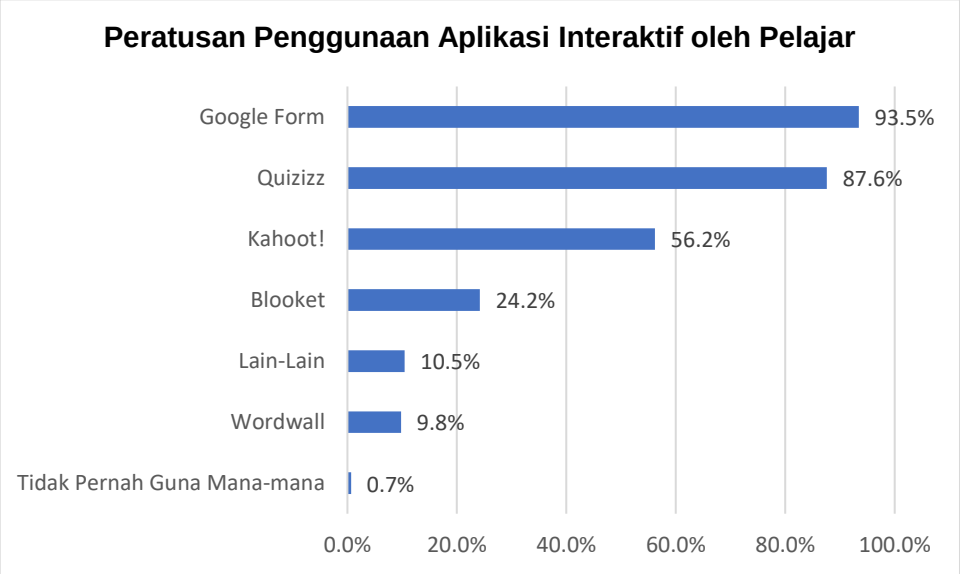
3.3 Persepsi Terhadap Keberkesanan Aplikasi Interaktif

Skala 1-5 digunakan untuk mengukur persetujuan pelajar terhadap pernyataan keberkesanan aplikasi interaktif.

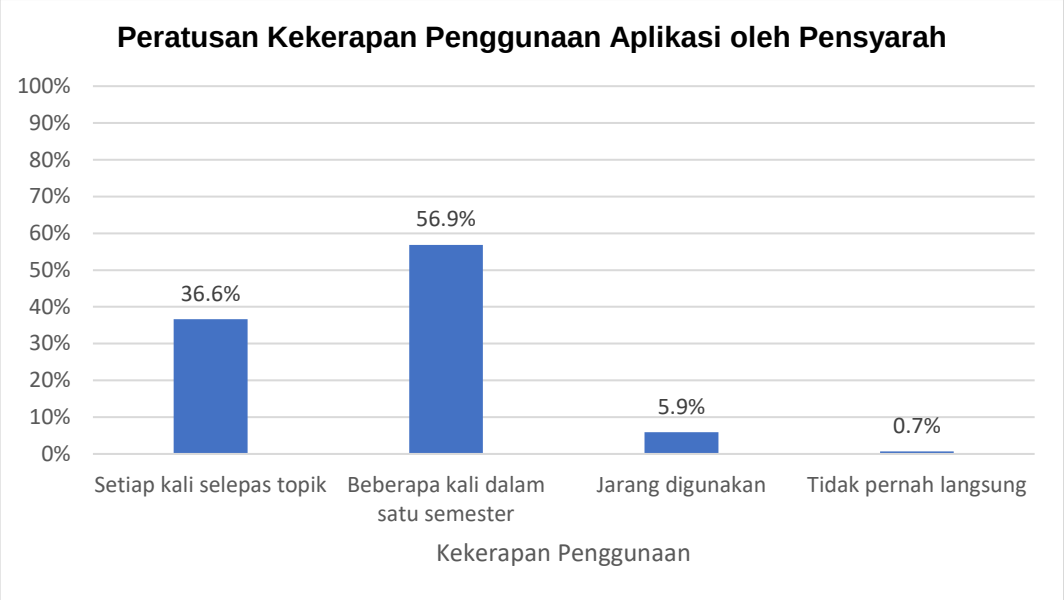
Pernyataan	Purata Skor (1-5)
Aplikasi interaktif membantu saya memahami topik lebih baik.	4.2
Saya lebih mudah mengingati isi pelajaran melalui latihan interaktif.	4.2
Penggunaan aplikasi menjadikan kelas lebih menarik.	4.5
Saya lebih fokus semasa sesi latihan interaktif berbanding kaedah biasa.	4.2
Latihan melalui aplikasi membantu saya mengenal pasti kelemahan sendiri.	4.2
Saya mahu lebih banyak latihan menggunakan aplikasi interaktif dalam kelas.	4.3

Purata skor persepsi menunjukkan pelajar bersetuju bahawa aplikasi interaktif membantu mereka dalam memahami topik dan menjadikan pembelajaran lebih menarik. Peningkatan motivasi dan fokus juga jelas dilihat berdasarkan skor yang tinggi.

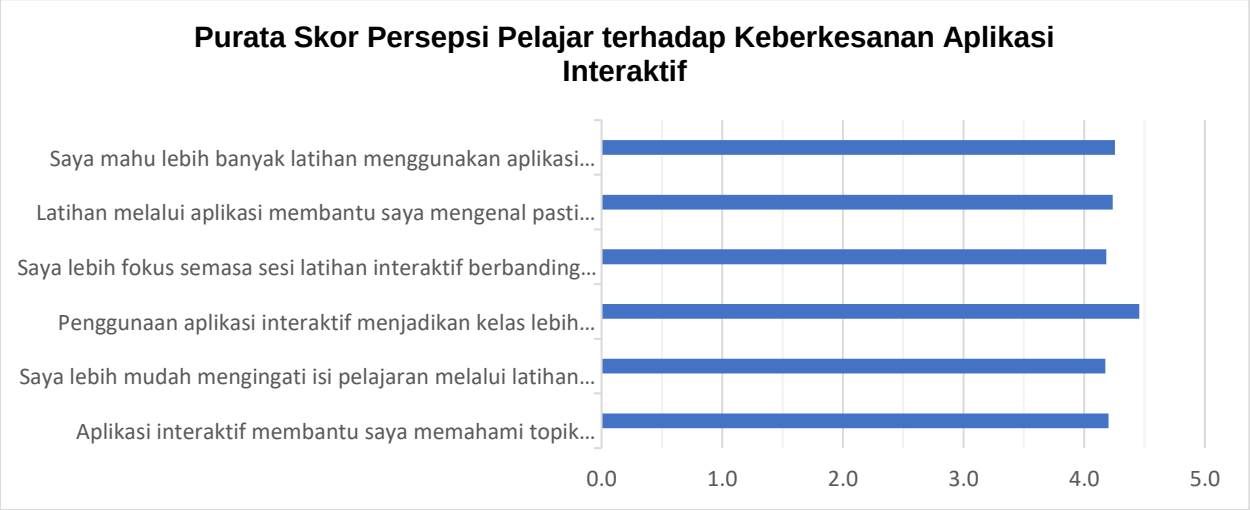
3.4 Paparan Grafik Data Survey



Graf 1: Peratusan Penggunaan Aplikasi Interaktif oleh Pelajar



Graf 2: Peratusan Kekerapan Penggunaan Aplikasi oleh Pensyarah



Graf 3: Purata Skor Persepsi Pelajar terhadap Keberkesanan Aplikasi Interaktif

4 KESIMPULAN

Kajian ini menumpukan kepada persepsi pelajar terhadap keberkesanan aplikasi interaktif dalam pembelajaran di KPTMAS. Data menunjukkan pelajar mempunyai pandangan positif yang konsisten terhadap aplikasi seperti Kahoot!, Quizizz dan Google Form. Walaupun kajian ini tidak mengukur kefahaman pelajar secara langsung, dapatan mencadangkan aplikasi interaktif berperanan penting dalam meningkatkan motivasi dan minat pembelajaran. Kajian lanjutan disyorkan untuk menggabungkan penilaian prestasi akademik bagi mendapatkan gambaran lebih menyeluruh.

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The Micro-Creds Challenges: A Beginner's Quest

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ABSTRACT

Nowadays, the development of high-speed internet, the demand for hybrid-based learning, and the evolution of various advanced artificial intelligence (AI) technologies have made learning accessible to everyone who wants to learn. Therefore, it is no longer feasible for the institution of higher learning (IHL) to delay the adoption of innovative teaching and learning approaches to avoid falling behind. Many IHLs worldwide are paying increasing attention to micro-credentials (MCs), including Universiti Selangor (UNISEL). Despite the determination to make it happen, the IHL's challenges were undeniable. A qualitative approach was employed, combining surveys and on-site experience to collect data from the participants. The sample consisted of twelve (12) academic staff from the Faculty of Engineering and Life Sciences, UNISEL, who were actively involved in the MCs course development in 2024. The data were analyzed thematically, focusing on identifying recurring challenges, correlations, and patterns in the responses. As a beginner, the key findings revealed by the respondents are that implementing MCs requires a comprehensive upskilling of the academic staff (beginner), sufficient budget, and support from the management. Furthermore, balancing course preparation with other academic and non-academic responsibilities, as well as managing scheduling with the Unit Pusat Digital (UPD), can be overwhelming if it is not taken into serious consideration. Ultimately, the challenges encountered while developing the MCs course were summarized in this paper. The research findings have consequences for the development of university policies, particularly those focused on MCs, that will direct the execution of comparable projects for academicians in UNISEL and other IHLs in the future.

KEYWORDS: Micro-credentials (MCs), UNISEL, Policies, Challenges, Technology, Unit Pusat Digital (UPD)

1 INTRODUCTION

Today's digital landscape transforms education through high-speed internet, hybrid learning approaches, and artificial intelligence (AI) systems. Institutions of Higher Learning (IHL) must increasingly adopt new teaching strategies to stay competitive in the market and quickly meet the growing needs of their existing and potential students. Since micro-credentials (MCs) provide specialised education packages with adaptable formats, which is known in boosting employability and sustaining lifelong learning efforts, along with addressing the needs of upskilling and reskilling, filling specific skill gaps while preparing learners for job roles, (Fernando et al., 2023; Cheng et al., 2024), they are increasingly being adopted by prominent IHLs. MCs have expanded rapidly across the world, including Malaysia. MC integration into Malaysian

IHLs' curricula has advanced significantly in recent years (Rami et al., 2024), and Universiti Selangor (UNISEL) has begun to actively address this demand since the end of 2023.

Despite providing various benefits such as creating navigable spaces for both students and academic staff, MCs present manifold complexities. These credentials face multiple integration challenges as they try to fit into conventional educational structures. According to (Maina et al., 2022), educational institutions or IHLs need to handle MCs integration cautiously by moving from traditional knowledge transfer to active learning models that utilize authentic assessment (Lang, 2023; Rami et al., 2024; Reed, 2023b). The main difficulty regarding MCs arises from their lack of standardized framework standards between diverse educational and professional domains, which creates uncertainty about the qualification's worth and usability for employers and learners (McGreal et al., 2022; Alasmari (2024). IHLs, therefore, require detailed investigation to develop best practices and come out with fundamental framework standards in designing effective MCs which align with their mission and vision (Maina et al., 2022; Cheng et al., 2024; Raj, 2024). Financial limitations are another obstacle to establishing MCs in IHLs, in addition to the above-mentioned challenges (Varadarajan et al., 2023; Romasanta, J.K.N. & Diloy, M.A., 2024)

IHLs that want to meet evolving job market requirements must overcome three significant barriers in their micro-credentialing practices: standardization issues, recognition mechanisms, and maintenance of academic integrity standards (Rottmann & Duggan, 2021; Lang, 2023; Sharma, 2024). This is the successful implementation formula of MCs in higher education (Orman et al, 2023; Raj, 2024; Rami et al., 2024). In addition, highlighting the need to improve leadership involvement, technology proficiency, and support structures for the successful implementation of MCs is vital, too. In short, the crucial part played by university management in promoting the incorporation of MCs into IHLs' curricula assists in the smooth sailing of the programme. Hence, IHLs need to review these challenges and address the best practices in overcoming them. Ultimately, a working framework must be established by the IHL so that a strategic and clear plan for the courses can be accomplished by the academic staff and the person in charge (PIC). To guarantee seamless delivery within academic standards, the academic staff and the PIC must specify a suitable mechanism for teaching and learning. Moreover, a collaboration with industry partners has somehow assisted in the success of the MC's design and implementation (Orman et al., 2023; Raj, 2024).

On other aspects, the technological environment functions as an essential component that determines how MCs are experienced by learners. The implementation of digital issuance platforms for MCs creates enhanced access while improving learner participation, but these advancements raise issues about distribution inequalities and digital access (Kumar et al., 2022; Miao, 2023). IHLs using technology to deliver MCs should improve accessibility for all learners through essential resources while guaranteeing adequate support to excel in new educational systems (Alvarez et al., 2022; Tee, 2023).

As UNISEL started to embark on its journey in establishing MCs, this study investigates the difficulties faced by academic staff at UNISEL in their initial planning and implementation stages in preparing MC courses in 2024. They are the first group of academic staff who are officially selected as the first batch to experiment and take up the challenges in preparing the MC courses in UNISEL. The study is keen to analyse the key factors that drive MCs' realization success and what is needed to improve the process of this transition in UNISEL. The research outcomes are seen to have crucial effects on university policy-making structures and forthcoming MCs establishment programs. The findings will support educational theories about MCs while helping educational institutions, specifically UNISEL, in preparing guidelines for upcoming MC courses. Like others, while micro-credentialing offers numerous potential benefits, UNISEL academic staff encounter several challenges throughout the process. Since the majority of academic staff members are unfamiliar with micro-credentialing methodologies and procedures, difficulties have arisen as a result of their lack of exposure, knowledge, and proper guidelines. Similar to what was highlighted by (Varadarajan et al. 2023; Romasanta, J.K.N. & Diloy, M.A., 2024; Rami et al., 2024), insufficient financial, lack of organisational, and technical support make it much more challenging for UNISEL's academic staff to complete the MC courses.

In summary, the academic staff and the Unit Pusat Digital (UPD) administrative team had to devote enormous amounts of time to the development of MCs in 2024, which, to some degree, overwhelms their overall teaching commitment and other commitments. An absence of established policy structures creates

additional difficulties that make integrating MCs as educational elements into university systems more challenging.

2 LITERATURE REVIEW

Micro-credentials represent a major upcoming trend in the educational sector of Malaysian institutions, particularly the higher education entities. Educational micro-credentials deliver strong benefits for improving the employment prospects of students and connecting teaching goals with professional market requirements. Educational institutions have observed heightened interest among school educators, together with the business sector personnel and undergraduate students, regarding the adoption of micro-credentials. MCs enable brief competency-based learning activities to grant official certifications for distinctive abilities via digital processes that validate certifications or awards. The present analysis evaluates micro-credential programs in Malaysian universities regarding operational efficiency as well as commercial success and Asian policy contexts and implementation challenges, together with proposed solutions (Josephine, 2023; Sharma, 2024; Alasmari, 2024). Additionally, a review that incorporates recent MC program research is conducted to comprehend technology methodologies and learning approaches, as well as effective programs that align with the standards of the Malaysian Qualifications Agency (MQA) and the Engineering Accreditation Council (EAC) for Science, Technology, Engineering, and Mathematics (STEM) and engineering applications, industrial requirements, and coding procedures (Wheelahan and Moodie, 2021; Thi et al. 2022; Zou 2023).

Micro-credential software represents multiple technological approaches that develop remote delivery networks and testing platforms. Nowadays, there are numerous tools and software available that can be utilised by educational institutions. For instance, under the Credly platform, educational institutions gain the ability to configure badges and move them across platforms, which helps students achieve skill recognition for MC programs (Ruddy & Ponte, 2019). Through digital badges, micro-credentialing allows learners to show their work-related skills to potential employers (Reed, 2023b). The technological system complements current educational concepts since organizations implement digital learning platforms to improve enrollment rates and user engagement (Lyu, 2023).

Traditional classroom teaching forms part of blended learning methods used by MC programs alongside their online teaching components. Student participation through the educational method reaches new heights, showing better outcomes because it allows the creation of personalized learning plans (Sharma 2024). For engineering courses, in particular, MCs can be designed and implemented using the scaffolding teaching methods as their primary approach, as this method builds up student skills through organized sequences (Cook, 2021). As for the assessment quality, Ruddy & Ponte (2019 emphasize that the use of collaborative assessments ensures professionals obtain the required competencies through their engagement in active collaboration and peer learning activities.

The learning approaches in MC programs focus on competency-based education (CBE), which uses skill mastery as its essential principle instead of traditional time-based educational approaches (Tee, 2023). The application of this learning method suits STEM courses best because students excel through real-world implementations of previously learned information. The participation of engineering students through MC-based courses has improved drastically as both theoretical concepts and real-world practice are taught through new methods and pedagogy. This claim is supported by Eager and Cook (2019 in their study. Flexible educational credentials help students align their learning pathway to both professional targets and industrial targets, thus increasing their worth in contemporary job markets (Temjanovski, 2023).

As mentioned earlier, different educational institutions have established MC programs that demonstrate positive effects for improving workforce development skills and enhancing employment choices by minimizing the skill gaps through upskilling their current employees' knowledge and skills. Due to this, MCs' programmes are gaining acceptance from various international accreditation standards

globally. For instance, the European Credit Transfer and Accumulation System (ECTS) enables Estonian universities to recognize more than 120 MCs programs to be inculcated in their university programme structure (Tammeleht, 2023). This is also supported by the MQA as academic programs can maintain their reliability and integrity by following education standards imposed by MQA and other accreditation parties through MCs courses design and implementation (Abdullah M.,2023)

2.1 Effective Micro-Credential Programs: Industry Acceptance and Workforce Alignment

In general, to ensure effective, holistic, and dynamic micro-credential programs, the programmes must be capable of producing specific student qualities to fulfil the industry and employers' requirements. According to Abdullah F.,2023 and Rami et al. (2024), MCs should integrate into an instructive system that develops continuous learning alongside career readiness (Abdullah F., 2023). Furthermore, digital badges used in the MCs programme have become an enhanced method to exhibit student achievements for employer recognition (Perkins & Pryor, 2021). To ensure an effective MCs programme is delivered, Halim & Jill (2023) emphasize that the design of MCs should incorporate pedagogical, technological, and evaluative aspects to achieve quality and effective micro-credential development.

As mentioned earlier, one of the proven impactful MC programs is when it obtained industry acceptance and workforce readiness. The use of MCS significantly strengthens student perception of job readiness through the delivery of skills that directly address employer specifications (Zou, 2023), hence, this criterion needs to be part of the MCs programme goals (Ahsan, 2023; Alasmari, 2024).

2.2 Challenges and Resolutions

Various obstacles impede the general uptake of micro-credentials (MCs) among Malaysian universities despite their potential advantages. Ahmat et al. (2021) have highlighted that insufficient knowledge among key parties stands as the primary obstacle to developing effective MC programs (Ahmat et al., 2021). Other challenges are highlighted in the *Introduction* section earlier. One of the solutions to the above-mentioned challenges is to establish a quality assurance system, as it may highlight the need to establish an MCs standard that maintains their credibility (Kumar et al, 2022). These challenges can be overcome through a productive partnership between educational facilities, industry, and accreditation bodies, which would develop unified structures for MC acceptance standards that reach the desired quality levels and job market compatibility (Navanitha et al., 2022). In Malaysia, MQA, together with the EAC, leads the development of MC standards. The standards are devised through MQA guidelines confirming they fulfil the national educational benchmarks (Mhichíl et al., 2023). On the other hand, the EAC, that is focusing on engineering education, stresses the need to match MCs with industry needs, which improves their professional acceptance (Navanitha et al., 2022).

As the academic staff is one of the primary stakeholders of MCs in the context of IHL, as mentioned in the introduction, hence, it is important to identify the key challenges faced by the academic staff and to find the best resolution in overcoming them. This leads to the selection of two (2) theoretical frameworks that align with the study's main objective. These are the Concerns-Based Adoption Model (CBAM) and the Technology Acceptance Model (TAM) (Correia, A.P., 2021; Miao et al., 2024). In general, TAM explains users' acceptance and resistance to new educational technology like MCs, through its focus on emphasizing the importance of *Perceiving Usefulness (PU)* and *Perceiving Ease of Use (PEOU)*, while CBAM addresses the concerns and needs of educators during the process of adopting innovation, which all aligns well with academics' initial experiences in UNISEL and the evolving concerns it raises.

2.3 Related Micro-Credential Policies in Asia

Different regions of Asia follow distinct approaches when implementing MCs policies. According to Sharma's multi-country study, developed countries have successfully implemented MCs while Malaysia, together with other developing countries, remains at the nascent stage of integrating MCs (Sharma, 2024). However, MQA demonstrates proactiveness through its MCs guideline development to match worldwide evaluation standards. The transformation of MCs' policies creates essential conditions for the sustainable growth of these educational units across international borders.

In summary, MC-based certification programs offered in Malaysian universities provide valuable opportunities to boost graduation potential while making academic achievements directly relevant to working environments. However, their success hinges on effective implementation, industry acceptance, and robust policy frameworks. Malaysian universities will advance this academic advancement by implementing appropriate solutions based on MQA and EAC guidance.

3. METHODOLOGY

More More institutions of higher learning (IHLs) are realising that micro-credentials (MCs) are a reliable way to verify specific skills and competencies. Nevertheless, numerous challenges prevent MCs from being widely accepted, especially for beginners who may not be familiar with this relatively new kind of educational validation. This study aims to explore the challenges that beginners (academic staff) face in designing and preparing the MC courses. It employs a qualitative study approach to obtain a comprehensive understanding of the challenges encountered by beginners in the field of MCs. A qualitative method is appropriate since it enables the investigation of individual experiences, viewpoints, and the interpretations academics make towards MCs.

A survey form was distributed to the respective participants, and they were given two (2) weeks to complete the questionnaires. The sample size of the respondents consists of twelve (12) faculty academies that are engaging or have actively engaged with the MCs programs assigned by the faculty management in 2024. These respondents are identified as beginners in the sense that they have limited prior knowledge of MCs or are new to the concept. Specifically, the respondents included are the people who have taken all or a portion of at least one MC course in the past twelve (12) months. In addition, a review of the current literature was also part of this study, among others, identifying related theoretical frameworks that best suited prior to outlining the objectives and questionnaires, examining the micro-credential-related case studies, articles, their course descriptions, and user reviews. On top of the survey and literature reviews, the respondents' on-site experiences were used in this study.

To make the study more solid, scholarly, and convincing, a well-defined framework is identified. The present study focuses on evaluating MCs' challenges through the lens of two frameworks: *Concerns-Based Adoption Model (CBAM)* and *Acceptance Model (TAM).* The questionnaire set is structured according to these frameworks and is divided into seven (7) parts, designated as Part A through Part G. Part A includes demographic-related questions, which include the gender, duration of service, and age of the respondents. Parts B to Part F involve the question related to *upskilling/training needs, budget/resources, management support, balancing MCs with other responsibilities,* and *scheduling challenges with Unit Pus at Digital (UPD),* which, among others, include the Likert-scale (LS) type of questionnaires. On top of giving respondents a variety of choices to express how much they agree or disagree with a statement, the LS rating scale is also used to gauge opinions, attitudes, or behaviours of each key area/challenge, compared to a basic yes/no or agree/disagree response. In general, the average time to finish the questionnaires is between ten (10) and fifteen (15) minutes.

4. RESULTS AND DISCUSSIONS

The survey was conducted to explore and identify the challenges faced by academic staff in implementing MC courses at UNISEL, particularly in the context of upskilling requirements, institutional support, and workload management. A total of twelve (12) academic staff members participated, providing valuable insights into their experiences and preferences. Most of them were female, while only 25% were male. In terms of age, 58.3% of respondents were above 45 years old, followed by those in the 30–45 years old range. Interestingly, all respondents have worked at UNISEL for more than 10 years, which emphasizes that although they are experienced educators, they are relatively new to the concept and implementation of MC. The survey findings highlight six key areas influencing the successful implementation of micro-credential (MC) programs at UNISEL, which include upskilling/training needs for MC, budget and resources for MC, management support for MC, balancing MC with other responsibilities, scheduling challenges with UPD, and final thoughts and suggestions. Each of the key areas is covered in detail.

i. Upskilling/Training Needs for MC

The implementation of MC in higher education is a major change designed to meet the changing needs of students. However, this change brings significant implications for academic staff, particularly regarding their preparedness and competency. The findings from the survey reveal that 83.3% of respondents believe that the implementation of MC programs requires *significant* upskilling or training for academic staff, while the remaining 16.7% acknowledge the need for some level of upskilling or training.

The most important areas of upskilling or training for academic staff are digital teaching tools and technology, followed by course and instructional design, online teaching methodologies, assessment and evaluation techniques, and industry-specific knowledge for MC courses. Despite recognizing these needs, most respondents admitted that they felt unprepared, and none of them had formal training before participating in MC development, which is very new in UNISEL. This gap between the importance of training and the level of preparedness highlights the need for proper training initiatives to effectively prepare academic staff for MC implementation.

The findings also highlight the various ways academic staff stay updated with the latest trends and developments related to MC, as shown in Figure 1. A majority of respondents indicated that they rely on online courses and webinars, as well as YouTube videos, to stay updated. This shows that digital platforms are the most popular and accessible for acquiring new knowledge and skills related to MC. In addition, 58.3% of respondents mentioned that they depend on references and information shared by peers and experts, emphasizing the importance of informal peer networks in their professional development. Peer collaboration or mentoring was chosen by 41.7% of respondents. Less commonly chosen options included reading journals, books, and articles by 33.3% and attending industry conferences or seminars by 16.7%. Other sources, such as peer sharing and LinkedIn, were only selected by 8.3% of respondents. Overall, these findings show that even with the extensive use of digital tools, peer support is still crucial. This emphasizes the need to promote a culture of ongoing professional involvement to ensure the academic staff continues to stay relevant in a rapidly changing educational area.

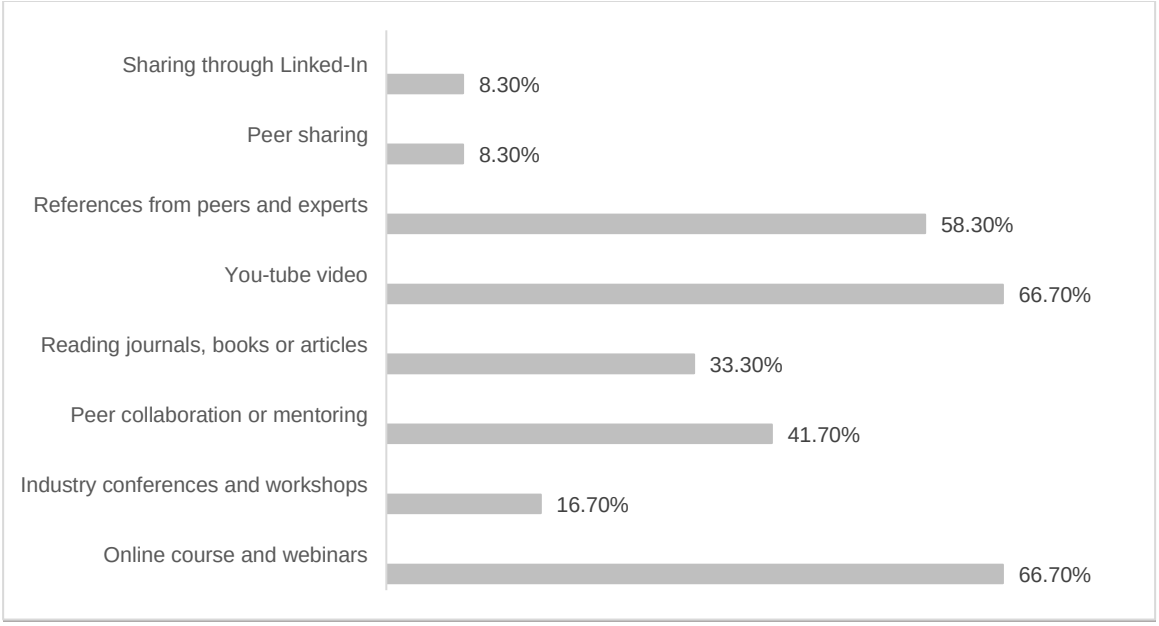


Figure 1: Various ways academic staff stay updated with the latest trends and developments related to MC.

ii. Budget and Resources for MC

The survey results provide important information on how financial and resource assistance are thought to be sufficient for the creation and implementation of MC programs. 41.7% of respondents indicated that while some level of support is present, more resources are needed to ensure the successful implementation of MC. To enhance the development and delivery of MC programs, prioritizing resource allocation, including financial support, access to technological tools, and training provisions, is required. More resources are necessary to empower academic staff and to ensure the long-term success of micro-credential initiatives.

The survey results also highlight the varying levels of financial support needed across different categories required for the effective delivery of MC programs at UNISEL, as shown in Figure 2. A majority of respondents emphasized that funding for course development tools or software and studio or smart classroom enhancement budgets is very important, with both categories receiving the highest levels of agreement. This indicates a strong need for technical infrastructure and digital tools to ensure quality in the MC program. Similarly, financial compensation for additional workload was also considered very important by a majority of respondents, followed by traveling costs between campuses and grooming and appearance budgets.

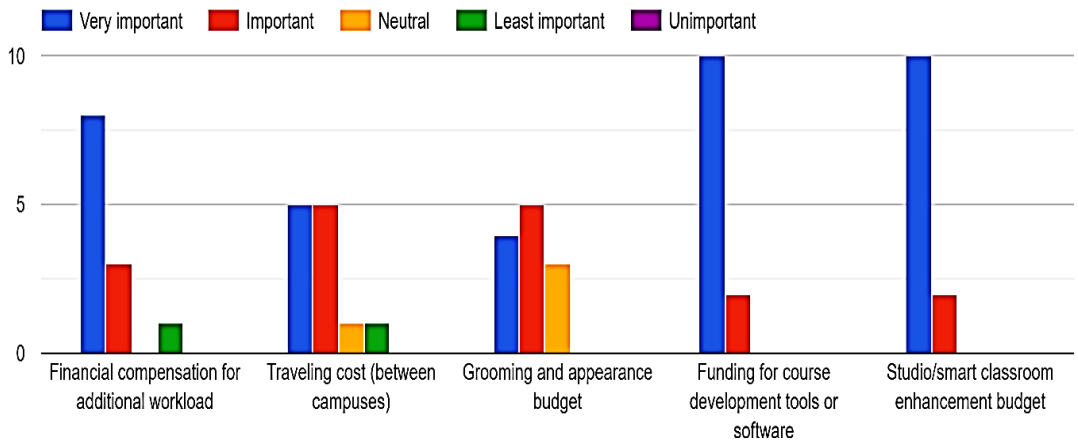


Figure 2: The varying levels of financial support needed across different categories

In terms of resource support, the majority of the respondents emphasized that access to technical support and resources under the UPD was ranked as the most important support component. This highlights the significant role of digital infrastructure and technical guidance in the development and implementation of MC content, especially for academic staff who may be new to digital instructional design. Followed by the access to development tools or software was identified as the second most important resource. This highlights the necessity for appropriate platforms, applications, and digital solutions that enable efficient course creation, interactive content delivery, and learner engagement in online and blended formats. Followed by access to teaching assistants, this was valued for its potential to reduce workload. Even though this is not as critical as the other resources, this support was still assumed as important, especially in managing course facilitation. Lastly, access to administrative help was ranked the least important among the listed options. Although still considered useful, it appears to be less urgent compared to technical support, development tools, and teaching assistants.

Limited access to funding and resources emerged as a significant barrier to successful MC implementation. Without proper allocation of financial and material support, the development and sustainability of MC courses remain at risk. These limitations significantly affect course development quality and the ability to maintain innovation in teaching.

iii. Management Support for MC

In terms of management and institutional support, the findings indicate that while there is some level of awareness among management regarding the additional workload involved in the development and delivery of micro-credential MC programs, further support may still be helpful. Although there is room for improvement in terms of clarity and involvement, 59% of respondents believed that management is somewhat aware. About 33% said that management completely understood the amount of work needed, while the remaining respondents believed that management fully recognizes the extent of the effort required. This may be due to the fact that MC implementation is still a relatively new practice at UNISEL**,** and both academic and administrative units are in the early stages of adapting to it. These findings highlight the need to encourage better arrangements and increase awareness at the institutional level. The management needs to play an active role in MC programs to ensure that the workload involved is properly accounted for. Additionally, establishing clear guidelines and policies for MC will provide a solid framework to support the effective implementation of these programs.

iv. Balancing micro-credential (MC) with other responsibilities

The survey, as shown in Figure 3, depicts the experience balancing the preparation of Micro-Credential (MC) courses with other academic responsibilities such as teaching, grading, and student consultations. More than 90% of respondents believe that preparing MC courses is challenging or very challenging. It indicates that preparing MC courses is perceived as a substantial challenge by the majority of academic staff. The 8.3% who responded neutral suggest that they neither agree nor disagree that preparing MC courses is challenging. Notably, none of the responses chose not very challenging or not challenging at all, meaning that no one found the task effortless.

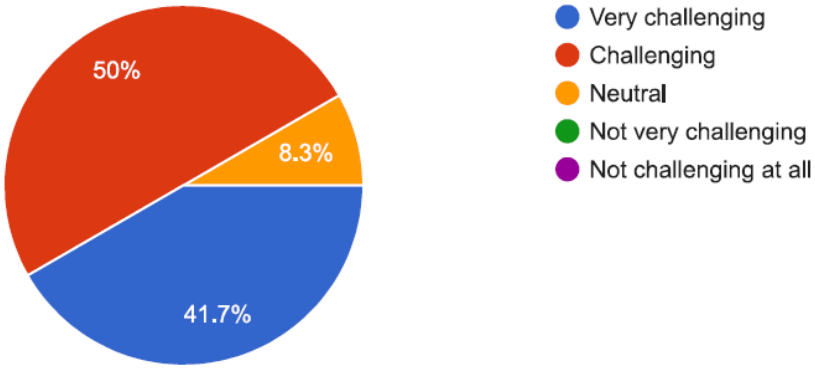


Figure 3: Experience balancing the preparation of MC courses with other academic responsibilities

Furthermore, the survey findings revealed that the preferred choice among respondents for managing workload conflicts between MC and other academic responsibilities is re-prioritizing tasks, followed by working extra hours and requesting deadline extensions. Delegating responsibilities was the least preferred among all choices. These findings align with earlier results showing that those who rated MC preparation as challenging or very challenging were more inclined to re-prioritize their tasks.

To mitigate these challenges, respondents suggest actionable faculty/UNISEL support advocating for reducing the number of other courses assigned and offering flexible time. Other suggestions include proposing adjusted deadlines or timelines for academic tasks and providing more support staff. These solutions align with the identified pain points, which can alleviate pressure, burnout, and foster a more sustainable balance between MC programs and other responsibilities.

v. Scheduling challenges with Unit Pusat Digital (UPD)

Unit Pusat Digital (UPD) is an important unit that respondents deal with on the MC program. According to the twelve (12) respondents' experiences, frequent scheduling conflicts were the most commonly reported challenge when dealing with the UPD on MC programs.

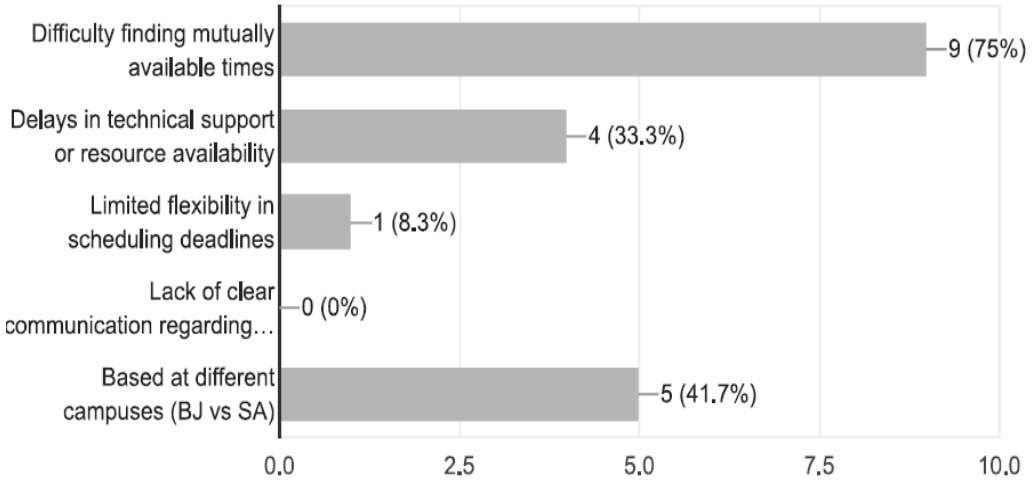


Figure 4: Experience balancing the preparation of MC courses with other academic responsibilities

As shown in Figure 4, the most significant scheduling-related issue with 75% was difficulty in finding mutually available time between the academic staff and UPD unit due to their respective academic responsibilities and workloads. Another issue with 41.7% is the location difference between campuses, Bestari Jaya versus Shah Alam. All twelve (12) responders are from the Faculty of Engineering and Life Sciences, Bestari Jaya campus, whereas the main UPD office is on the Shah Alam Campus. This geographical distance may provide logistical and time constraints. 33.3% of respondents reported delays in technical support or resource availability, possibly due to limited resources at UPD. Most of the respondents suggested additional support staff and resources in collaboration and scheduling with UPD for MC development. Moreover, limited flexibility in scheduling deadlines, with 8.3%, was the least significant issue.

Working with UPD rarely encountered delays or difficulties. In terms of communication was not perceived an issue demonstrating that the communication channels with UPD are clear and effective for coordinating MC activities such as technology needs, content upload, platform support and other aspects leading them to believe better scheduling flexibility and communication with UPD would help reduce the workload challenges related to MC while addressing logistical and resource constraints.

vi. Final thoughts and suggestions

The survey results from respondents reflect a varied opinion on whether to continue with the MC task or vice versa. The different degrees of confidence or clarity about their readiness to proceed resulted in similarly distributed responses. Furthermore, some respondents portrayed his/her lacked of interest in continuing this effort. However, despite being new to MC, the respondents reported valuable experiences in gaining new knowledge while conducting the recording sessions with UPD. The task also acknowledges the collaborative support among academic staff within the faculty. These insights underscore the potential benefits of MC programs, even though there are several improvements needed.

5. RECOMMENDATIONS

Based on the survey findings, several key suggestions and recommendations are proposed to support the successful implementation of MC, particularly in UNISEL. Several important areas need more attention to help ensure that MC initiatives are implemented successfully. These include offering structured training programs tailored to those new to MC, particularly in areas such as online instructional design and digital content creation. A successful MC program can also be achieved by allocating a sufficient budget for tools, support services, and academic compensation. Ensuring easier access to user-friendly platforms and targeted technical assistance will further support academic staff. In addition, establishing clear MC policies

may provide helpful guidance to the academic staff, along with structured training and technical support (equipment and staffing) for the UPD involved in MC development. Moreover, acknowledging the additional workload involved in MC development through appropriate planning may encourage greater academic engagement and long-term success. Ensuring strong support and awareness across all levels of the university is essential to foster a more conducive environment for MC programs. Finally, aligning MC courses with current industry demands is crucial to enhance relevance and employability. Finally, strengthening partnerships with industry stakeholders is also vital to ensure the practical applicability and value of MC programs. Moving forward, addressing these suggestions and recommendations in implementing the suggested enhancements could significantly boost participation, engagement, and the overall success of MC programs at the university.

6. CONCLUSION

The introduction of micro-credential (MCs) programs represents a promising step towards more flexible and accessible learning opportunities. The success of these initiatives, however, depends on the level of preparedness and support available to academic staff. The survey findings reveal that there are areas that could benefit from further development, particularly in upskilling, funding, and overall institutional support. Enhancing these aspects through thoughtful planning and resource allocation would help strengthen the implementation process. Not only that, balancing MC with other responsibilities, scheduling challenges with UPD aspects must be considered. In conclusion, with focused efforts, UNISEL is well-positioned to become a successful MC program, fostering innovation in teaching and expanding lifelong learning pathways for a diverse group of learners, which requires a multifaceted and strategic approach.

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Penggunaan Gamifikasi Dalam Membantu Pelajar Menguasai Kursus Ekonomi

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ABSTRAK

Kajian ini dijalankan bagi meneroka keberkesanan penggunaan gamifikasi dalam membantu pelajar menguasai kursus Ekonomi di Kolej Poly-Tech MARA Batu Pahat. Gamifikasi merupakan pendekatan pedagogi yang melibatkan elemen permainan seperti ganjaran, cabaran, dan persaingan sihat dalam konteks pembelajaran untuk meningkatkan minat dan penglibatan pelajar. Dalam era digital yang berkembang pesat, pelajar sering kali menunjukkan minat yang lebih tinggi terhadap kaedah pembelajaran interaktif dan menyeronokkan. Seramai 114 pelajar semester empat daripada program Diploma Pengurusan Sumber Manusia (AB107) di Kolej Poly-Tech MARA Batu Pahat telah menjadi responden kajian. Kaedah tinjauan kuantitatif digunakan melalui edaran soal selidik berstruktur yang menilai persepsi, motivasi, serta pemahaman pelajar terhadap kandungan kursus. Analisis statistik deskriptif menunjukkan bahawa pelajar mempunyai tahap penerimaan yang tinggi terhadap penggunaan gamifikasi, dan elemen ini berjaya meningkatkan motivasi serta kefahaman mereka terhadap konsep ekonomi yang sering dianggap abstrak. Kajian ini mencadangkan agar gamifikasi diterapkan secara meluas dalam pengajaran subjek bersifat teori bagi mewujudkan pengalaman pembelajaran yang lebih interaktif dan menyeronokkan. Kajian akan menggunakan statistik deskriptif, termasuk ukuran kecenderungan pusat (min, median, mod) dan ukuran penyebaran (*variance, standard deviation, range*).

Kata kunci: Gamifikasi, Ekonomi, Pendidikan Tinggi, Motivasi Pelajar, Pembelajaran Interaktif

1 PENGENALAN

Dalam era pendidikan abad ke-21, pendekatan pengajaran dan pembelajaran telah mengalami pelbagai transformasi selaras dengan perkembangan teknologi digital dan keperluan pedagogi semasa. Kaedah pengajaran tradisional yang terlalu berpusatkan pensyarah dan berasaskan kuliah semata-mata semakin dipersoalkan keberkesanannya, terutamanya dalam kalangan pelajar yang memerlukan pendekatan lebih interaktif dan menyeronokkan untuk mengekalkan motivasi dan minat terhadap sesuatu subjek. Kursus Ekonomi, yang sering dianggap sebagai subjek abstrak dan teoritikal, menjadi antara cabaran utama dalam menarik minat pelajar terutama di peringkat pengajian tinggi. Oleh itu, inovasi dalam pedagogi

seperti penggunaan gamifikasi semakin mendapat perhatian dalam kalangan pendidik sebagai alternatif yang berpotensi meningkatkan penguasaan pelajar dalam kursus ini.

Gamifikasi merujuk kepada penggunaan unsur-unsur permainan dalam konteks bukan permainan seperti pendidikan, perniagaan dan kesihatan. Dalam konteks pendidikan, gamifikasi bukan bermaksud menjadikan seluruh kursus sebagai permainan video, tetapi lebih kepada menyuntik elemen permainan seperti ganjaran, cabaran, pencapaian, papan skor, serta persaingan sihat bagi mewujudkan suasana pembelajaran yang lebih menarik, interaktif dan mendorong keterlibatan pelajar. Menurut Deterding et al. (2011), gamifikasi dalam pendidikan mampu meningkatkan motivasi pelajar secara intrinsik dan ekstrinsik, sekaligus memperkukuhkan pemahaman konsep serta pencapaian akademik mereka.

Kursus Ekonomi sering kali mencabar kerana memerlukan pelajar memahami konsep teori yang kompleks seperti penawaran dan permintaan, elastik harga, keluk utiliti, dasar fiskal dan monetari, serta penggunaan model matematik tertentu. Sekiranya pengajaran hanya berasaskan kuliah dan hafalan, pelajar berisiko hilang tumpuan, motivasi, dan gagal memahami aplikasi sebenar konsep ekonomi dalam kehidupan seharian. Maka, penyepaduan gamifikasi dilihat mampu menyediakan satu pendekatan yang lebih holistik dalam memperkasakan penguasaan pelajar terhadap topik-topik ekonomi melalui pendekatan yang lebih praktikal, visual dan bersifat eksperimen.

Kajian lepas menunjukkan bahawa penggunaan gamifikasi dalam pendidikan memberi kesan positif terhadap hasil pembelajaran. Sebagai contoh, kajian oleh Hamari et al. (2014) mendapati bahawa elemen permainan seperti pencapaian dan ganjaran meningkatkan minat serta komitmen pelajar dalam sesuatu kursus. Selain itu, kajian oleh Subhash dan Cudney (2018) menunjukkan bahawa gamifikasi membantu pelajar memahami konsep abstrak dengan lebih baik apabila mereka dapat menerapkannya dalam simulasi atau tugasan interaktif yang menyerupai situasi sebenar. Dalam konteks kursus Ekonomi, aplikasi seperti simulasi pasaran, kuiz interaktif, dan aktiviti pembelajaran berasaskan senario telah menunjukkan potensi tinggi dalam membantu pelajar membina pemahaman yang lebih mendalam dan bermakna.

Tambahan pula, pelajar generasi kini yang dikenali sebagai *digital natives* cenderung kepada pendekatan pembelajaran yang bersifat teknologi, visual, dan pantas. Maka, penggunaan gamifikasi bukan sahaja relevan dengan gaya pembelajaran mereka, tetapi juga mampu meningkatkan keterlibatan aktif dalam bilik darjah. Ia turut menyumbang kepada suasana pembelajaran yang lebih menyeronokkan, mengurangkan tekanan, serta memupuk semangat kerjasama dan persaingan sihat dalam kalangan pelajar.

Namun begitu, walaupun gamifikasi menunjukkan potensi besar, masih terdapat kekangan dan cabaran dalam pelaksanaannya. Antaranya ialah kekurangan kefahaman dalam kalangan pensyarah terhadap reka bentuk gamifikasi yang berkesan, kesesuaian elemen gamifikasi dengan objektif kursus, serta isu teknikal seperti infrastruktur ICT dan ketersediaan perisian yang sesuai. Selain itu, masih terdapat kekurangan kajian empirikal yang menyeluruh mengenai keberkesanan gamifikasi khususnya dalam pengajaran kursus Ekonomi di institusi pengajian tinggi tempatan.

Justeru itu, kajian ini dijalankan bagi meneliti keberkesanan penggunaan gamifikasi dalam membantu pelajar menguasai kursus Ekonomi. Kajian ini bertujuan untuk mengenal pasti elemen-elemen gamifikasi yang paling berkesan, menilai kesan penggunaannya terhadap tahap pemahaman dan motivasi pelajar, serta mengenal pasti cabaran-cabaran yang dihadapi dalam pelaksanaannya. Dapatan daripada kajian ini dijangka dapat menyumbang kepada pembangunan strategi pedagogi yang lebih inovatif dan efektif dalam

pengajaran kursus Ekonomi, di samping memberi panduan kepada para pendidik dan penggubal dasar dalam memperkasakan amalan pengajaran dan pembelajaran di peringkat pengajian tinggi.

2 KAJIAN LITERATUR

Gamifikasi didefinisikan sebagai penerapan elemen-elemen permainan ke dalam konteks bukan permainan bagi meningkatkan penglibatan pengguna (Deterding et al., 2011). Dalam konteks pendidikan, gamifikasi tidak bermaksud menggantikan pengajaran dengan permainan, tetapi menggunakan unsur seperti sistem mata, lencana, papan skor, tahap pencapaian dan ganjaran untuk meningkatkan motivasi dan fokus pelajar (Kapp, 2012). Beberapa kajian menyokong bahawa gamifikasi boleh mempertingkatkan minat pelajar, membina sikap positif terhadap pembelajaran, dan menambah baik hasil akademik (Subhash & Cudney, 2018).

Gamifikasi banyak diperkukuh melalui teori pembelajaran dan motivasi seperti *Self-Determination Theory* (Deci & Ryan, 2000), yang menekankan keperluan pelajar terhadap autonomi, kecekapan dan hubungan sosial. Unsur permainan seperti ganjaran dan cabaran dapat memenuhi keperluan psikologi ini dan seterusnya meningkatkan motivasi intrinsik pelajar. Begitu juga dengan *Flow Theory* (Csikszentmihalyi, 1990), yang menjelaskan bagaimana pelajar akan lebih terlibat apabila mereka berada dalam keadaan "arus" iaitu tertumpu sepenuhnya kepada tugasan yang mencabar tetapi masih boleh diuruskan.

Banyak kajian lepas telah membuktikan keberkesanan gamifikasi dalam pelbagai bidang pengajian. Sebagai contoh, Hamari et al. (2014) dalam kajian meta-analisisnya mendapati majoriti kajian menunjukkan kesan positif gamifikasi terhadap penglibatan dan prestasi pelajar. Kajian oleh Alsawaier (2018) pula mendapati bahawa gamifikasi mendorong pelajar lebih aktif, kreatif dan berdikari dalam pembelajaran. Dalam konteks pembelajaran dalam talian, gamifikasi turut berfungsi sebagai alat pemangkin untuk mengekalkan motivasi pelajar sepanjang kursus (Domínguez et al., 2013).

Walaupun kursus Ekonomi sering dianggap sebagai subjek teoritikal, beberapa kajian telah menunjukkan bahawa pendekatan gamifikasi dapat menjadikan pembelajaran ekonomi lebih mudah diakses dan menyeronokkan. Kajian oleh Buckley dan Doyle (2016) menunjukkan bahawa pelajar yang menggunakan aplikasi gamifikasi dalam pembelajaran Ekonomi menunjukkan tahap pemahaman dan kehadiran yang lebih tinggi berbanding kumpulan kawalan. Penggunaan simulasi pasaran, kuiz interaktif, dan permainan peranan (role-play) ekonomi turut membantu pelajar menerapkan teori dalam situasi dunia sebenar (Nouri et al., 2019).

Walaupun keberkesanan gamifikasi telah terbukti dalam banyak kajian, terdapat juga cabaran dalam pelaksanaannya. Antaranya ialah kekangan masa dan kemahiran pensyarah dalam merekabentuk bahan gamifikasi, kekurangan sokongan teknologi, serta persepsi negatif sesetengah pelajar yang menganggap elemen permainan sebagai sesuatu yang tidak serius (Seaborn & Fels, 2015). Selain itu, gamifikasi yang tidak selaras dengan objektif pembelajaran boleh menyebabkan pelajar hanya mengejar ganjaran tanpa memahami isi kandungan kursus.

3 PENYATAAN PERMASALAHAN

Kursus Ekonomi sering dianggap sukar dan membosankan oleh pelajar kerana sifatnya yang teoritikal dan abstrak. Kaedah pengajaran tradisional seperti kuliah dan nota semata-mata tidak mampu menarik minat atau meningkatkan pemahaman pelajar, terutamanya apabila kandungan tidak dikaitkan dengan situasi dunia sebenar. Keadaan ini telah menyebabkan ramai pelajar menghadapi masalah untuk menguasai konsep-konsep ekonomi penting, seterusnya menjejaskan prestasi akademik dan motivasi

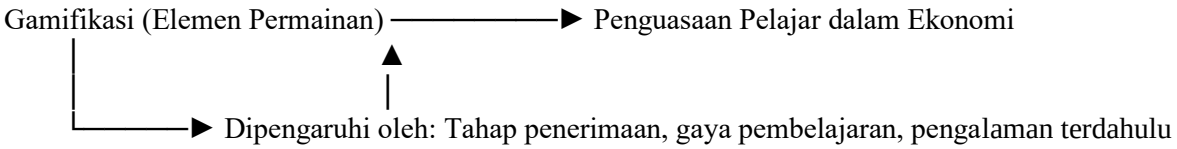
mereka dalam kursus ini. Tambahan pula, keberkesanan pendekatan gamifikasi bergantung kepada tahap penerimaan pelajar, reka bentuk pembelajaran, dan kesesuaian elemen permainan dengan objektif kursus. Maka, kajian ini dijalankan bagi meneliti bagaimana gamifikasi boleh membantu meningkatkan penguasaan pelajar dalam kursus Ekonomi, mengenal pasti elemen gamifikasi yang paling berkesan, dan memahami cabaran pelaksanaannya di peringkat pengajian tinggi.

3.1 Objektif Kajian

i. Mengenal pasti tahap persepsi pelajar terhadap penggunaan elemen gamifikasi dalam kursus Ekonomi.
ii. Menilai kesan gamifikasi terhadap motivasi dan penglibatan pelajar dalam proses pembelajaran.
iii. Mengukur sejauh mana penggunaan gamifikasi membantu pelajar memahami konsep-konsep dalam kursus Ekonomi.

3.2 Persoalan Kajian

i. Apakah tahap persepsi pelajar terhadap penggunaan elemen gamifikasi dalam kursus Ekonomi?
ii. Apakah kesan gamifikasi terhadap motivasi dan penglibatan pelajar dalam proses pembelajaran?
iii. Sejauh mana penggunaan gamifikasi membantu pelajar memahami konsep-konsep dalam kursus Ekonomi?



4 METODOLOGI

Kajian ini menggunakan pendekatan kuantitatif melalui reka bentuk tinjauan deskriptif, bagi menilai keberkesanan penggunaan gamifikasi dalam membantu pelajar menguasai kursus Ekonomi. Responden kajian terdiri daripada 114 orang pelajar semester 4 dalam program Diploma Pengurusan Sumber Manusia (AB107) di Kolej Poly-Tech MARA Batu Pahat. Instrumen kajian yang digunakan ialah borang soal selidik berstruktur yang mengandungi item-item berkaitan persepsi pelajar terhadap elemen gamifikasi seperti sistem ganjaran, cabaran permainan, dan pemahaman konsep. Kaedah gamifikasi yang telah diguna pakai dalam kajian ini adalah *Canva, Educarplay, Kahoot dan Quizzes*. Data yang diperoleh dianalisis menggunakan statistik deskriptif seperti min, median, mod, julat, sisihan piawai, dan varians untuk mengenal pasti corak taburan dan kepelbagaian skor responden.

4.1 Sampel Kajian

Sampel bagi kajian ini terdiri daripada 114 pelajar semester 4 Diploma Pengurusan Sumber Manusia (AB107) di Kolej Poly-Tech MARA Batu Pahat.

4.2 Instrumen Kajian

Borang soal selidik yang menggunakan *Google Form* berstruktur yang mengandungi item-item berkaitan adalah seperti: Bahagian A (demografi responden), Bahagian B (Persepsi terhadap Gamifikasi), Bahagian C (Motivasi dan Pengelibatan Pembelajaran) dan Bahagian D (Pemahaman dan Prestasi Akademik). Semua item soal selidik bagi setiap bahagian menggunakan skala Likert 5 mata (1 = Sangat Tidak Setuju, 5 = Sangat Setuju).

4.3 Kaedah dan Analisis Data

Item-item dalam soal selidik ini adalah dibina sendiri oleh penyelidik berdasarkan literatur berkaitan gamifikasi dan pembelajaran interaktif (Brockmyer et al., 2009; Deci & Ryan, 1985), serta disesuaikan dengan konteks kursus Ekonomi di intitusi pengajian tinggi. Kajian rintis (pilot test) juga telah dijalankan ke atas 30 orang pelajar untuk menguji kefahaman item soal selidik dan memastikan kebolehpercayaan instrument (Hertzog, M. A. ,2008). Nilai Cronbach's Alpha bagi setiap bahagian adalah melebihi 0.878, menunjukkan tahap kebolehpercayaan yang baik iaitu berhampiran dengan nilai 1. Nilai Cronbach's Alpha bagi instrumen soal selidik dalam kajian ini adalah 0.878, menunjukkan tahap kebolehpercayaan yang baik (George & Mallery, 2003; Nunnally & Bernstein, 1994). Oleh itu, instrumen ini dianggap sesuai dan boleh dipercayai untuk digunakan dalam kajian utama. Kajian adalah berbentuk deskriptif, di mana nilai min dan sisihan piawai yang dianalisa akan dibahagikan kepada empat julat iaitu 1.0 hingga 1.89 dinyatakan sangat rendah, 1.90 hingga 2.69 dinyatakan sederhana rendah, 2.70 hingga 3.49 dinyatakan sederhana 3,50 hingga 4.29 dinyatakan tinggi dan 4.30 hingga 5.00 dinyatakan sangat tinggi (Haron & Mohamed, 2016). Data telah dianalisa dengan menggunakan perisian *Statistical Package for Social Science (SPSS)* versi 28.0.

5 ANALISA DATA

Jadual 1: Min dan Sisihan Piawai bagi Persepsi terhadap Gamikasi

Bil.	Item	Min	Sisihan Piawai	Taksiran Min
1.	Saya faham maksud dan konsep gamifikasi.	3.79	0.43	±0.08
2.	Saya pernah menggunakan elemen permainan dalam proses pembelajaran saya sebelum ini.	4.17	0.93	±0.17
3.	Sistem ganjaran seperti markah atau hadiah mendorong saya untuk belajar lebih aktif.	4.46	0.52	±0.10
4.	Kehadiran cabaran permainan menjadikan pembelajaran lebih menyeronokkan.	4.00	0.58	±0.11
5.	Saya berasa lebih teruja untuk belajar apabila elemen permainan digunakan dalam kelas.	4.11	0.81	±0.15

Berdasarkan Jadual 1, tahap persepsi pelajar terhadap penggunaan gamifikasi berada pada tahap tinggi hingga sangat tinggi (min antara 3.79 hingga 4.46). Ini menunjukkan bahawa majoriti pelajar menyedari dan memahami konsep gamifikasi serta menerima penggunaannya dalam konteks pembelajaran. Item yang mencatatkan min tertinggi ialah "Sistem ganjaran seperti markah atau hadiah mendorong saya untuk belajar lebih aktif" (min = 4.46), menandakan bahawa pelajar sangat terpengaruh oleh elemen ganjaran. Penemuan ini selari dengan teori *Behaviorism*, di mana ganjaran berfungsi sebagai penguat (reinforcer) dalam meningkatkan tingkah laku pembelajaran yang diingini. Selain itu, dapatan menunjukkan bahawa kehadiran cabaran permainan dan elemen interaktif mampu menjadikan pembelajaran lebih menyeronokkan (min = 4.00) serta meningkatkan keterujaan pelajar untuk belajar (min = 4.11). Hal ini menyokong dapatan kajian Hamari et al. (2014) dan Subhash & Cudney (2018), yang menyatakan bahawa gamifikasi mampu merangsang minat dan keterlibatan pelajar terhadap sesuatu topik yang sukar difahami.

Jadual 2: Min dan Sisihan Piawai bagi Motivasi dan Penglibatan Pembelajaran

Bil.	Item	Min	Sisihan Piawai	Taksiran Min
1.	Gamifikasi menjadikan saya lebih motivasi untuk menyertai aktiviti pembelajaran	4.49	0.61	±0.11
2.	Saya lebih fokus apabila elemen permainan digunakan dalam pengajaran	4.10	0.59	±0.11
3.	Gamifikasi mendorong saya untuk berusaha mencapai markah yang lebih baik.	3.82	0.49	±0.09
4.	Saya berasa lebih yakin untuk menyumbang dalam perbincangan kelas apabila mengunakan pendekatan gamifikasi.	4.18	0.91	±0.17
5.	Elemen persaingan yang sihat melalui gamifikasi meningkatkan semangat belajar saya.	4.43	0.53	±0.10

Jadual 2 menunjukkan bahawa semua item berkaitan motivasi dan penglibatan pelajar mencatatkan min melebihi 3.80, dengan nilai tertinggi dicatatkan pada item "Gamifikasi menjadikan saya lebih motivasi untuk menyertai aktiviti pembelajaran" (min = 4.49). Ini menunjukkan bahawa elemen gamifikasi seperti persaingan, ganjaran, dan cabaran berjaya menanam semangat motivasi intrinsik dan ekstrinsik dalam kalangan pelajar. Dapatan ini memperkukuh teori *Self-Determination* (Deci & Ryan, 2000), yang menekankan keperluan pelajar terhadap autonomi, kecekapan, dan hubungan sosial untuk meningkatkan motivasi. Sebagai contoh, elemen persaingan sihat (min = 4.43) dan peningkatan keyakinan dalam menyumbang dalam kelas (min = 4.18) menunjukkan bahawa gamifikasi juga mampu memupuk interaksi sosial dan keyakinan diri.

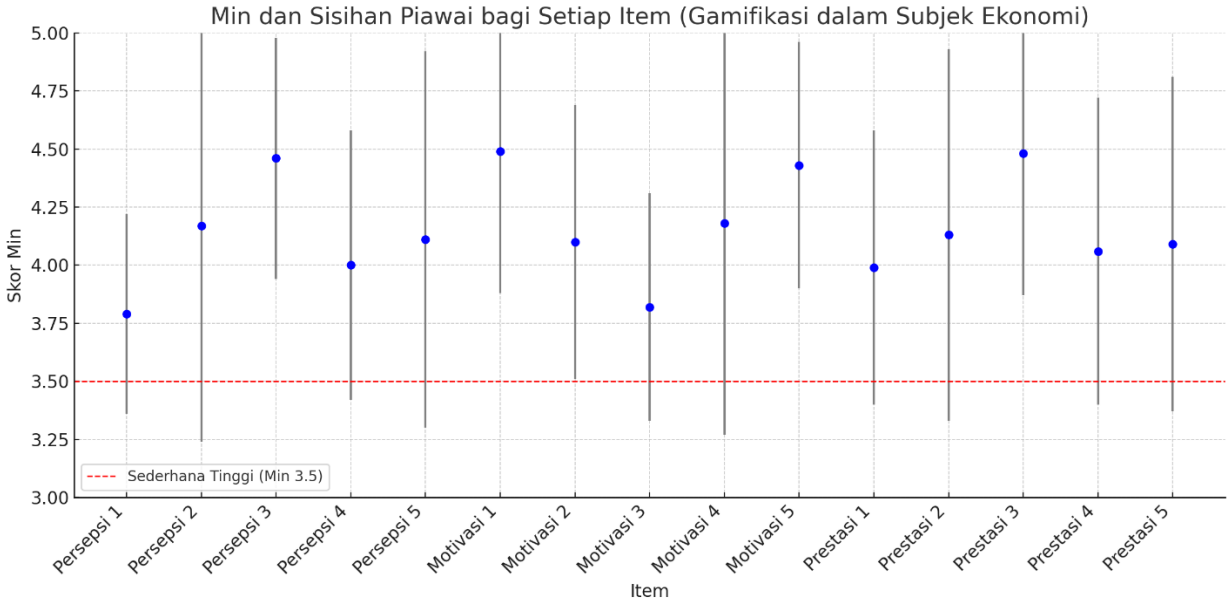
Jadual 3: Min dan Sisihan Piawai bagi Pemahaman dan Prestasi Akademik

Bil.	Item	Min	Sisihan Piawai	Taksiran Min
1.	Saya lebih mudah memahami konsep ekonomi yang abstrak apabila menggunakan aktiviti berbentuk permainan.	3.99	0.59	±0.11
2.	Gamifikasi membantu saya mengingati isi Pelajaran dengan lebih baik.	4.13	0.80	±0.15
3.	Saya merasakan prestasi saya dalam kursus ekonomi meningkat selepas menggunakan pendekatan gamifikasi.	4.48	0.61	±0.11

4.	Permainan yang diselitkan dalam pengajaran membantu saya menyelesaikan masalah ekonomi dengan lebih baik.	4.06	0.66	±0.12
5.	Saya lebih yakin untuk menghadapi penilaian apabila pembelajaran disampaikan melalui gamifikasi.	4.09	0.72	±0.13

Jadual 3, pula menunjukkan bahawa penggunaan gamifikasi bukan sahaja memotivasikan pelajar, malah meningkatkan pemahaman mereka terhadap kandungan kursus. Item "Saya merasakan prestasi saya dalam kursus Ekonomi meningkat selepas menggunakan pendekatan gamifikasi" mencatatkan min tertinggi iaitu 4.48. Ini menunjukkan bahawa penggunaan elemen permainan membantu pelajar menyerap dan mengaplikasikan konsep ekonomi dengan lebih berkesan. Selain itu, pelajar juga melaporkan bahawa aktiviti permainan membantu mereka menyelesaikan masalah ekonomi dengan lebih baik (min = 4.06) dan lebih yakin menghadapi penilaian (min = 4.09). Penemuan ini bertepatan dengan kajian oleh Buckley & Doyle (2016), yang mendapati bahawa pelajar yang menggunakan aplikasi gamifikasi menunjukkan tahap kehadiran, kefahaman dan pencapaian akademik yang lebih baik. Kajian ini tidak melibatkan kumpulan kawalan kerana reka bentuk yang digunakan adalah deskriptif kuantitatif. Menurut Creswell (2012), kumpulan kawalan tidak diperlukan dalam kajian tinjauan yang bertujuan meneroka persepsi atau hubungan antara pemboleh ubah.

Gambar Rajah 1: Analisa Ukuran Penyebaran



Gambar rajah 1, menunjukkan nilai min dan sisihan piawai bagi setiap item yang dikaji berkaitan gamifikasi dalam kursus Ekonomi. Secara keseluruhan, semua item mencatatkan nilai min antara 3.79 hingga 4.49, menandakan pelajar memberikan respons yang positif terhadap penggunaan gamifikasi. Item yang paling tinggi ialah berkaitan motivasi pelajar untuk menyertai aktiviti pembelajaran (min = 4.49). Sisihan piawai pula berada dalam julat sederhana, menunjukkan respon pelajar agak konsisten walaupun terdapat sedikit perbezaan pendapat. Ini membuktikan bahawa gamifikasi bukan sahaja meningkatkan minat pelajar, tetapi juga membantu dalam pemahaman dan penglibatan mereka dalam proses pembelajaran.

5.1 Implikasi Umum

Secara keseluruhannya, dapatan kajian menunjukkan bahawa gamifikasi merupakan pendekatan pedagogi yang berkesan dalam meningkatkan minat, motivasi, dan prestasi pelajar dalam kursus yang bersifat abstrak seperti Ekonomi. Namun, keberkesanan gamifikasi sangat bergantung kepada reka bentuk instrumen, penyampaian yang konsisten oleh pensyarah, serta penerimaan pelajar terhadap pendekatan ini. Gabungan elemen ganjaran, cabaran, persaingan, dan keseronokan perlu dirancang dengan teliti agar selaras dengan objektif pembelajaran. Sekiranya elemen ini disalahgunakan, ia berisiko menjadikan pelajar terlalu fokus kepada ganjaran semata-mata dan mengabaikan penguasaan ilmu secara mendalam.

6 KESIMPULAN DAN CADANGAN

Kajian ini telah menunjukkan bahawa penggunaan gamifikasi dalam pengajaran kursus Ekonomi memberikan kesan yang positif terhadap persepsi, motivasi, penglibatan, serta pemahaman pelajar. Dapatan menunjukkan bahawa elemen gamifikasi seperti cabaran, dan persaingan sihat bukan sahaja menjadikan pembelajaran lebih menyeronokkan, tetapi juga meningkatkan kefahaman pelajar terhadap konsep Ekonomi yang abstrak. Pelajar menunjukkan tahap motivasi yang tinggi apabila elemen permainan digunakan, di samping peningkatan prestasi akademik secara keseluruhan. Ini membuktikan bahawa pendekatan gamifikasi mampu menjadi strategi pedagogi alternatif yang berkesan dalam pengajaran dan pembelajaran kursus Ekonomi di peringkat pengajian tinggi.

6.1 Cadangan

Berdasarkan dapatan kajian, beberapa cadangan boleh dikemukakan seperti:

i. **Latihan kepada pensyarah:** Pihak institusi disaran menyediakan latihan kepada pensyarah untuk membina kemahiran dalam merancang dan melaksanakan elemen gamifikasi yang sejajar dengan objektif kursus.

ii. **Pembangunan aplikasi pembelajaran:** Pembangunan aplikasi atau platform pembelajaran berasaskan gamifikasi khusus untuk kursus Ekonomi wajar dipertimbangkan bagi memudahkan pelaksanaan secara sistematik dan berterusan.

iii. **Gabungan pendekatan pedagogi:** Gamifikasi boleh digabungkan dengan pendekatan lain seperti pembelajaran berasaskan masalah (*Problem-Based Learning*) atau pembelajaran kolaboratif untuk meningkatkan lagi keberkesanan pengajaran.

iv. **Kajian lanjutan:** Penyelidikan masa hadapan disarankan untuk meneroka keberkesanan gamifikasi dalam subjek lain serta membandingkan kesannya antara pelajar lelaki dan perempuan atau pelajar daripada latar belakang akademik yang berbeza.

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Benefits and Challenges of Using ChatGPT for Academic Writing in Malaysian ESL Classrooms

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ABSTRACT

This study explores how ChatGPT, a widely used Artificial Intelligence (AI) writing tool, contributes to the improvement of student writing in English as a Second Language (ESL) classrooms in Malaysia. The research focuses on its effects on content and organization, as perceived by ESL teachers.This paper presents a study on the impact of ChatGPT as a formative feedback tool on the writing skills of undergraduate ESL students. Using a qualitative approach with a case study design, data was collected through document analysis and interviews. The study analyzed 10 student assignments and conducted semi-structured interviews with three ESL lecturers from a private university in Ipoh, Perak, Malaysia.

KEYWORDS: ChatGPT, English language, Writing skills

1 INTRODUCTION

Artificial Intelligence (AI)-powered writing tools are becoming increasingly common in English as a Second Language (ESL) classrooms. These tools offer features such as grammar correction, writing assistance, and the ability to produce written content, including essays, autonomously. In today's globalized society, proficiency in the English language has become a crucial skill for individuals aiming to succeed in personal, academic, and professional spheres (Sari, 2023).

Globally, artificial intelligence (AI)-driven automated feedback is fast becoming the norm (Rad et al., 2023). Based on a large language model, ChatGPT, a relatively new addition to the repertoire of AI tools, can provide meaningful writing samples (Barrot, 2023), adjust the difficulty level of texts matching learners' proficiency level (Bonner et al., 2023), offer advice regarding various structural aspects of a text and translate it (Imran & Almusharraf, 2023), and facilitate guided writing (Kohnke et al., 2023).

While Yan (2023) has reported benefits to students' writing skills through its use, he has also warned that its use can threaten academic honesty and ethicality in writing.

According to Mahapatra (2024), ChatGPT as a formative feedback tool on the writing skills of undergraduate ESL students. Since artificial intelligence-driven automated writing evaluation tools positively impact students' writing, ChatGPT, a generative artificial intelligence-propelled tool, can be expected to have a more substantial positive impact. Formative feedback positively impacts students' writing (Anderson & Ayaawan, 2023). Usually associated with formative assessment strategies such as self-and peer assessment, formative feedback can be directed to address students' needs for explanation (Bozorgian & Yazdani, 2021; Zhang et al.,2023) concerning various aspects of writing such as content, organization, grammar, vocabulary, and style.

2 LITERATURE REVIEW

2.1 Positive effects

ChatGPT is said to be the latest natural language system that was published on 30 November 2022 (Castelvecchi, 2022). Teachers are encouraged to employ the artificial intelligence system in the classroom. Education and innovation experts, including Naidu (2023), have pushed teachers and institutions to reconsider the use of ChatGPT and other generative AI tools in education. These tools are a part of young people's lives and should be integrated into the curriculum. ChatGPT is helping the students with their English essay writing tasks. ChatGPT can assist students in practicing several writing genres, including essays, reports, and formal communication (Imran & Almusharraf, 2023). Moreover, ChatGPT has positively impacted those who had issues in writing. Zhai (2022) discovered that ChatGPT helps students and researchers generate writing that is logical, correct, systematic, and informative. Many studies have mentioned that ChatGPT definitely has helped students in their academic writing. ChatGPT can enhance a number of learning outcomes in several domains, such as language acquisition, academic writing and research, learner autonomy, and individualized learning (Atlas, 2023).
Additionally, ChatGPT provides feedback on students' writing, which encourages them to use it more frequently. Students can improve their writing abilities by using ChatGPT to get comments on their work (Baidoo-Anu and Owusu Ansah, 2023). From the perspective of digital literacy, Hamouma and Menezla (2019) highlight in a study of 80 EFL students a strong positive correlation between students having good digital literacy (including digital writing tool literacy) and students developing their English academic writing performance. However, using ChatGPT to produce entire articles and content from A to Z is unacceptable and may raise ethical concerns (Eke, 2023).

Theoretically, the utilization of ChatGPT for leveraging formative feedback can be placed within a framework comprising Barrot's (2023) theory. Barrot's (2023) theory of ChatGPT as a reliable writing tool that can provide immediate, need-based, and tailored feedback to students as they move through different stages of writing. The current study was built on these two theories as its aim was to utilize ChatGPT as a formative feedback tool involving SA and PA, and assess its impact on students' academic writing skills.

2.2 Drawbacks and Ethical Concerns

There are a number of disadvantages that come along with the usage of ChatGPT in writing. As is known, the presentation of answers on ChatGPT does not include the source of the answers. Qadir (2022) suggests that false information can be obtained using ChatGPT for a variety of reasons, including user-suggested prompts or input, training data quality, and application limitations. Students' overreliance on using ChatGPT has degraded their critical thinking skills, problem-solving, and imagination. All those skills are important, especially for the writing activity, because with those skills the students can improve their writing. if they have over-reliance on ChatGPT, they can only do a writing assignment using ChatGPT (Sok & Heng, 2023). Students' creativity has deteriorated significantly after the development of ChatGPT. Generative models can only produce replies based on patterns in the data they encounter during training, which can limit users' creativity and originality (Baidoo-Anu & Ansah, 2023).

2.3 Theoretical Framework

This review adopts the Technology-Based Learning Model proposed by Hsu et al. (2012) as the foundation for our research synthesis. This model underscores the importance of categorizing literature based on (1) application domains, (2) research methods, and (3) research issues when examining future trends in

technology-enhanced learning. It has been widely applied in various research reviews (e.g., Hwang & Chang, 2023; Liu & Hwang, 2023).

Notably, Hwang and Chang (2023) utilized this model to explore trends in chatbot-based education. Their review revealed that chatbots were most frequently applied in language learning, followed by engineering and computer science. In terms of research methodology, most studies employed quantitative approaches, followed by mixed-methods and qualitative designs. Additionally, they identified key research gaps, particularly the need for effective learning designs and strategies for chatbot integration.

As illustrated in Figure 1, we applied the three constructs of the Technology-Based Learning Model to analyze literature on ChatGPT-supported ESL/EFL education. A preliminary analysis of empirical studies (e.g., Bin-Hady et al., 2023; Mizumoto & Eguchi, 2023; Mohamed, 2024; Yan, 2024; Young & Shishido, 2023) included in Meniado's (2023) review helped establish a foundation for our synthesis. This initial step enabled us to identify a broader range of ChatGPT applications, research methods, and emerging issues across studies, ensuring a more comprehensive examination of its role in language education.

Research Questions

The study addressed the following two research questions:

1. What are the positive effects of using ChatGPT on the writing skills of undergraduates in an ESL classroom?
2. What are the negative effects of using ChatGPT on the writing skills of undergraduates in an ESL classroom?

3 METHODOLOGY

This research adopts a qualitative approach using a case study design to explore the phenomenon in depth. Two main methods were employed: document analysis and semi-structured interviews. For the document analysis, written essays from 10 diploma students were examined. Five students wrote their essays with the assistance of ChatGPT, while the other five completed their essays without using ChatGPT. In addition, two lecturers who taught these students were interviewed to gain further insight into the teaching and learning context. The semi-structured interview format allowed for flexibility while maintaining consistency in exploring relevant themes and perspectives.

3.1 Participants

The participants comprised 10 undergraduate students and 2 lecturers from a private university located in Ipoh, Kinta, Perak, Malaysia. These individuals were purposefully selected to provide insights based on their experiences and relevance to the study's objectives. All participants studied English as a second language and had undergone 11 years of English education within the Malaysian school system. Their ages ranged between 20 and 23 years.

4 FINDINGS AND DISCUSSION

The findings revealed that the integration of ChatGPT positively influenced students' writing performance, particularly in areas such as sentence structure, vocabulary usage, and overall essay organization. Students who used ChatGPT demonstrated more coherence and fluency in their writing compared to those who did not.

However, several challenges were also identified. Despite improvements in content and structure, students in the experimental group still faced issues with writing mechanics, including punctuation, capitalization, and spelling. This suggests that while ChatGPT can enhance certain aspects of writing, it

may not fully address foundational language errors and should be complemented by teacher guidance and proofreading practices.

4.1 Performance Of Students Who Used ChatGPT

4.1.1 Benefits Observed

Improved Sentence Structure

A central aspect of integrating ChatGPT into language education lies in its potential to improve students' writing skills (Ahmed, 2023). Moreover, earlier research has demonstrated that incorporating AI into education can enhance students' writing abilities (Pandia & Sibarani, 2023). Students who used ChatGPT showed marked improvement in their ability to construct complex and coherent sentences. Their essays demonstrated better syntactic variety and fluency.

For example:

"True growth happens when we step out of our comfort zone."

"In the end, I finished my speech and even won an award of excellence."

"This speech not only gave me an award, but it also made me believe in myself."

These examples reflect a growing command of compound and complex sentence forms. ChatGPT likely served as a model, helping students internalize and replicate effective sentence patterns.

Enriched Vocabulary Usage

There was a clear improvement in students' lexical choices. Words such as stunning, resembled, fabulous, and self-confidence appeared in the essays—terms that suggest a move toward more expressive and varied vocabulary. These are words not typically found in their earlier writing or classroom materials, indicating that ChatGPT may have broadened their exposure to new and useful vocabulary. The tool appeared to function as a built-in thesaurus and language model, helping students access and apply more appropriate and engaging word choices. For example, ChatGPT facilitate real-time dialogue, allowing students to acquire new expressions, enhance their vocabulary for more precise communication, and gain greater confidence in using the language (Karatas et al., 2024; Pham et al., 2024; Yeh, 2024).

Clear Essay Organization

All five students demonstrated effective essay organization, with each paragraph focused on a single main idea. This contributed to a logical progression of ideas and enhanced overall coherence. The ability to separate and develop distinct points across paragraphs is a fundamental academic writing skill. The use of ChatGPT may have supported this process by providing structural suggestions or models for paragraph development. According to Marzuki et al. (2023), the integration of AI writing tools can significantly enhance the quality of EFL students' writing, thereby contributing to improved language learning outcomes.

For instance, Student 1 began their essay with a clear and focused introduction: "A memorable experience from my life that taught me an important lesson is a Chinese speech contest in secondary school." This opening effectively sets the context and reflects a strong sense of organization from the outset. Graham et al.'s (2023) meta-analysis of 406 intervention studies demonstrated that instruction isolating the writing process through methods like peer assistance, teacher feedback, or computer-assisted instruction positively impacted idea generation, organizational skills, writing knowledge, and motivation.

Furthermore, Student 2 opened their second paragraph with the sentence, "Firstly, I started to create a timetable to focus on my study." The use of a cohesive device ("Firstly") not only links the paragraph to

the introduction but also signals a clear transition, indicating the student's awareness of paragraph unity and flow.

In addition, Student 3 concluded their essay by writing, "From this experience, I learned that leadership is not about control but collaboration." This reflective closing reinforces the main message of the essay and demonstrates the student's ability to bring ideas to a thoughtful conclusion, contributing to the overall cohesion and impact of the text.

4.2 Challenges Identified

Persistent Punctuation and Capitalization Issues

Despite the improvements noted above, students continued to struggle with basic writing conventions. According to Sülükçü & Kirboğa (2020), punctuation marks are crucial for comprehending the intended meaning of written phrases. Punctuation was often misused or omitted, especially commas and apostrophes. In addition, there were noticeable capitalization errors, particularly with unnecessary capitalization of common nouns or mid-sentence words. Examples include:

"But my teachers and Friends encouraged me…" — Friends should not be capitalized.

"I Learned that self-confidence is not something you are born with but built through practice and courage." — Learned should be lowercase.

These examples suggest students may not have fully grasped capitalization rules, and that AI tools like ChatGPT do not always prevent such issues unless students pay close attention during revision.

Spelling Errors

Several spelling errors were observed, particularly with more complex or unfamiliar words. Common examples included:

strength → strenght

nervous → nerves

test → text

These mistakes indicate that while students benefited from exposure to richer vocabulary through ChatGPT, they sometimes struggled to reproduce these words accurately. Additional instruction in spelling and proofreading remains necessary. According to Perkins (2023), Language Learning Machines (LLMs) are effective instruments for examining and identifying mistakes in EFL writing. Yet, students are making mistakes with the help of ChatGPT.

4.3 Performance of Students Who Did Not Use ChatGPT

Sentence Structure

Students in the control group, who wrote their essays without the aid of ChatGPT, displayed several issues in sentence construction.

For example, Student A wrote:

"Before i studying at the university, i think it like an experience that more enjoyable than working after primary school."

This sentence is grammatically incorrect and lacks clarity. The phrase "Before i studying…" is ungrammatical and indicates a misunderstanding of verb forms. A more accurate version would be: "Before

I studied at the university, I thought it would be a more enjoyable experience than working after primary school."

Student B wrote:

"There is one day, I was study as usual and after school I waited my parent to fetch me home for lunch." This sentence contains several grammatical errors, including incorrect verb tenses, improper article usage, and awkward phrasing. A clearer version could be: "One day, I was studying as usual, and after school, I waited for my parents to fetch me home for lunch." This example highlights common difficulties faced by students in maintaining tense consistency, selecting appropriate articles, and forming coherent sentences.

Persistent Punctuation and Capitalization Issues

Several students consistently made punctuation and capitalization errors. For instance, Student A repeatedly used the lowercase "i" instead of the capitalized "I", demonstrating a lack of awareness of basic writing conventions.

Student C wrote:

"I sat alone on my desk and not conversing with anyone not until my friend, Linda, arrived." This sentence reflects incorrect use of prepositions, verb tenses, and overall sentence structure. A corrected version might be: "I sat alone at my desk, not conversing with anyone until my friend, Linda, arrived."

These examples suggest that students without access to AI writing support struggled more with foundational language skills, particularly grammar, sentence construction, punctuation, and capitalization.

4.4 Interview Results

The following responses were gathered from three lecturers at the same private university based on these questions:

How has AI affected students' writing?
Do students rely too much on AI?
What are your concerns about AI in assignments?

Lecturer 1:

"Students' writing skills have improved, with better grammar, structure, and word choice. ChatGPT is a helpful tool, providing valuable ideas and enhancing students' thinking maturity. Plagiarism is not a major issue, as lecturers require students to cite their sources properly."

Lecturer 2

"Students feel less stressed about assignments because they rely on ChatGPT for better vocabulary. However, many submit AI-generated work without understanding what they have written. Some students copy entire AI-generated responses and submit them without modification. This raises ethical concerns, as learning should be an experiential process where students actively engage in developing their skills."

Lecturer 3:

"AI has positively impacted students' assignments by helping them refine and enhance their content. However, some students over-rely on AI and contribute little of their own input. Additionally, many fail to provide proper citations for AI-generated content."

The three lecturers acknowledged both the benefits and challenges of using AI in academic writing. They observed that AI tools like ChatGPT help students improve their grammar, structure, and vocabulary, making their writing more polished. However, concerns were raised about students relying too much on AI

without fully understanding their work. Many students copy AI-generated content without adding their own input or citing sources properly. This over-reliance raises ethical concerns, as learning should be an active process. While AI can support writing development, it should be used as a tool for enhancement rather than a replacement for critical thinking and independent learning.

5 LIMITATIONS

Despite the positive findings of this study, there are several limitations that should be considered when interpreting the results. First, the study focused on a small sample size of only 10 students, which may limit the generalizability of the findings. A larger sample with a more diverse group of students across different proficiency levels would provide a more comprehensive understanding of the impact of ChatGPT on academic writing. Additionally, the study was conducted over a short period, and the long-term effects of using AI tools like ChatGPT were not examined. Future research should explore the sustained impact of AI assistance on writing skills over time. Another limitation is that the study only focused on one type of essay, a descriptive essay. Other genres of writing, such as argumentative or analytical essays, may present different challenges and benefits when using ChatGPT. Lastly, the study did not account for potential differences in how students engage with AI tools based on their individual learning styles or technological familiarity, which could influence the outcomes.

6 RECOMMENDATIONS

Based on the findings, it is recommended that ESL educators consider integrating AI tools such as ChatGPT into writing instruction to support students' development in key areas like sentence structure, vocabulary, and overall essay organization. However, it is crucial that students receive proper guidance on how to use these tools responsibly. Educators should train students to use ChatGPT as a supplementary aid rather than a replacement for original thinking and effort. A blended instructional approach that combines traditional grammar teaching with AI support can help address persistent issues in punctuation, capitalization, and spelling. Additionally, teachers themselves should undergo professional development to become familiar with the capabilities and limitations of AI tools, ensuring that they can guide students effectively in a balanced and ethical manner.

7 IMPLICATIONS

This study has several implications for ESL teaching and learning in Malaysian classrooms. First, it highlights the potential of AI tools like ChatGPT to transform conventional pedagogical practices by introducing innovative methods for improving academic writing. The positive results from students who used ChatGPT suggest that such tools can enhance writing instruction when used appropriately. Second, the findings suggest the need for curriculum updates that reflect the growing relevance of digital tools in education. Embedding AI literacy into writing instruction can help prepare students for a technology-driven academic and professional landscape. However, educators and institutions must also be mindful of equity issues. Unequal access to AI tools may widen performance gaps among students, so ensuring that all learners have equal opportunities to use and benefit from such technologies is essential.

8 SIGNIFICANCE

This study holds significant implications for both ESL pedagogy and educational technology. The findings suggest that AI tools like ChatGPT can play a crucial role in enhancing students' writing abilities, particularly in areas such as sentence structure, vocabulary development, and essay organization. By integrating AI into the classroom, educators can offer personalized writing support, helping students

improve their language proficiency in a more interactive and accessible way. Moreover, the study contributes to the ongoing conversation about the potential of AI in education, providing insights into its benefits and challenges. This research highlights the importance of balancing traditional teaching methods with innovative technological tools to create more dynamic and effective learning environments. Ultimately, the study lays the groundwork for future research in this area and provides valuable insights for educators looking to incorporate AI into their teaching practices to foster student success.

9 CONCLUSION

This study examined the impact of ChatGPT on academic writing in a Malaysian ESL classroom, comparing the performance of students who used AI tools with those who did not. The findings revealed that ChatGPT can significantly enhance writing quality, particularly in areas like grammar, sentence structure, vocabulary, and overall organization. Students who used ChatGPT showed clear improvements in these aspects, demonstrating its potential as a valuable educational tool.

However, the study also highlighted several concerns, notably students' over-reliance on AI. Many students struggled with understanding the content they submitted, relying heavily on AI-generated responses without fully engaging with or modifying the material. Ethical concerns about plagiarism and the lack of proper citation practices were also raised by lecturers, indicating that the use of AI in academic settings must be carefully monitored and integrated into the learning process.

The findings suggest that while AI tools like ChatGPT can support the development of writing skills, they should be used as a complementary tool rather than a substitute for independent learning. Educators should encourage students to actively engage with AI-generated content, ensuring it enhances rather than replaces their learning experience. Future research could further explore the long-term effects of AI on writing skills and academic integrity.

In conclusion, AI offers significant potential in improving students' writing performance, but its use must be balanced with critical thinking and proper academic practices to ensure it contributes positively to students' learning experiences.

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Keberkesanan Pembelajaran Berasaskan AI dalam Kalangan Pelajar Diploma in Computer Science (CC104) KPTMAS

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ABSTRAK

Kajian ini menilai keberkesanan pembelajaran berasaskan kecerdasan buatan (AI) dalam kalangan pelajar Diploma in Computer Science (CC104) di Kolej Poly-Tech MARA Alor Setar (KPTMAS). Data diperoleh melalui soal selidik yang mengumpulkan maklumat mengenai pengalaman pelajar menggunakan platform AI, serta impaknya terhadap motivasi dan prestasi akademik. Hasil kajian menunjukkan majoriti pelajar menggunakan alat AI seperti ChatGPT dan CoPilot yang membantu mempercepat proses pembelajaran, mempermudah pemahaman konsep kompleks, dan meningkatkan motivasi belajar. Walaupun terdapat cabaran teknikal seperti capaian internet perlahan dan kekurangan sokongan pensyarah, pelajar mencadangkan penambahbaikan seperti pembelajaran yang disesuaikan dan maklum balas segera. Kajian ini memberikan pandangan penting bagi merangka strategi berkesan penggunaan AI dalam pendidikan tinggi (Smith & Johnson, 2019; Tan & Lee, 2020; Ministry of Higher Education Malaysia, 2020; UNESCO, 2021).

KATA KUNCI: Pembelajaran AI, Motivasi Pelajar, Prestasi Akademik, Teknologi Pendidikan, Diploma in Computer Science

1 PENGENALAN

Perkembangan pesat teknologi kecerdasan buatan (AI) telah membuka pelbagai peluang inovatif dalam sektor pendidikan. AI bukan sahaja digunakan untuk mengautomasi proses, tetapi juga menyediakan pengalaman pembelajaran yang lebih interaktif dan personal. Teknologi seperti ChatGPT dan CoPilot adalah contoh aplikasi AI yang membantu pelajar memahami konsep yang kompleks dan mempercepatkan proses pembelajaran mereka (Smith & Johnson, 2019).

Di Malaysia, transformasi digital pendidikan menjadi agenda penting bagi meningkatkan daya saing dan kualiti pendidikan tinggi【Ministry of Higher Education Malaysia, 2020】. Dalam konteks Kolej Poly-Tech MARA Alor Setar (KPTMAS), pengenalan AI dalam program Diploma in Computer Science (CC104) diharapkan dapat meningkatkan motivasi pelajar dan prestasi akademik secara signifikan. Walau bagaimanapun, pelaksanaan teknologi baru ini tidak bebas cabaran. Masalah teknikal, seperti capaian internet yang tidak stabil, dan kekurangan sokongan daripada pensyarah adalah antara isu yang perlu diberi perhatian serius (UNESCO, 2021; Tan & Lee, 2020).

Kajian ini bertujuan mengkaji secara menyeluruh impak penggunaan AI terhadap pengalaman pembelajaran pelajar, khususnya dari aspek motivasi, prestasi akademik, serta cabaran yang mereka hadapi. Dengan memahami faktor-faktor ini, institusi pendidikan dapat merangka strategi lebih berkesan untuk mengintegrasikan teknologi AI dalam proses pengajaran dan pembelajaran.

2 METODOLOGI

Kajian ini menggunakan pendekatan kuantitatif yang melibatkan soal selidik dalam talian bagi mengumpulkan data daripada pelajar Diploma in Computer Science (CC104) di KPTMAS. Soal selidik ini direka untuk mengumpulkan maklumat tentang latar belakang pelajar, penggunaan alat AI, tahap motivasi, prestasi akademik, serta cabaran yang dihadapi semasa menggunakan teknologi tersebut.

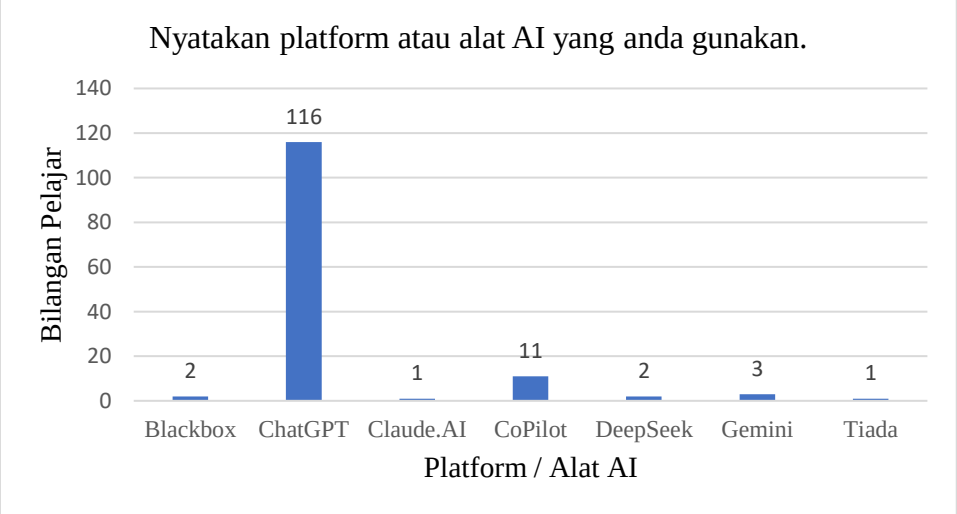
Penggunaan soal selidik membolehkan pengumpulan data yang sistematik dan mudah dianalisis secara statistik deskriptif untuk mendapatkan gambaran menyeluruh. Selain itu, soalan terbuka dalam soal selidik membolehkan penilaian kualitatif melalui analisis tematik untuk mengenal pasti isu dan cadangan yang dikemukakan oleh pelajar (Dutt & Sharma, 2021).

Proses pemilihan responden menggunakan kaedah persampelan mudah yang menyasarkan semua pelajar dalam program berkenaan. Data yang dikumpul dianalisis menggunakan perisian statistik untuk menentukan peratusan dan purata skor, manakala analisis tematik dilakukan secara manual bagi soalan terbuka. Analisis prestasi akademik dilakukan berdasarkan data senarai dekan merentasi 4 semester (Semester 1, Semester 2, Semester 4, dan Semester 5) melibatkan 56 pelajar keseluruhan. Pendekatan ini membolehkan kajian menghasilkan dapatan yang tepat dan relevan terhadap objektif penyelidikan.

3 HASIL DAN PERBINCANGAN

3.1. Penggunaan Alat AI dalam Pembelajaran

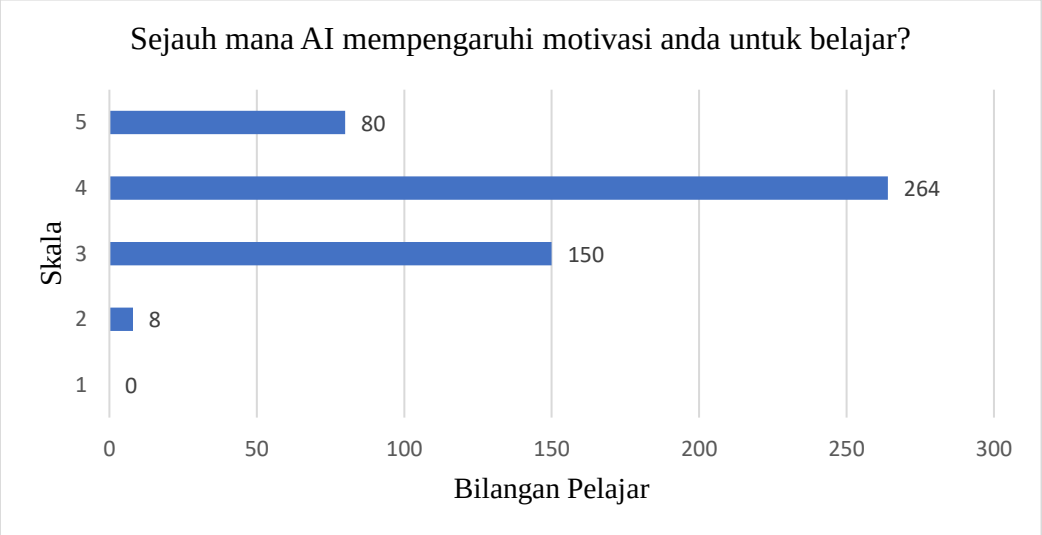
Data kajian menunjukkan bahawa platform AI yang paling popular digunakan oleh pelajar ialah ChatGPT dan CoPilot. Penggunaan teknologi ini bukan sahaja mempercepat proses pencarian maklumat, tetapi juga membantu pelajar untuk memahami konsep-konsep yang sukar dengan cara yang lebih interaktif dan praktikal (Smith & Johnson, 2019).



Graf 1: Platform AI yang digunakan oleh pelajar

3.2. Kesan Terhadap Motivasi Pelajar

Sebanyak 80% responden melaporkan peningkatan motivasi belajar setelah menggunakan alat AI. Pengalaman pembelajaran menjadi lebih menarik kerana AI menawarkan pelbagai fungsi interaktif seperti pemberian maklum balas segera dan penyesuaian kandungan mengikut keperluan pelajar (Ali & Bakar, 2020). Hal ini selari dengan laporan UNESCO (2021) yang menyatakan AI dapat mempertingkatkan penglibatan pelajar secara signifikan melalui pendekatan pembelajaran adaptif dan interaktif.



Graf 2: Kesan AI terhadap motivasi pelajar

Nota: Skala motivasi dari 1 (Sangat tidak memotivasi) hingga 5 (Sangat memotivasi).

3.3. Impak Terhadap Prestasi Akademik

Kajian mendapati 95% pelajar merasakan prestasi akademik mereka bertambah baik melalui penggunaan AI. Alat AI memudahkan pemahaman dan penguasaan topik yang kompleks, sekaligus meningkatkan keupayaan pelajar untuk menghadapi peperiksaan dan menyiapkan tugasan dengan lebih baik (Dutt & Sharma, 2021).

Kajian ini turut disokong dengan peningkatan prestasi akademik pelajar yang menunjukkan hasil yang sangat memberangsangkan. Data keputusan akademik merentasi empat semester (Semester 1, Semester 2, Semester 4, dan Semester 5) melibatkan 54 orang pelajar bagi kohort 0723 secara keseluruhan menunjukkan beberapa penemuan utama:

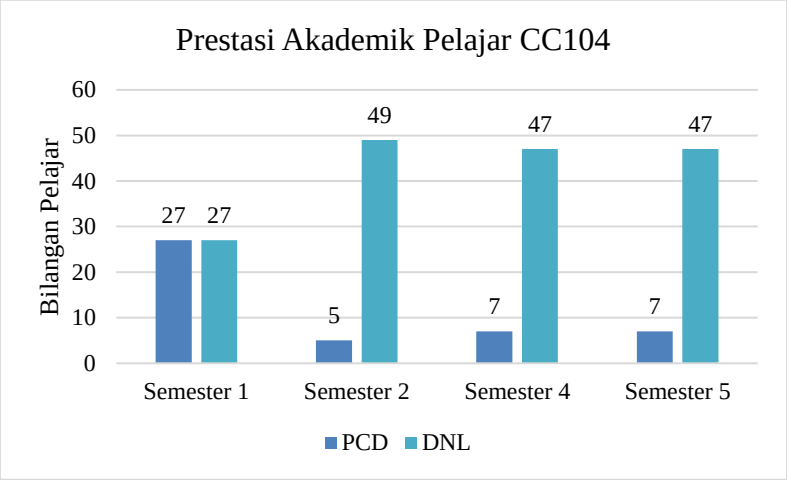
Prestasi Keseluruhan Yang Cemerlang: Kadar senarai penerima anugerah dekan mencapai 78.7% bagi keseluruhan empat semester. Pencapaian ini menunjukkan keberkesanan pendekatan pembelajaran berasaskan AI yang telah diimplementasikan.

Semester Terbaik: Semester 2 mencatatkan pencapaian yang luar biasa dengan kadar senarai dekan 90.7% (49 daripada 54 pelajar). Ini menunjukkan bahawa pelajar telah mula menyesuaikan diri dengan penggunaan teknologi AI dan merasai manfaatnya dalam pembelajaran.

Kecemerlangan Yang Konsisten: Semester 4 dan Semester 5 kedua-duanya mengekalkan prestasi senarai penerima anugerah dekan yang kukuh sebanyak 87%. Prestasi ini membuktikan bahawa manfaat pembelajaran berasaskan AI dapat dikekalkan dalam jangka masa panjang.

Peningkatan Yang Stabil: Terdapat trend peningkatan yang jelas dari Semester 1 (50%) ke Semester 2 (90.7%). Peningkatan dramatik ini menunjukkan bahawa pelajar memerlukan masa penyesuaian dengan teknologi AI sebelum dapat memanfaatkannya sepenuhnya.

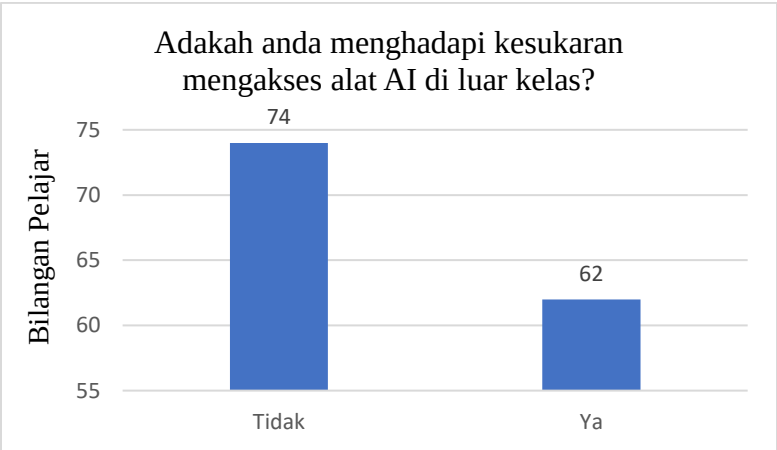
Taburan Yang Seimbang: Semester 1 menunjukkan pembahagian sama rata 50-50 antara pelajar yang mencapai senarai dekan (*Dean List* (DNL)) dan yang tidak mencapai (*Proceed* (PCD)). Ini menunjukkan tahap permulaan yang neutral sebelum pelaksanaan penuh pembelajaran berasaskan AI.



Graf 3: Prestasi akademik pelajar bagi 4 semester.

3.4. Cabaran dalam Penggunaan Alat AI

Walaupun banyak manfaat diperoleh, beberapa cabaran utama juga dikenalpasti. Antaranya adalah masalah capaian internet yang perlahan (35% pelajar), kesukaran dalam memahami cara penggunaan alat AI (25%), dan kekurangan sokongan teknikal daripada pensyarah (20%). Isu-isu ini menghalang penggunaan teknologi AI secara optimum dan menuntut tindakan segera dalam aspek infrastruktur dan Latihan (Ministry of Higher Education Malaysia, 2020; Tan & Lee, 2020).



Graf 3: Kesukaran akses kepada alat AI di luar kelas

3.5. Cadangan untuk Penambahbaikan

Pelajar mencadangkan beberapa penambahbaikan untuk meningkatkan keberkesanan pembelajaran berasaskan AI, termasuk penyediaan pembelajaran yang lebih disesuaikan mengikut keperluan individu, pemberian maklum balas segera, antara muka pengguna yang mesra dan mudah difahami, serta peningkatan sokongan teknikal (Ali & Bakar, 2020; UNESCO, 2021).



Graf 4: Ciri yang diharapkan untuk meningkatkan keberkesanan pembelajaran AI

Nota:

No	Ciri-ciri
1	Membolehkan pembelajaran disesuaikan mengikut keperluan setiap pelajar.
2	Memberikan maklum balas dengan cepat tentang kemajuan pelajar.
3	Mempunyai antara muka yang mudah digunakan dan difahami.
4	Menyediakan kandungan yang sesuai dengan apa yang dipelajari di KPTMAS.
5	Menyediakan pembelajaran interaktif seperti kuiz atau simulasi.
6	Boleh digunakan bersama bahan pembelajaran lain yang ada di KPTMAS.
7	Menyediakan sokongan dalam pelbagai bahasa.
8	Ada panduan yang mudah difahami, seperti video atau tutorial.
9	Memberikan peringatan untuk membantu mengurus masa pembelajaran.
10	Menyediakan alat untuk melihat kemajuan pembelajaran pelajar.
11	Sesuai dengan silibus pembelajaran di KPTMAS.

4 KESIMPULAN

Kajian ini membuktikan bahawa penggunaan kecerdasan buatan dalam pembelajaran memberikan impak positif terhadap motivasi dan prestasi akademik pelajar Diploma in Computer Science di KPTMAS. AI memudahkan pelajar memahami konsep kompleks dan meningkatkan minat mereka terhadap pembelajaran. Bukti objektif prestasi akademik menunjukkan pencapaian yang cemerlang dengan kadar senarai dekan keseluruhan 78.7%, peningkatan dramatik dari 50% pada Semester 1 kepada 90.7% pada Semester 2, dan prestasi tinggi yang konsisten sebanyak 87% pada Semester 4 dan Semester 5. Pencapaian ini menyokong keberkesanan pembelajaran berasaskan AI dalam meningkatkan standard akademik pelajar. Namun, cabaran teknikal seperti masalah capaian internet dan kekurangan sokongan daripada pensyarah perlu diatasi melalui strategi dan pelan tindakan bersepadu. Institusi pendidikan disarankan menyediakan latihan yang mencukupi untuk pelajar dan pensyarah serta memperbaiki infrastruktur teknologi bagi memaksimumkan potensi penggunaan AI dalam pendidikan tinggi.

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Beyond the textbook: The Effectiveness of MindTap in Promoting Self-Centered Learning (SCL) and Academic Efficiency

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ABSTRACT
Recent advancements in self-directed learning (SDL) and self-performing learning systems (SPL) have been enabled by the availability of digital platforms across different areas of higher learning. This pilot research focuses on evaluating the success of self-centered learning (SCL) by Cengage's interactive educational platform MindTap on university students's academic efficiency. This qualitative research was executed through a semi-structured interview with an open-ended questionnaire for a particular group of undergraduates (Diploma and Bachelor Degree) students of Universiti Sultan Azlan Shah (USAS) who utilized MindTap for an entire academic term. MindTap's guided autonomy, active achievement, goal directed behavior, and complex control functions promoted self-management, advanced learning strategies and great enhancement in academic performance. Respondents revealed that they are likely to experience enhanced motivation, positive treatment to time management, and ownership of the learning change. In particular, four major user center challenges emerged. First, response to a first time user experience was considered unfriendly. Second, there are mixed usability perceptions regarding the user interface. Third, there are perceived technological constraints. Finally, the added convenience experienced by a last user. The study seeks to inform evolving discourses surrounding digital pedagogy. These results stress the need of choosing an appropriate platform and its design critically to help enhance the students' engagement and learning results. Further research is suggested to build on these results through large comprehensive experiments, longitudinal studies, and the application of new technologies like artificial intelligence, adaptive personalized systems, and data-driven learning analytics.

Keywords: *Digital Learning Platforms, MindTap, Self-Centered Learning (SCL), Academic efficiency, Student autonomy, higher education.*

1 INTRODUCTION

The introduction of digital learning platforms into higher education has changed the student interaction with academic content. The development of technology in the world expands opportunity for auto-didacticism, adding to the effectiveness of well-aimed learning goals. An example would be MindTap created by Cengage, a complete online option that incorporates textbook content, film clips, quizzes, and tailored coaching to support modular, interactive learning (Cengage, 2023). MindTap has been known to

be interactive and gives students a personalized learning experience that fills each student's knowledge gaps, allowing students to put more focus into their learning. Cengage (2023) also writes than students reported greater engagement and better grades when using MindTap.

Taking control of one's own learning enables learners to independently determine, pursue, and assess their learning objectives, allowing self-determined persistence. The role of self-directed learning in online learning environments has gained emphasis with emerging research. In one study, a meta-analysis by Doo and Zhu (2024) found moderation to self-directed learning was positively correlated with learning achievement. In light of academic achievement, self-management and motivation were crucial.

MindTap is developed based on the SDL principles that provide tailor-made learning experiences, immediate feedback and study resources in various learners' preferences. Such characteristics not only foster engagement but also improve academic achievements. (A study by Altinpulluk et al, 2023 on the relationship of SDL and academic achievement indicates that the innovative application of digital platforms such as MindTap can greatly promote affective learning strategies.

Similarly, the use of digital learning tools is associated with better engagement and satisfaction of students with academic learning. Studies have shown that students using digital resources such as MindTap are more motivated and are also more academically efficient. An example is research on the investment of students in use of digital resources that revealed that the tools, indeed, support self-directed learning activities and academic performance.

These results notwithstanding, more empirical work is needed in the area of the effects of MindTap on SDL and academic efficiencies. The present study attempts to remedy this gap by examining use of and experience with MindTap by students, and evaluating its effect on students' learning autonomy as well as academic achievement. This study aims to gather preliminary thoughts on how digital platforms might be optimised to help promote SDL within higher education and what to consider to support this process.

1.1. Research Objectives

This study aims to:

i. Explore student perspective of digital learning and MindTap.
ii. Determine student learning experience of MindTap
iii. Examine the relationship between students' use of MindTap and their perceived academic efficiency.

1.2. Research Questions

Research questions include:

i. How do students use MindTap to guide and manage their learning?
ii. What challenges do students face when using MindTap independently?
iii. To what extend do students believe MindTap contributes to their academic efficiency?

1.3. Significance of the Study and Research Gap

The adoption of technology in higher education has transformed the way learners retrieve and interact with educational resources. Among these technologies, MindTap stands out as one of the most popular applications which integrates course materials, interactivity, and individualized learning pathways. While many studies have looked into the effectiveness of e-learning environments, (Broadbent & Poon, 2015; Almarashdeh, 2016) very few have focused on the role of MindTap with regard to self-directed learning and academic results in higher education.

Self-centered learning, which stems from self-regulated learning and learner autonomy frameworks, emphasizes students' control over their learning in terms of setting objectives, timelines, and personal assessments (Zimmerman, 2002; Panadero, 2017). In this case, MindTap provides powerful features in the form of calendars, progress trackers, quizzes, and multimedia tools that are integrated within

the platform that can be accessed in real time. These features align with most contemporary pedagogical paradigms; however, some gaps still exist. Specifically, there is a lack of empirical research assessing the effectiveness of these features in enhancing learners' independent learning skills and overall academic performance.

Furthermore, as concentric literature has noted, educational e-learning platforms have been discussed predominantly in matters of functionality or satisfaction by the learner (Sun et al., 2008; Liaw et al., 2007). There remains a meta-research concern on how particular features of a platform encourage or support a student's meta-cognitive growth and self-efficacy. This is especially pertinent in the new post-pandemic context of education, where blended and fully online schooling has become the standard. Understanding whether platforms such as MindTap go above and beyond simple content delivery is critical—specifically, whether they truly support deeper cognitive engagement and promote academic productivity.

This research is important because it attempts to address the gap in research and analysis concerning the effectiveness of MindTap on self-centred learning and academic performance at a university level. This study enriches the understanding of digital learning technologies by capturing the primary perceptions and experiences of the users themselves. The findings of this study contribute an important data input and insight to Cengage and also helps educators, policymakers and instructional designers contemplating the adoption or improvement of such platforms to be more supportive of autonomous, purposeful, and effective learning by tailoring the technologies to the evidence presented in this study.

2 LITERATURE REVIEW

2.1 Self-Directed Learning (SDL) in Higher Education

Self-Directed Learning (SDL) is associated with learners: deciding upon, diagnosing, setting goals, finding, selecting and making use of resources, and assessing to improve learning. Such an approach is becoming more and more important at all levels of higher education, including distance and blended learning.

Khalid, Bashir, and Amin (2020) also compared SDL between students in ODL and in conventional universities. Their results showed that there was a significant correlation between SDL and educational performance ($P<0.001$) and that, e-learners have a better readiness for SDL.

Additionally, Saeid and Eslaminejad (2017) examined students' SDL readiness and their levels of academic self-efficacy and achievement motivation. Their study demonstrated a significant positive relationship between higher SDL readiness and higher academic self-efficacy and motivation, and the need to develop SDL skills to improve academic achievement.

2.2. Digital Learning Platforms (DLP) and Academic Efficiency

With the introduction of digital learning platforms, the way of delivering education has changed with the promise of interactive and personal learning experience. Such platforms play a key role of accelerating academic efficiency, because there is a flexible access to resources and a self-paced learning. Recent literature confirmation during the last few years, the importance of digital learning tools has been proved to some extend in promoting student motivation and knowledge retention (Doo and Zhu, 2024). Digital platforms may be able to facilitate a learner-centred approach through the provision of real-time analysis and interactive content, which can enable the learner to self-assess and progress at their own pace (Clark, 2021).

The interrelationship among uses of technology, SDL and student engagement, from which positive effects on performance emanate, was taken up by Rashid and Asghar (2016). In addition, research in Frontiers in Psychology (2022) indicated that digital learning systems play a large role in affecting student's learning motivation and behaviour. The study pointed out that educational application (apps) and virtual classrooms can optimize learning experiences and students' motivation to learn.

A recent review by Brugliera in 2024 looked into what makes Digital Learning Platforms (DLPs) work better for students. The study pointed out some important things to consider, like the tech setup, how teachers communicate and interact with students, and the different personalities and learning styles of students. It found that when DLPs are designed thoughtfully, they can really help boost student interest and their grades, especially in learning settings where both online and in-person teaching happen.

On a related note, another study by Salas-Pilco and colleagues in 2022 took a closer look at online learning. They found that several factors come into play in its success. Things like how convenient it is for students, the flexibility of online courses, and how well students manage their own learning were key points. The findings showed that students who are good at staying on task and regulating their own study habits tend to make the most of the flexible nature of online learning platforms. They really thrive when they can learn at their own pace and on their own schedule.

2.3. MindTap as a Tool for Enhancing SDL and Academic Efficiency

MindTap is a digital learning platform made by Cengage that's all about creating a personalized learning environment. You'll find loads of interactive content, get real-time feedback on how you're doing, and have access to analytics that help you keep track of your learning journey. What's cool is that it lets students take control of how they learn, which really aligns with self-directed learning.

Now, while there aren't a ton of studies that focus specifically on how well MindTap works, its setup clearly encourages self-directed learning. For example, you get instant feedback on your progress, and you can choose your own learning paths. This can really boost your motivation and help you manage your own learning better, which tends to lead to better results in school.

In a study by Clark (2021), they looked into how ready business students were for self-directed learning and how it affected their grades. The results showed that students who felt more ready to learn on their own tended to do better in their studies. This really points to the idea that platforms like MindTap, which support learners in taking charge of their education, might actually help students succeed academically. Overall, it seems that when students have the tools and support to direct their own learning, they might just come out on top.

Doo and Zhu (2024) did a study that showed a medium effect size (g=0.508) of self-directed learning on how well people learn online. This backs up how helpful digital tools like MindTap can be for independent learning. The platform includes features like quizzes and guided practice that fit nicely with Knowles' ideas about adult learning, especially when it comes to self-management and staying motivated.

2.4 Comparative MindTap Effectiveness with other Platforms

A leading platform like Canvas and Moodle, that is known for its flexibility and strength as an open-source suite of tools, and also for often being difficult to configure and for not including instructional materials. MindTap, in contrast, boasts ready-made modules with assessments as well as tools for monitoring progress, which work to keep students more accountable and teach them better time management.

As Clarks (2021) note, the students that use MindTap generally find the structure and content of their learning experience more satisfactory than those who use the standard learning management systems.posed a specific modeled response for social interaction based on the arena in which the subject engaged the operator. This matches what Cengage's own reports show, with MindTap users enjoying better course completion rates and higher exam scores (Cengage, 2023).

Table 1: Comparison of Features across Selected Digital Learning Platforms

Features	MindTap	Blackboard	Edmodo	Google Classroom
Built-in Content	Yes	No	Limited	No
Learning Analytics	Strong	Advanced	Basic	Basic

UI/UX	Moderate	Moderate	Friendly	Simple
Mobile Apps Support	Yes	Yes	Yes	Yes
Ideal User Group	Higher Ed	Higher Ed	K-12	K-12 & Colleges
Integration/Customization	Moderate	High	Low	High (G-Suite)

When compared four popular digital learning platforms — MindTap, Blackboard, Edmodo and Google Classroom — we will start to see discrepancies in the content that is integrated, the analytical tools, user experience and more. The weighted comparison for Table 1 has been compiled from platform documentation and recent studies such as Al-Fraihat et al (2020), Cengage (2023), Iftakhar (2016) and Trust (2017).

3 METHODOLOGY

3.1 Research Design

This study used a qualitative case study method to explore at how well MindTap works as a digital learning tool for helping students at Universiti Sultan Azlan Shah (USAS) with self-directed learning and improving their academic performance. A case study is a good choice because it helps to understand students' experiences in their actual learning environments (Creswell, 2013).

3.2. Respondents

This research is aimed at undergraduate students working towards their Diplomas or Bachelor's Degrees in courses of HRM6013 Human Resource Management, HRM6083 Change Management, and WKU6033 Organizational Behavior. These courses are part of a university setup where students use of MindTap for their learning. To gather the data, we decided to focus on a selected group of 10 participants who are regular users of MindTap in their studies. There are a few key criteria for these participants:

i. The students who have consistently used MindTap for at least a full semester. This way, we know they have enough experience with the tool to provide valuable insights.
ii. Secondly, we want participants from a mix of different academic programs so we can get a broad perspective on how MindTap works for various fields of study.
iii. Lastly, it's important that these students are willing to take part in interviews. We want them to share their experiences openly, so their willingness to engage is crucial for the success of this study.

3.3. Data Collection Method

Data collected using semi-structured interviews, allowing respondents to share in-depth insights while enabling the researcher to probe for clarity and elaboration. All interviews were recorded (with consent) and transcribed for analysis. Interviews protocol includes:

i. Students' perceptions of MindTap's features and usability
ii. The impact on MindTap on time management, academic performance and motivation
iii. Reflections on how MindTap supports or challenges self-directed learning behaviours.

3.4. Instrument Development

The interview questions developed based adaptation on:

i. Self-Directed Learning (SDL) frameworks (Knowles, 1975)
ii. Academic efficiency models (Zimmerman, 2002)
iii. Previous research instruments such as those from Clark (2021) and Saeid & Eslaminejad (2017).

4 FINDINGS AND ANALYSIS

The thematic findings and analysis derived from interviewing students who used MindTap in their academic courses will be presented in this section. The collected data revealed extensive information about students' interactions with MindTap and its effectiveness in promoting self-centered learning (SCL) together with academic efficiency. Key insights about students' platform experiences in promoting self-centered learning (SCL) and academic efficiency emerged from the thematic analysis.

4.1. Respondent's Demographic Background

The study includes demographics details about the respondents in Table 2. The study included second-year undergraduate students between 20- and 23-years old pursuing diploma and degree programs.

Most respondents stated their usage of the MindTap platform was limited to under six months. The analysis uses background information to position participant responses according to their academic level and digital learning exposure. Analyzing participant demographics profiles is essential to determine how academic experience and platform usage duration affect perceptions of platform effectiveness.

Table 2: Respondent Demographics

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	5	50%
	Female	5	50%
Age	21	2	20%
	22	2	20%
	23	2	20%
	24	2	20%
	25	2	20%
Programme of Study	Diploma of Business Administration	3	30%
	Bachelor of Business Administration (BBA)	4	40%
	Bachelor of Accounting (BOA)	1	10%
	Degree of Counselling	1	10%
	Degree of Islamic Studies	1	10%
Year of Study	Year 2	3	30%
	Year 3	7	70%
Duration of MindTap Use	Less than 6 months	20	100%
Frequency of Use	Occasionally (weekly)	6	60%
	Frequently (Daily)	4	40%

4.2. Perceived Usefulness and Ease of Use

(Adapted from Park, 2009- Technology Acceptance Model)

The research revealed that 70% of participants found MindTap to be both *"relatively straightforward" and "user friendly"* during their initial use. The user-friendly nature and intuitive navigation of MindTap simplifies the learning process for students when they encounter new educational technologies. During their first registration experience, 30% of students experienced *"confusion and complicated difficulties".* The account registration process presented challenges that caused student confusion. The multiple steps required during the registration process which asks users to input extensive

information led students to view MindTap's interface as unfriendly to users. Students experienced additional difficulties with complicated access code retrieval after payment which impacted their initial platform experience and increased their learning time. The majority of students rated the registration difficulty for a MindTap account as 'neutral' on a five-point scale due to confusing steps during registration and excessive required information as well as challenges in acquiring the access code.

The majority Because MindTap is a methodical and well-structured system, all respondents (100%) said *"it makes it easier for them to complete tasks and stay on track with their studies".* When the lecturer gave out quizzes and assignments, the calendar's features alerted the students to the due dates. Better time management and completion of academic assignments are facilitated by centralized access to resources.

According to students, MindTap offers them structured and interactive activities that help them develop their comprehension and support their independent learning. MindTap makes the materials and resources easily accessible and helps students gain a deeper understanding of the course. It offers a thorough explanation of a specific subject along with real-world examples and scenarios (case study). When they complete the case study, *"they receive prompt feedback on the correct response and are aware of the areas that require improvement and attention"*. A number of students emphasized particular features, like e-books, chapter notes, and videos, as being especially beneficial and simple to use. These findings align with Davis's (1989) Technology Acceptance Model (TAM), particularly the construct of Perceived Ease of Use, suggesting that a simple interface promotes more frequent and confident usage.

4.3. Student Engagement (Adapted from Martin & Bolliger, 2018)

According to the students, MindTap helped them feel *"more engaged with their course content."* Clarity and a sense of connection to learning resources and materials were enhanced by the interactive elements, which included quizzes, flash cards, and revision exercises. Compared to a physical book, the MindTap's organized and streamlined version made it simpler to access at any time and from any location. Additionally, MindTap makes them feel like they've improved their study skills and accomplished something. These results align with the engagement dimensions described by Martin and Bolliger (2018), which highlight interaction and content layout as important engagement factors.

Although involvement was usually strong, some findings suggested that MindTap activity participation was sometimes teacher-led. Students said they used the platform *"when instructed by the lecturer,"* implying that outside cues could still influence use instead of total autonomous involvement. Others also answer that *"they have a drive and desire to do regular revision in preparation for the class to be ready with the chapter discuss".*

Motivation by means of structure was another notable topic. Students said MindTap *"easy to access and more engaging than read a physical book because its provide interactive and immediate feedback (grade graph) that made them feel more motivated to do better for next task"*. This framework seems to promote momentum and a feeling of success, therefore strengthening the natural drive to finish tasks.

4.4. Learning Efficiency and Academic Outcomes (Adapted from Bond et al, 2020)

MindTap According to students, because of the single access point to resources and due dates, MindTap *"keeps students focused (priority) on their work."* And features like "quiz deadlines" and when assignments could be submitted allowed for easier study management. MindTap Guides their time stress helps me take care not to mention stress Participants' responses: It makes managing your school assignments way easier, take advantage and delegate the task I'm doing it and finish it before the dead lines and don't have time to waste. The due dates and the dates of the quizzes were clearly displayed so students could stay organized and be prepared. These findings also coincide with the framework of Martin and Bolliger (2018) for student engagement in that there is a focus on interacting meaningfully in online learning.

Feedback that the students provided shows a good acceptance to the MindTap platform with regards to impact on performance, support of organization, and user satisfaction. They furnish evidence

that academic performance has significantly improved, *"before using MindTap, my academic performance was very much poor compare after I have started using MindTap for self-study,"* and further elaborates that improved performance is because of MindTap the reinforcement of the fundamental concepts are reduces regular practices quizzes, read e-book, flash card and video. These findings resonate well with the prior work indicating the pedagogical affordances of digital learning tools in higher education. Table 3 Generic Presentation of the Research Findings the Real Student Performance Data by Subject for MindTap.

Table 3: Student's Academic Performance by Subject Utilizing MindTap.

Subject	Grade	Number of Student	MindTap Usage
WKU6033 Organizational Behaviour	A	7	Yes
	B+	3	Yes
HRM6013 Human Resource Management	A	9	Yes
	B+	1	Yes
HRM6083 Change Management	A	4	Yes
	B+	6	Yes

The students emphasized the importance of organized features like timed sessions and the content chart. These features were identified as being conducive to improved structuring and retention. The specific reference to *"learning every single time"* is indicative of how the repetitious and discrete nature of the platform can accommodate the articulation and scaffolding of more advanced concepts. The useful organizational tools that students referred to included calendar and progress tracker, notes on subtopics also in another voice.

4.5. Satisfaction, Content and Platform Quality (Adapted from Sun et al, 2008)

The response, which represents an alternative view on the educational value of MindTap tempered by significant pedagogical/staffing demands as well as the financial and technological challenges, is detailed below. Content quality of MindTap was expressed as satisfaction. The students remarked that saving time and energy, as the result of using the platform, *"is one of the benefits of the platform and it makes the learning process more efficient."* The respondent likes the quality of the matter and of the content in general which is, in his words: *"great, well-structured, relevant, informative, updated features and interactive".* These findings are validate by further studies pointing out that learners appreciate educational technologies that help them perform academic assignments with ease and less cognitive load.

The only technical issue mentioned was that of intermittent disconnection from the internet which resulted in random automatic logout. Some notes were slow load time and lag (buffering), quiz submission trouble and system errors. However, despite the mentioned drawbacks, the respondents report these matters did not seriously interfere with their learning. This represents some kind of tolerance or habituation on the part of users, but it also points towards a necessary provision of stable internet for institutions keen in making the best use of this platform.

Students were *"very likely to recommend MindTap to a friend and lauded its convenience as well as the multi-dimensional utility".* These aspects consisted of facilitated use, time and energy work relieving and an improved better understanding. The recommendation speaks to *"the potential of the platform's broader adoption and to the perceived benefit from digital learning environments to enhance student success".* Despite the recommendations of the respondents for MindTap, they also raise the concern of cost. *"Paying the RM69 subscription fee per subject per year is seen as overbearing, especially to students from a low-income family"*. This observation highlights a spectre of equity in digital education: Great content is often the bottleneck. The comment serves as a piece of evidence-based research for the ongoing debate in higher education about the concealed costs of academic success in the digital media era.

5 DISCUSSION

Results from responses of participants provide strong evidence on the effectiveness of MindTap in promoting self-centred learning (SCL) and regulating academic effectiveness. Self-directed learning (SDL) which includes traits of autonomy (Self-Control, Self-management, Self-governance), self-regulation (Intention, Metacognition, Strategies), and learner responsibility (Goldman, 2012) is increasingly hailed as the fulcrum of 21st century education. The evidence collected in this research demonstrate that MindTap is an effective platform that can be used to foster these educational tenets.

Students would also like seeing additional features with MindTap that would further encourage independent learning such as voice playback and highlighting in the notes for example. These features allow student interaction with content on a personal level, reinforcing comprehension and retention of content. The ability to listen back to notes and highlight important points are aspects of self-regulated learning, such as metacognitive awareness and strategic planning, which are central to the content of the material (Zimmerman, 2002). They support student paced learning, consistent with Knowles' (1975) andragogy theory where adults learn best when given control and responsibility for their learning.

Along with the best class content and technology tools, MindTap also includes our highly acclaimed student support and retention elements that help our students stay organized and use their time effectively. According to students, these tools enabled them to better schedule their time, become regular studies and have insight about deadlines and goals. These findings are in line with previous literature which suggests that in digital learning environments when content is combined with organizational tools it increases student productivity and self-efficacy (Broadbent & Poon 2015).

Additionally, some students agreed to significant performance improvements in their academic performance after pairing with MindTap. Regular testing and instant feedback supported ongoing study, and deepened comprehension in accordance with a constructivist view which stresses that the more learners are actively involved in the learning process the better the outcome (Biggs, 2012). These gains show that MindTap is not only content-oriented, but also a cognitive scaffolding tool for education.

On the other hand, there were some restrictions also found in this study. The cost of the MindTap subscription, which was prohibitively expensive for some students, was a repeated issue. This concerns of affordability pending important questions about digital access and equity in education. With deeper integration of MindTap into educational curriculum, both institutions and developers need pricing models that don't exclude students for financial reasons. Some technical problems, such as slow loading or lag time, were also mentioned, though, as the majority of students said, they did not substantially interfere with their learning experience.

In summary, MindTap may be an effective tool to encourage SCL and academic efficiency. Its learner-centred applications, resources and activities facilitate development of independent learning skills and enhanced study skills resulting in improved academic outcomes. However, wider incorporation of these platforms in routine practice should be partnered with measures to overcome the barriers of cost and technical reliability. With some careful refinement though, MindTap could be a force to reckon with in the ever-changing world of digital and andragogy learning.

6 CONCLUSION AND RECOMMENDATIONS

This work analysed the contribution of MindTap as a digital learning environment for SCL (Self-Centered Learning) and the improvement of academic productivity by higher education students. Such results serve to support that such structured instructional pathways, interactive assets and embedded formative assessments of MindTap support the development of learner autonomy, motivation and performance. Students felt that self-regulation was boosted, study habits improved and the engagement with the course material increased, providing empirical evidence that confirms the extant literature on the beneficial impact that digital technologies have on independent learning pathways.

However, a number of restrictions were recognized. Technological access, digital literacy and user experiences of a platform interface are just some of the mediating factors that expose inequalities which

need to be bridged in order for MindTap to be most effective for all learning communities. Moreover, due to this being an initial homogenous sample of study, it is also necessary to treat these results with caution in terms of generalizing to wider populations.

Recommendations derived from these findings are suggested. First, there is the need for MindTap to further develop adaptive learning in order to customize educational experiences for the diverse population of learners. Second institution should offer all students and teachers thorough induction and ongoing digital literacy support to minimize access and usability hurdles. Third, instructors should also use MindTap as one piece in a pedagogical approach, linking the active learning, formative assessment and reflective learning activities it supports to enhance the success of their students.

Lastly, additional longitudinal studies with bigger and more diverse samples and cross-institutional comparisons are needed to confirm and extend these findings. Exploiting the adoption of artificial intelligence, learning analytics and gamification with MindTap Investigating the integration of artificial intelligence (AI), learning analytics and gamification into MindTap may lead to the development of new avenues for driving engagement, SDL (self-directed learning) and such academic achievement in the complicated environment at the higher level of education.

7 FUTURE RESEARCH

Since this study is one of the first explorations of the extent to which MindTap is an effective tool for increasing SCL and students' efficiency in the classroom, there are a few important directions for future research.

First, other researchers should employ quantitatively large-scale designs in multiple educational settings to verify (and generalize) our findings. Increasing sample size, as well as cross-pollination of student population will strengthen the external validity of the findings.

Further, experimental work with treatment/control groups are required to demonstrate more conclusive cause and effect relationships between MindTap use and the efficiency of academic performance, learning, and independence. Quasi-experimental or RCTs (Randomized controlled trials) would be better evidence for measure the effectiveness.

Third, employing qualitative research methodologies (i.e., in-depth interviews and focus groups) with both students and faculty can help reveal richer understandings of users experience and motivations, as well as barriers to using digital learning platforms such as MindTap.

One another important area is the incorporation of developing technology, include artificial intelligence (AI), adaptive learning systems and augmented reality into platforms like MindTap. Studies should investigate how such tools can also help to improve and personalize the self-directed learning (SDL) experience.

Lastly comparative studies across different cultures, languages and sociodemographic backgrounds would be useful in investigating how the take-up platforms can be placed within their contexts. Comparative research like this could offer useful insights for the development of culturally relevant and inclusive learning technologies.

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Challenges in Applying Generative AI to Engineering Education: A Study of Possible Interventions

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ABSTRACT

The integration of generative artificial intelligence (GenAI) into engineering education has revealed unprecedented opportunities for enhancing pedagogical practices, learning experiences, and research methodologies. However, its adoption is accompanied by numerous challenges that hinder its widespread and effective implementation. This study examines the challenges associated with the utilization of GenAI in engineering education with the aim of isolating the top five challenges and proposing viable solutions. The selection of these challenges was a complex endeavour due to the extensive range of potential issues, which span from fundamental to intricate matters. To facilitate this examination, data were gathered from secondary sources and analyzed using a descriptive approach, with results presented in tabular format for clarity. The identification and selection of relevant literature as well as the reporting of results were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. For each identified challenge, potential solutions are proposed. The findings indicate that the top five challenges, in decreasing order of significance, include: accuracy issues, ethical considerations, excessive reliance on GenAI tools, integrity of assessments, and data privacy concerns. By isolating these challenges and offering practical solutions, this research endeavours to provide a strategic framework for educators and policymakers to optimize the potential of GenAI while addressing its inherent limitations.

KEYWORDS: Generative AI; Challenges; Engineering Education; Pedagogy

1 INTRODUCTION

The advent of generative artificial intelligence (GenAI) has revolutionized numerous domains, including education. GenAI systems, such as ChatGPT (text generation), MusicGen and MusicLM (audio generation), midjourney (image generation) and DALL-E (image generation), can produce human-like text, images, and designs, making them highly applicable in engineering education (Chiu, 2023; Dwivedi et al., 2023). These tools enable personalized learning, enhance problem-solving skills, and simulate real-world engineering scenarios (Lu et al., 2023). However, their adoption in education, especially in engineering disciplines, presents a complex set of challenges that require critical assessment. The reasons for this are as follows:

First, engineering education is distinct from other disciplines due to its emphasis on the integration of theoretical knowledge with practical application as well as its focus on precision, reliability, and

adherence to rigorous standards. It demands a multidisciplinary approach, combining mathematics, physics, and computer science with hands-on design and problem-solving skills. This unique combination of theory and practice creates specific challenges and opportunities when applying GenAI tools.

Second, engineering projects often involve iterative design processes and collaboration among diverse teams. Generative AI can assist in these processes by generating multiple design options, automating repetitive calculations, and facilitating visualization. However, the risk of over-reliance on AI or the generation of biased or flawed outputs necessitates a tailored approach to its use in engineering education (Wang and Li, 2022).

Thirdly, teaching responsible AI use is emphasized by the ethical and societal ramifications of engineering solutions. In addition to learning how to utilize GenAI tools, engineering students should be aware of the larger implications of implementing AI-generated ideas and systems in practical settings. This ethical dimension, combined with the technical rigor of engineering, underscores the need to study GenAI in engineering education separately (Brown et al., 2021).

Finally, engineering education often involves complex simulations, prototyping, and experimentation—areas where GenAI can provide significant value (Johri et al., 2023a). For example, AI can optimize designs for 3D printing, model structural behaviour under various conditions, or simulate fluid dynamics. These applications are highly specific to engineering and highlight the need for research focused on tailoring generative AI tools to meet these specialized requirements (Lu et al., 2023).

Given that the engineering education landscape is uniquely demanding, requiring the integration of theoretical knowledge with practical applications, it is imperative to deploy GenAI tools that can potentially bridge this gap by automating repetitive tasks, facilitating innovative design, and providing instant feedback on student performance (Wang and Li, 2022). However, the unregulated use of GenAI raises significant concerns. Ethical issues, such as plagiarism and intellectual property violations, are becoming more pronounced as AI-generated content becomes indistinguishable from human work (Brown et al., 2021). Additionally, the accuracy of AI outputs is heavily dependent on data quality and this poses challenges in engineering contexts where precision is paramount (Smith et al., 2022). In addition, faculty and students often face barriers to adopting GenAI due to limited technical expertise, resistance to change, and inadequate institutional support (Jones et al., 2020). In addition, the development of essential skills in engineering education—critical thinking and creativity—could be hindered by an over dependence on GenAI tools (Ju, 2023). The possibilities and difficulties of GenAI in the classroom have been the subject of numerous studies, however, few have comprehensively analyzed the challenges specific to engineering disciplines and their possible solutions.

This study uniquely focuses on the top five challenges associated with integrating generative AI into engineering education, emphasizing both the technical and pedagogical dimensions. Unlike prior research that often generalize the deployment of GenAI in education, this study showcases a robust assessment tailored to the distinctive requirements of engineering disciplines. By systematically evaluating possible solutions for each challenge, the study offers a practical framework for overcoming barriers to generative AI adoption. This approach ensures that the benefits of AI integration can be fully realized while mitigating its risks, paving the way for a more effective and responsible use of GenAI in engineering education.

This research is organized into several key sections to ensure a logical and comprehensive exploration of the topic. The second section will show the research design while the third section would examine existing studies, identifying gaps, challenges, and potential solutions proposed in each research as well as detail the approach used to identify, categorize, and analyze the top five challenges. The fourth section would discuss these challenges and provide actionable strategies for addressing challenges. The fifth section will conclude the study and suggest areas for future research.

1.1 Historical Context of Disruptive Technologies in Education

As days go by, the teaching and learning landscape keeps getting sophisticated as a result of the technological revolutions dotting the space per second (see Figure 1). Whereas every technological

innovation comes with its benefits, there are equally attendant challenges. Frenkel and Emara (2024) asserted that the advent of the calculator generated apprehensions among mathematics educators over students' ability to comprehend the underlying mechanisms of their calculations when calculators were allowed. Similar concerns were raised with the advent of the PC, increased access to the internet, and now, with access to GenAI.

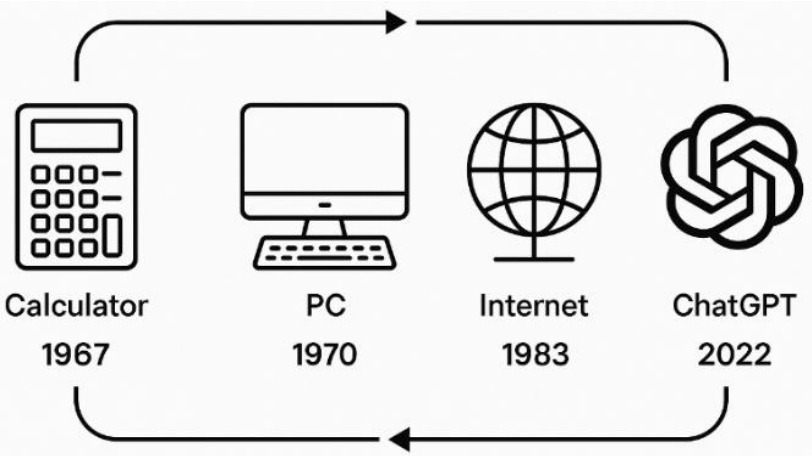


Figure 1: Historical development of disruptive technologies in education

One of the key distinctions between these tools is their reliability. Calculators rarely yield erroneous calculations, and educators have devised methods to integrate their use in the classroom without undermining students' problem-solving skills. Internet access is regarded as a disruptive tool; although the dependability of online information warrants ongoing vigilance, the utilization of personal computers and the internet has become a standard resource in educational settings. GenAI tools such as ChatGPT is the next disruptive technology in teaching and learning. Much like the calculator and the PC before it, GenAI may be poised as the next opportunity for educators to reevaluate their methods and can make the case for increased critical thinking and information literacy skills in all disciplines. Regardless of how academics feel about the future use of AI in tertiary education, the reality is, it is nowhere and will become increasingly integrated into the structure of education (Honig et al., 2025). Students are able to use it in a wide range of ways, both legitimate and malicious, that may not be detectable (Uzun, 2023). Since GenAI is here to stay, further exploration and examination of how it can or should be incorporated into STEM education and professions is vital.

1.2 Objective of the Study

The objective of this study is to critically examine the specific challenges associated with integrating GenAI into engineering education and to propose context-specific, pragmatic interventions that address these challenges. By focusing on the specific solutions, this work would serve as a guide to educators, especially in the field of Engineering in responsibly leveraging GenAI to enhance learning outcomes and preserve the core educational values of engineering disciplines.

1.3 Theoretical Framework of the Study

This study is underpinned by the Unified Theory of Acceptance and Use of Technology (UTAUT) framework which aims to explore the behavioural intentions of educators and students toward GenAI adoption. This framework is based on four constructs namely: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). These constructs help explain variability in adoption and resistance trends among students and engineering educators of GenAI.

2 RESEARCH DESIGN

This review utilizes the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to systematically find, select and analyze pertinent material. Only studies pertaining to engineering education that concentrate on the application of generative AI; encompassing all engineering disciplines, including chemical, electrical, civil, petroleum, mechanical, food, agricultural, and computer engineering; authored in English; and published from 2022, following the release of the predominant generative AI, ChatGPT, to the present were included. The study rejected all research pertaining to non-engineering education, non-GenAI studies, and those whose language of publication is not English.

Electronic database searches were performed via Google, the Education Resources Information Center (ERIC), SCOPUS, teaching and learning conference proceedings, and Web of Science, among others. Engineering education and GenAI subject heading phrases were utilized in conjunction to retrieve data from each accessed database. The methodology employs the strategy illustrated in Fig. 2. The pertinent articles obtained from the internet databases were chosen in three phases. In the initial phase, after inputting the pertinent keywords in each database, the titles of articles that satisfied the addition and elimination benchmarks were evaluated to retain only those titles pertinent to the review. The initial search results from the entire databases considered resulted in 727 articles, then 76 duplicates were removed resulting in 651 unique articles for further evaluation. In second phase, the abstract of each of the articles obtained based on title screening further studied for relevancy and only abstracts that contained relevant information related to engineering education and GenAI were considered. In this case, 616 articles were screened out for not meeting the search criteria. In the third stage, the complete text of the articles obtained from the abstract screening was also examined for relevance and inclusion. This process resulted in the eligibility and inclusion of 32 papers in the final review. The PRISMA chart shown in Figure 2 illustrates the steps and the number of papers considered.

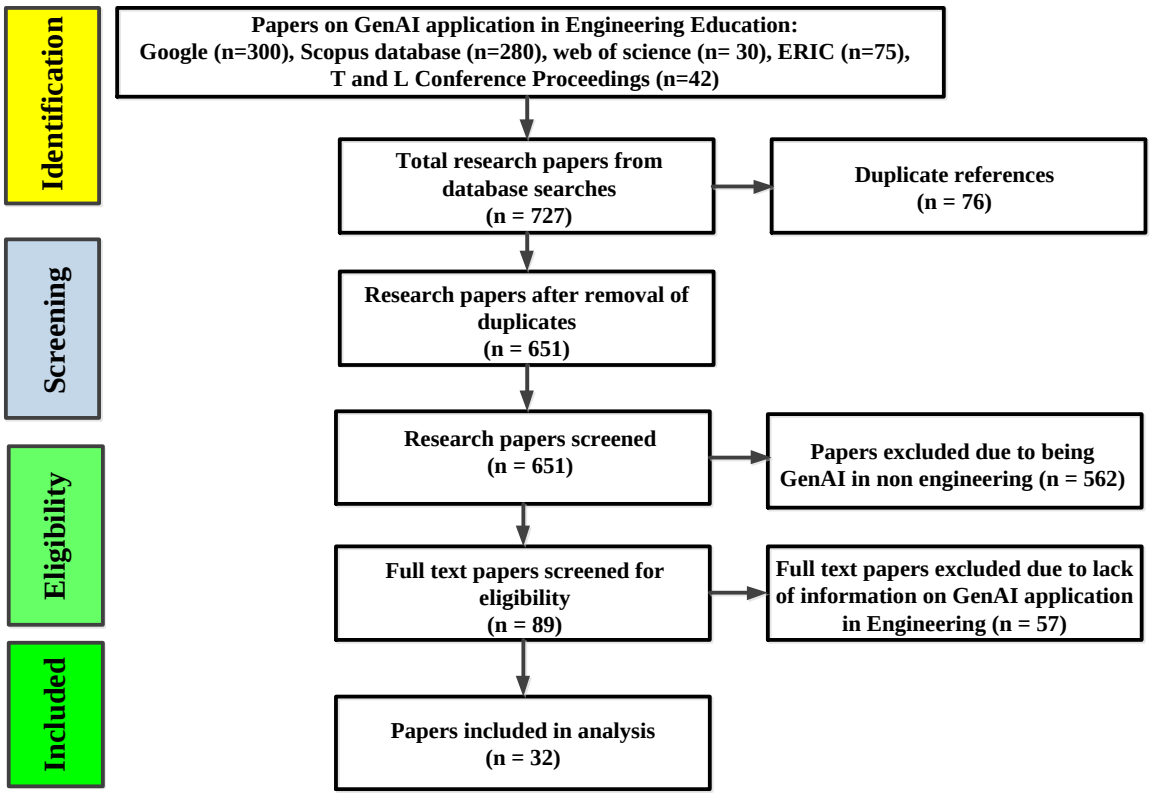


Figure 2: Flow chart of literature search strategy

3. ANALYSIS OF RESULTS FROM LITERATURE SEARCH

The integration of GenAI into engineering education has become a burgeoning area of research, offering transformative possibilities for teaching, learning, and innovation. The review identifies the challenges as highlighted by previous authors as well as their solutions, providing a foundation for choosing the top five challenges. Table 1 is a snapshot of existing studies on the use of generative AI in higher education teaching and learning. In this direction, 32 studies were isolated and analyzed.

Table 1 Synopsis of previous studies on the use of GenAI in Engineering Education

Reference	Study Focus	Challenges	Solutions proffered
Nikolic et al. (2023)	ChatGPT	Assessment integrity	Using graphs and tables that are difficult for students to turn into writing, giving presentations, and doing lab work
Qadir (2023)	ChatGPT	Plagiarism, overreliance, misinformation, privacy concerns	Being familiar with and adhering to correct citation standards can help students avoid accusations of plagiarism
Tsai et al. (2023)	Benefits of integrating LLM into chemical engineering education	Incorrect code execution ability, inability to perform unit conversions	Implementing a methodical strategy that divides the activity into smaller, more precise subtasks is a practical way to tackle the problem of timed-out responses in complex tasks.
Bernabei et al. (2023)	Students use of ChatGPT in writing essays in mechanical and management engineering	Trust, usefulness & performance expectancy, fairness & ethics, social influence	Thinking things through, getting the right training, and analyzing the tool's results critically are all essential for an effective adoption. Teaching students to think critically and solve problems.
Vidalis and Subramanian (2023)	Students' perspective of AI in engineering education	Ethical considerations, accuracy, plagiarism, dependency	Provide more resources and training opportunities for students. Promote awareness of ethical considerations
Johri et al. (2023b)	Ethical implications of the use of GenAI	Data privacy bias, transparency and opacity, academic integrity. plagiarism, deskilling, fair use of AI-generated content and accessibility	Development of comprehensive ethical AI frameworks that address the unique challenges posed by GenAI
Daun and Brings (2023)	Deploying GenAI such as ChatGPT in software engineering education	Assessment integrity, Inaccuracy	Oral exams, group projects, and presentations should be adopted as this would require students to articulate and defend their ideas and solutions.
Pham et al. (2023)	Benefits and challenges that students may encounter when utilising ChatGPT-3.5	Inconsistent or unexpected answers	Development of robust assessment rubrics tailored to the context of incorporating GenAI tools. Use of alternative assessment methods such as oral presentations or technical demonstrations.
Goswami and Souppeza (2024)	Chat GPT, natural language processing & computer vision	Adaptability, ethical considerations, adaption of soft skills and lifelong learning, assessment and feedback methods	None

Reference	Study Focus	Challenges	Solutions proffered
Orduño-Osuna et al. (2024)	GenAI integration into engineering education	Improving the quality of education is necessary to close the skills gap and meet the demand for qualified engineers.	For integration to be successful, ethical factors and human supervision are essential.
Fatahi et al. (2024)	Students' assessment in Civil Engineering	Limitations in handling complex calculations	Sensible measures need to be employed to verify the usefulness of incorporating generative AI tools in assessment tasks
Yelamarthi et al. (2024)	Applications of GenAI in Engineering courses	Academic integrity, plagiarism, bias, accuracy	Institutions should establish clear guidelines and ethical frameworks for GenAI in content generation to mitigate these challenges
Simelane and Kittur (2024)	Instructors perspective on ChatGPT's effect on T&L experiences	Inaccuracies and over-reliance	Instructors should educate students on its limitations and proper use
Frenkel and Emara (2024)	Effect of GenAI on students' performance in final examination in mechanical engineering	Plagiarism, over dependence issues leading to skill attenuation, inconsistent when providing references, no	Instructors should incorporate questions that make use of plots, charts, or other visual schematics in assignments or take home exercises
Zhang and Chang (2024)	Outcomes of implementing GenAI in electrical engineering	Plagiarism, bias, data privacy, academic integrity	Implementing advanced plagiarism detection software
Harris and Kittur (2024)	GenAI's role in undergraduate engineering education	Ethical considerations, the quality and bias of AI-generated content, overreliance	Consider developing GenAI-resistant examination questions to maintain the credibility and integrity of engineering assessments
Stankovski et al. (2024)	Use of GenAI tools/platforms in Industrial Engineering & Mechatronics	Inaccuracy of generated content	None
Alberd et al. (2024)	Student survey taking into account ethical considerations in given assignments	Plagiarism, lack of ethical guidelines, transparency & accountability	The educational community should remain vigilant in addressing the ethical implications of AI use, ensuring transparency, fairness, and inclusivity.
Margetts et al. (2024)	Student attitudes towards AI tools	Academic integrity, over-reliance	Summative assessments should still include substantial human supervision.
Javareshk et al. (2024)	Impact of GenAI on students' performance in product design	Plagiarism, accuracy	Educators should teach students to use GenAI effectively and be able to critically review, consider and translate AI generated content
Osunbunmi et al. (2024)	Students' learning experiences & Instructors' perspective	Plagiarism, algorithmic bias, transparency, equity, data privacy	The data upon which these GenAI tools are trained should be inclusive so it could serve diverse learners.
Narayan and Saharan (2024)	Implementation of GenAI strategies in	Academic integrity, plagiarism, accuracy	Innovative project-based learning, Evaluating AI generated solutions,

Reference	Study Focus	Challenges	Solutions proffered
	electrical/ robotics engineering		
Camacho-Zuñiga et al. (2024)	Ethical and responsible application of GenAI in higher education from undergrads perspective in Mexico	Lack of human interaction, Limited understanding and contextual awareness, Bias, over-dependence & skill degradation Ethical and academic concerns, Data privacy, impact on employability	Redesigning the assignments to focus on human skills and values that GenAI cannot replicate;
Mellqvist and Mozelius (2024)	Students' perspectives of the integration of GenAI in the educational practices	Overreliance on AI, accuracy and reliability; designing effective prompts	By integrating AI's benefits with human insights, the most effective method was a hybrid one that combined AI-generated criteria with those that were produced manually.
Quince et al. (2024)	Ethical considerations of utilising GenAI in engineering	Bias, error, intellectual ownership, misuse (academic misconduct), transparency	Constant communication and revision of ethical frameworks between the academic community and industry.
Khan et al. (2024)	Applications, assessments and implications of GenAI	Coding or writing assistance, design methodology, and personalization.	Research should be used extensively to guide the design processes of GenAI personalized learning.
Guillén-Yparrea and Hernández-Rodríguez (2024)	Students' familiarity with GenAI, its applications, and its moral dilemmas	Plagiarism	Lecturers should understand the latest AI technologies and apply cutting-edge approaches to teach students how to use them responsibly.
Zhao et al. (2024)	Existing challenges in delivering engineering courses in Chinese universities	Over dependence and its effects on skill degradation, plagiarism	Suggested reforms to the engineering educational system based on a thorough analysis of GenAI's advantages and disadvantages.
Belkina et al. (2024)	Factors that facilitate or hinder effective use of Gen AI	Bias and reliability	There is a great deal of room for improvement in engineering education that could result from using GenAI. This would benefit both students and instructors.
Dai (2025)	Student accounts and perspectives regarding GenAI use	Inaccuracy, shallow knowledge, reliance on existing data, and limited creativity, broad, superficial, or irrelevant solutions provided	To build a clear consensus on the function and value of GenAI inside the curriculum, policymakers, educators, and accreditation agencies must work together in a coordinated and purposeful effort to integrate GenAI.
Honig et al. (2025)	How and why students engage with GenAI-based learning activities in chemical engineering	Performance and effort expectancy: trust, accuracy, response speed, transferability	The performance expectancy construct was the most significant barrier and enabler to uptake of the genAI learning tool. AI teaching tools should be adopted for addressing social anxiety as a barrier to learning, for some students.
Akolekar et al. (2025)	Evaluation of GenAI tools in	Accuracy	Present GenAI based solutions to learners and request they verify its

Reference	Study Focus	Challenges	Solutions proffered
	solving problems in mechanical engineering		accuracy spotting out errors and correcting them

3.1 Selection of the Top Five Challenges

Table 2 summarizes the five most cited challenges related to generative AI use in engineering education, drawn from an analysis of the literature shown in Table 1. In column 3 of Table 1, the challenges are consolidated since most of the entries were either duplicated or were worded in similar words. This is summarized in Table 2. From the consolidation of the challenges in Table 2, accuracy concerns top the list, followed closely by ethical considerations, highlighting growing worries over responsible AI use and the integrity of information and then over-reliance issues. While these are expected, less visible yet significant issues include academic integrity and data privacy, which, though mentioned less often, point to potential long-term academic and security impacts.

Table 2 Summary of challenges in using GenAI in engineering education

Consolidated Challenge	Sub challenges	Percentage
Accuracy issues	Trust Performance Expectancy Inconsistent / Unexpected Answers Limited Creativity / Shallow Responses Limited Contextual Awareness Algorithmic Reliability References & Unit Conversion Issues Bias (Accuracy & data bias)	35%
Ethical Considerations	Plagiarism Fair Use Transparency & Disclosure Intellectual property issues	28%
Overreliance/ Overdependence	Critical thinking degradation / Deskilling Social influence Lack of Human Interaction	20%
Academic Integrity	Assessment Integrity	11%
Data Privacy	Data safety	6%

3.2 Discussion of Findings

GenAI poses several challenges to engineering education, impacting teaching methodologies, academic integrity, research, and the broader educational ecosystem. Here is a discussion on the top five challenges:

i. Information accuracy and quality control: When GenAI tools provide responses that contradict factual accuracy, either erroneous or misleading outputs is the ultimate outcome (Chan and Hu, 2023). For instance, GenAIs can generate deepfakes which can mimic reality. Knowledge of this fact implies that not every information generated by GenAI are factually in order, thus leading to an attenuation in the reliability of the information produced by GenAI. Therefore, using inaccurate data generated from GenAIs in making engineering designs would lead to catastrophic outcomes.

The misinformation or inaccuracy could be as a result of the biases in data used to train GenAI algorithms (Monteith et al., 2024). Therefore, human oversight via high digital literacy as well as analytical thinking abilities on the part of GenAI users is necessary to assess GenAI content critically (Lubowitz, 2023). In addition, fact checking GenAI produced content against well known standards such as American Society of Mechanical Engineers (ASME), American Petroleum Institute (API) etc is the key to ensuring quality control over inaccurate information from GenAIs.

ii. Ethical considerations: The difficulty of identifying GenAI work and differentiating it from student-generated content is growing (Al-kfairy et al., 2024). This because GenAI simplifies the process of creating essays, reports, and other types of academic work for students, thus throwing up the debate as to who really can claim authorship and copyright ownership (Ullah et al., 2024). In numerous cases, when researchers or students utilize GenAI to produce parts of their work, they typically refrain from acknowledging GenAI as either the sole or co-author. This inertia to include the algorithm as a contributor to the study is a violation of academic honesty.

iii. Over-reliance: Excessive reliance on GenAI by students may present characteristics akin to addiction, particularly when they depend on it disproportionately for completing assignments, obtaining answers, rather than fostering independent learning. For example, a student who previously derived satisfaction from solving engineering problems may begin to utilize ChatGPT for every calculation. Over time, this reliance can hinder their ability to comprehend concepts independently thereby diminishing their critical thinking and problem-solving capabilities (Ju, 2023). Therefore, the overutilization of GenAI may supplant effective learning habits, thereby stunting students' intellectual development and thus rendering them less proficient in their academic pursuits without the aid of the tool. (Zhai et al., 2024). As a result of this effect, there is an ongoing debate about how the use of GenAI for educational purposes might affect the way students learn, think, and process information in the long term, including potential impacts on creativity, problem-solving skills, and deep understanding of subjects (Abbas et al., 2024; Kasneci et al., 2023).

iv. Academic integrity: The swift adoption of GenAI tools by students has the tendency to disrupt the education in schools of higher learning, prompting academics to express worries regarding the dangers it poses to academic integrity (Gruenhagen et al., 2024). Consequently, instructors face challenges about the optimal methods for assessing students' knowledge and understanding when they utilize GenAI to produce responses to assigned tasks (Poornesh, 2025). This challenge therefore opens an opportunity for educators to devise strategies that ensure that the integration of GenAI does not diminish students' learning abilities and creativity while also maintaining academic integrity.

v. Data privacy and confidentiality: The implementation of GenAI in engineering education raises substantial privacy issues due to the data-intensive nature of engineering systems. This frequently entails gathering sensitive information from sensors and actuators in essential process facilities, manufacturing or construction data encompassing client demands or preferences, as well as personal details such as biometric data. If students or educators input such sensitive or proprietary information into GenAI (e.g., research data or company-specific designs), there could be risks to data security or confidentiality (Hasan et al., 2024). This raises questions regarding its storage, potential access by individuals, and the possible future applications or misuses.

4 PROPOSED INTERVENTIONS TO THE HIGHLIGHTED CHALLENGES

Table 3 summarizes some practical interventions to the highlighted challenges in deploying GenAI in Engineering Education. These interventions can serve as a guide to instructors/lecturers, institutions and policy makers in adapting to the evolving landscape of GenAI while maintaining academic standards and professional competencies.

Table 3 Proposed interventions to identified challenges

Challenge	Practical Solutions in Engineering Education
Accuracy	-To foster critical thinking among students, it is necessary for instructors to present students with a solution produced by a generative AI tool such as ChatGPT and request them to verify its accuracy by identifying mistakes and then correcting them using peer-reviewed sources and technical standards such as ASME, IEEE, API etc (Akolekar et al., 2025). -Lecturers should assign tasks that require citation of validated engineering data.
Ethical concerns	-Integrate AI ethics into engineering curricula through case studies and scenario-based learning. -Promote discussions on real-world engineering problems -Use plagiarism detection tools alongside education on proper citation and paraphrasing. -Encourage open-ended design projects that require personalized solutions
Overreliance on AI	-Assign location specific projects since GenAI tools usually provide generic answers. -Enforce manual calculations or plots: Ask students to sketch or graph based on provided data. -To make it more challenging for students to convert tables and figures into text, ask questions that are context-specific instead of general, have them interact with evidence items like e-portfolios and drawings, and incorporate external files that require analysis.
Academic integrity	-Design assessments like oral defenses, lab-based tasks, or collaborative design work that are hard to fake. -It is advised to stick with invigilation-based in-person tests. -For online quizzes or tests, design application-heavy, contextual questions and embed questions as images. This prevents copy-paste and makes AI input harder. -Use browser lockdown software: Tools like Respondus LockDown browser prevent screen capture, switching tabs, or accessing external sites.
Data privacy	-Educate students on General Data Protection Regulation (GDPR) and data handling in engineering contexts. -For projects involving AI or IoT, enforce anonymized datasets and privacy-by-design principles.

5 CONCLUSION

This study attempted to highlight the challenges associated with applying GenAI in engineering education with a view to proffering practical suggestions to overcoming them. In order to properly contextualize these challenges within engineering education, a comprehensive literature review was undertaken. In this direction 32 relevant articles were culled from literature and the top five challenges were isolated. These challenges were discussed, and some practical solutions were presented. From the study, the following conclusions were reached.

i. The study concludes that GenAI can significantly enhance teaching methods, learning experiences, and research practices, offering new pedagogical opportunities.

ii. The integration of generative AI is obstructed by five key challenges: ethical concerns, over-reliance, accuracy issues, data privacy and maintaining academic/assessment integrity.
iii. The study emphasizes that addressing generative AI challenges requires context-specific solutions rather than one-size-fits-all remedies.
iv. For GenAI to serve as a constructive engineering educational tool, stakeholders must adopt a balanced and ethical strategy that minimizes dependency and maximizes empowerment, equity, and sustainability.
v. Due to the limited sample size of 32 articles reviewed and its concentration on engineering education, the results should be regarded as preliminary and exploratory. They cannot be extrapolated to other disciplines. Therefore, subsequent studies utilizing a larger, more heterogeneous sample is essential for yielding more substantial discoveries.

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Exploring Generative AI in Accounting Education: An Overview of Pedagogical Innovations, Challenges, and Future Trends

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ABSTRACT

The advancement in generative AI, especially large language models such as ChatGPT, is steering innovations in accounting education. Hence, this study critically examines the incorporation of generative AI tools into the accounting curriculum, focusing on pedagogical innovations, inherent challenges, and emerging future trends using empirical research and case studies synthesis and theory. The findings reveals that interactive learning is being enhanced using AI-driven platforms, thereby promoting personalised instructions and critical thinking among accounting students. The study further delves into addressing key challenges involving ethical considerations, data privacy concerns, and the digital divide that might hamper equitable access to advanced technologies usage in accounting education. Although generative AI has been demonstrated to revolutionise traditional accounting teaching methods, robust ethical governance frameworks and continuous pedagogical refinement are required for successful implementation. The study not only offers an understanding of the current practices but also highlights the directions for future research, emphasising the critical impacts of Gen AI in influencing the accounting education landscape.

KEYWORDS: Accounting Education; ChatGPT**;** Generative Artificial Intelligence; Pedagogical Innovations

1 INTRODUCTION

The increase in generative artificial intelligence (Generative AI) technologies, from big language models to code and data generators, has started to change not just professional practice but also the actual methods by which students acquire basic subjects (Wen et al., 2025). Generative AI offers both unmatched teaching possibilities and new difficulties in accounting education. It creates an avenue where increasing digital abilities must coexist with mastery of redefined conceptual frameworks, analytical techniques, and ethical judgment (Ferrell et al., 2024). Generative AI's ability to initiate conversational agents and automated financial report writing systems can provide on demand explanations, instructive examples, and real-time feedback on real life scenarios, thereby scaffolding student learning (Yuriev et al., 2025). Conversely, the ability of Generative AI to create biased reports, data entries, and analyses presents serious issues regarding student academic honesty, real life application integrity mastery, the curriculum design, evaluation, and communication of genuine reports to needing users (Risang Baskara, 2023).

Although there is increasing research on AI in higher education generally, thorough studies of generative AI's particular framework consequences for accounting education are still few. A few studies have rigorously investigated related challenges (e.g., data privacy, student misuse, faculty readiness) or expected future directions (e.g., co–creative assignments, AI-powered audit simulations, accreditation policy changes) (Giannakos et al., 2024; Hamad et al., 2024; Nedungadi et al., 2024). Early case studies

have recorded isolated teaching experiments such as using a chatbot to simulate client interviews or employing text-generation algorithms to illustrate financial-statement drafting but few have synthesised these innovations into transformative accounting educational context frameworks (Laiq & Dieste, 2020).

This study offers a methodical analysis of the current studies on generative AI applications in accounting education. The study begins with collecting recorded educational innovations, noting important trends in how accounting education uses generative tools for teaching, practice, and evaluation amidst current revolutions. The main issues and difficulties accounting educators and students face, like equality of access, loss of critical-thinking abilities, and dependability of AI-generated material, were examined. Based on antecedents, the possible developing themes that seem to influence the application of Generative AI in accounting education from adaptive learning systems that tailor accounting casework to legal frameworks controlling AI use in professional education settings were also examined.

This short review delves into the application of Generative AI in accounting education with an overview of present technologies, pedagogical advancements, emerging issues, stakeholder viewpoints, and prospects in accounting education. The study intends to provide a clear road map for accounting educators, curriculum developers, professional accounting bodies, and academic policymakers by means of synthesis of various strands: stressing "what works," identifying important considerations, and suggesting rich paths for research and practice. An integration of generative artificial intelligence into accounting education in the form of a novel framework was proposed based on Input Process Output (IPO) theory using its potential for new integration while preserving the basic intellectual and ethical values of the profession,

2 AN OVERVIEW OF GENERATIVE AI

Generative AI is an advanced machine learning model capable of producing human-like content such as text, code, graphics, and so on from prompts (Sun et al., 2024). Popularly used Generative AI include Anthropic's Claude, Google's Bard (Gemini), and OpenAI's ChatGPT (driven by GPT-4). ChatGPT as one of the most used GenAI has experienced tremendous growth as evidenced by 100 million users in two months following its November 2022 launch (Bisi et al., 2023). Generative AI offers both disturbance and possibility in higher education, including accounting courses. It can help report writing, problem-solving, and investigation of challenging situations (Yan et al., 2024). Nevertheless, its usage also raises questions about learning, ethics, and fairness (Shahzad et al., 2025).

Generative AI's development raises significant ethical questions, particularly regarding academic integrity (Yusuf et al., 2024). Cheating and plagiarism are the most identified concerns from the usage of Generative AI (Shaw, 2025). Many educators are concerned that students might exploit technologies such as ChatGPT to fraudulently finish assigned tasks (Rahman & Watanobe, 2023). Traditional plagiarism detectors have difficulties in detecting AI-generated material (Elkhatat et al., 2023). While some educators allow students to use Generative AI, others totally prohibit it (Lim et al., 2023). Many institutions are changing honor codes and assignment policies as a matter of course (McCabe et al., 2003; Tatum, 2022). Institutions such as the UK Quality Assurance Agency (QAA) and Australian regulator TEQSA underline the need for educational institutions to establish clear regulations on the use of artificial intelligence, hence defining what is permitted and how originality will be judged (Coates et al., 2025; Nartey, 2024). Practically speaking, this may mean mandating students to reference any Generative AI assistance on assignments or designing tasks for example, in-class exercises, oral examinations, or group projects where Generative AI use can be tracked or spoken about.

Apart from cheating, factual correctness is an issue that has been identified from the usage of Generative AI by students (Lee et al., 2024). Large language models (LLMs) such as ChatGPT tend to "hallucinations," or boldly present false or inaccurate facts (Guan et al., 2023). In accounting education, this may be risky if a student believes a Generative AI's response on, for example, a tax treatment or accounting norm that is incorrect. Some educators are of the opinion that students might require Generative AI literacy to identify these mistakes. Therefore, ethical education must involve guiding students to check Generative AI results against credible sources. Other ethical concerns identified when using Generative AI

are fairness and prejudice (Beg & Mehndiratta, 2024). Models of Generative AI trained on vast text corpora can carry over social prejudices, including gender/race stereotypes (Dacon & Tang, 2023). Ignoring these prejudices might show up in illustrations or instructional resources, teaching practices, students' assessment and students' expectations. For example, a Generative AI learning content may suggest biased information that can perpetuate discriminatory practices in accounting education and assessments. Additionally, the integration of AI in accounting education has the potential to hamper students independent critical thinking abilities and ethical implications discernments due to unethical over reliance. Hence, educators must critically assess AI-generated material and inform their students about possible prejudice or over reliance tendency to address these issues.

3 GENERATIVE AI APPLICATION IN ACCOUNTING EDUCATION

Accounting education is undergoing a technological revolution due to the impact of Generative AI (Ballantine et al., 2024). The increase in the use of Generative AI has led accounting educators to question traditional approaches to teaching accounting courses like management accounting, taxation, auditing, and financial accounting (Anica-Popa et al., 2024). These technologies, which excel at generating explanations, case studies, and assessments, greatly benefit educators and students alike. Still, worries about academic integrity, errors in AI-generated material, uncontrolled influence on students learning, and the lack of generally acceptable institutional adoption policy call for quick attention. Table 1 shows selected applications of Generative AI in accounting education.

When using Generative AI for tutoring, students can ask ChatGPT for quick clarifications of accounting concepts such as debits and credits, financial statements, or ethical dilemmas in audits. For instance, a student would question ChatGPT if they were struggling with a journal entry: "Explain the process of recording accrued revenue with an illustration." For example, "What are the ethical consequences of revenue recognition manipulation?" they may ask to review an ethical case study. This provides quick, adaptable help so students can learn at their own pace without having to wait for scheduled learning hours.

The automated feedback application entails the students sending narrative projects or structured reports, such as audit memos, revenue statements, etc., for Generative AI evaluation. The Generative AI might suggest improvements or modifications, point out mistakes, and find formatting inconsistencies. Particularly in large courses, this results in faster processing and consistent assessment. Though the final examination could still need human judgment, Generative AI might free educators from the duties of repeating comments, hence enhancing efficiency and enabling more personal contact between students and educators.

Accounting educators can prompt Generative AI to produce ethical simulations, forensic accounting questions, or audit scenarios. For example, "Develop a reasonable internal audit scenario for a retail company inventory misrepresentation." By quickly producing different and flexible teaching materials, this improves the educator's efficiency. It also increases case diversity, so exposing students to a wider range of real-world difficulties without the educator having to generate each one separately.

Generative AI can be prompted to provide several versions of conventional accounting problems, like depreciation schedules and ratio analysis. It can change difficulty levels or include contextual differences (e.g., different sectors) by means of tailored prompts. This allows individualised learning and lets students interact with different obstacles rather than just memorising past problems. Accounting educators can offer tailored practice sets to fit different student requirements and skills.

Chatting with Generative AI personas lets students mimic client or auditor interactions. For instance, ChatGPT may play the part of a confused consumer looking for tax advice or a sceptical auditor asking pointed questions about internal controls. This improves professional judgment and communication skills, both of which are essential in practical accounting. Unlike static role-play, GenAI simulations offer dynamic conversations that change according to students' responses, hence increasing involvement and authenticity.

Table 1: Potential application of GenAI in Accounting Education

Application area	Example of use	Advantages
AI Tutoring	ChatGPT justifications of ethical cases, diary entries	On-demand, adaptive support
Automated Feedback	AI grading of narrative reports or financial statements	Quicker turnaround, consistency
Case and Scenario generation	Case generation for fraud detection or auditing based on prompts	Instructor effectiveness, case diversity
Practice question bank	Variations of conventional accounting issues produced by artificial intelligence	Customise learning
Simulation role play	Students engage with artificial intelligence as customers or auditors.	Development of skills (professional judgment, communication)

4 INTEGRATING GENERATIVE AI INTO ACCOUNTING EDUCATION AND PRACTICE

Rapidly changing the scene of accounting education and practice, Generative AI tools like ChatGPT, Claude, and Gemini are emerging. Generative AI's capacity to improve learning involvement and the growth of higher-order cognitive skills is a recurring topic in research. For example, Krayyem Al-Hajaya et al., 2025) demonstrate that educators' deliberate use of ChatGPT promotes student motivation, critical thinking, and active learning. This fits with more general educational changes toward learner-centred settings that appreciate flexibility and technology literacy. Calderon et al. (2023), meanwhile, offer detailed analysis of student AI adoption behaviour patterns, noting gender, age, and academic level as moderating influences. These results point to the need for tailored Generative AI training plans in accounting courses to maximise fair access and utilisation.

Certain studies highlight the functional benefits of Generative AI systems in automating repetitive accounting chores. Rane et al. (2024) reported that both Gemini and ChatGPT are efficient in traditionally laborious sectors, including financial modelling, auditing, and customer service. This parallels Calderon et al. (2023), who point out two results in Generative AI use: its ability to streamline financial reporting and the related dangers of false information if used naively. The educational need in this situation is not only to bring Generative AI but also to develop students' evaluative and interpretative abilities about AI-generated outputs.

Anica-Popa et al. (2023) recommend an LLMs-based system architecture at the system design level that combines Generative AI with accounting processes, implying a new skill set for accounting practitioners, including AI systems cooperation. Given the incorporation of Generative AI in audit and assurance responsibilities worldwide, as Sobrinho and Moukadama (2024) note in the Swedish context, this reframes accounting skills to include digital intelligence and multidisciplinary problem-solving, an inevitable progression.

Although these prospects exist, several studies warn against excessive dependence on Generative AI, particularly in academic and professional environments. Apostol et al. (2023) clearly advise against using Generative AI in content generation for academic studies, stressing that its function should be limited to language improvement and translation. Fianko et al. (2024) also underline dangers to the integrity of professional degrees, pointing out that unrestricted AI use in tests can undermine public confidence in accounting certificates. These issues point to a larger demand for generally acceptable accounting AI standards, government systems, academic norms, professional accounting bodies AI uniformity ethical usage, and test procedures to guarantee the ethical integration of artificial intelligence.

Sales de Aguilar et al. (2024) finally highlight the disparity in how educators use ChatGPT in the UK higher education setting. This mismatch emphasises the need for institutional clarity and common instructional approaches to direct Generative AI use. Lacking such direction, Generative AI's capacity to improve research and teaching remains underrealized.

The various studies indicate that GenAI might improve the practical use of accounting as well as the learning process. Realising this potential, therefore, calls for a fair, ethically informed strategy addressing digital competencies, equity, academic integrity, and professional trust. Future work must consequently emphasise creating consistent frameworks for the responsible integration of Generative AI in accounting education as well as investigating longitudinal consequences on teacher responsibilities, student learning outcomes, employability, and labour market expectations.

Table 2: Selected studies on GenAI application in Accounting Education

Type of GenAI	Focus	Findings	Reference
ChatGPT	Approaches to Learning and Soft Skills Development.	Studies indicate that including and controlling generative artificial intelligence by accounting teachers can enhance student involvement, active learning, and higher-order soft skills such as critical thinking and analysis.	(Krayyem Al-Hajaya et al., 2025)
ChatGPT	A financial accounting of GenAI	The findings indicate that GenAI offers both beneficial and non-beneficial application	(Calderon et al., 2023)
ChatGPT	Determine the knowledge, abilities, and competencies necessary for accounting and auditing in the context of GenAI.	The authors present a novel LLM-based system model that may improve its GenAI features by working with like systems and offer an explanatory example to show its relevance in the accounting and audit field.	(Anica-Popa et al., 2024)
ChatGPT	Examine ChatGPT within the framework of UK higher education and the accountancy profession.	The study revealed that accounting researchers lack consistent direction in the application of ChatGPT.	(Sales de Aguiar, 2024)
ChatGPT	Influence of Generative AI on Sustainability Accounting Scholarship	The Journal makes clear stance on the application of GenAI in submissions, stressing that AI should be used exclusively for language enhancement and translation, not for producing research material.	(Apostol et al., 2024)
ChatGPT	Adoption and use of ChatGPT among higher education students majoring in accounting and finance.	The findings show gender moderation in the effect of effort expectation on behavioural intention, study level moderation in the role of social aspects on behavioural intention, and age moderation in the effect of enabling settings on ChatGPT use.	(Ziemba Ewa Wandaand Maruszewska, 2024)
Gemini or ChatGPT	GenAI in Finance and Accounting: Efficiency, Performance, and Adaptability	Findings revealed that Gemini and ChatGPT both excel in data analysis, financial modelling, reporting, auditing, and customer service duties.	(Rane et al., 2024)

ChatGPT	Adoption of artificial intelligence in Swedish auditing and accounting companies	Driven by efficiency improvements and better service delivery, Swedish auditing and accounting companies use Generative AI technology.	(Sobrinho & Moukadama, 2024)
ChatGPT	ChatGPT's Performance in Accounting and Auditing examination	The findings revealed that ChatGPT 3.5 properly addresses single-correct-answer multiple-choice questions, true/false assessments, and qualitative open-ended questions, hence simplifying routine tasks and offering thorough justifications.	(Atanasovski et al., 2023)
Claude, ChatGPT and Gemini	Effect of Ai Chatbots on the Terrain of Professional Accountancy Test	The findings revealed that AI chatbots could undermine confidence in accounting practitioners by affecting results of professional tests.	(Fianko et al., 2024)

5 PROPOSED FRAMEWORK FOR INTEGRATING GENAI INTO ACCOUNTING EDUCATION

Input Process Output (IPO) Theory

The accounting educational system involves input, process, and outputs mechanisms. Hence, the IPO model that describes and explains the structure and operation of a system or process underpins the proposed framework in this study. The IPO theory is a foundational framework used in many management fields for systems analysis, new integration, and organizational behaviour. Moreover, the theory posits that any system or procedure can be divided into three basic phases: inputs, processes, and outputs that serves as a basic structure for design and development (Zhang et al., 2022). According to the theory, all information, materials, and requirements that come into the system from its surroundings are referred to as inputs. These input components are what start the process. In this study, generative AI evolving needs, accounting educational leadership generative AI sense-making could all be considered inputs in an accounting educational system. The system's main function, which is to transform the inputs into the intended outputs occurs at the process stage. During this phase, several rethinking of pedagogical approaches, curriculum reviewing, algorithms, human interactions, stakeholder negotiation or mechanical operations may be involved here during generative AI integration in accounting education. Lastly, outputs are the outcomes, goods, services, or results that the process produces and are sent back to the environment or to another system after leaving the system. In this study's instance, future ready accounting graduates and knowledge that meet societal demands. The model can assist to define what goes in and what comes out in an accounting educational system are the outcomes. Thus, the IPO is relevant in the construction of the proposed framework.

Figure 1 depicts the proposed framework for integrating Generative AI into accounting education. The middle context symbolizes Generative AI, the fundamental technology shaping many facets of education and learning. Generative AI integration in accounting begins from accounting educational leadership Generative AI sense-making. Radiating out from this accounting educational leadership sense-making point are many important areas (Input AI integration) where Generative AI is being integrated in accounting education via instituted processes. These instituted processes are referred to as Generative AI integration processes in the proposed framework. From the framework, integrating Generative AI into accounting education involves accounting educational leadership Generative AI sense-making, Input AI integration strategies, Generative AI integration processes factors and these factors are related to the Generative AI integration outcome. Based on input process output theory, it is expected that accounting educational leadership Gen AI sense-making and identified input Gen AI integration strategies would influence the Gen AI processes put in place which in turn impact the desired Gen AI integration outcome.

Generative AI integration entails the leveraging of existing accounting educational processes by rethinking, reviewing, redefining and so on to optimize the needed benefits.

Generative AI can be used by accounting faculty/students to create different types of accounting documents, financial statements preparation, real life scenario analysis, algorithms, codes, simulations, journal entries and upskilling. Students can therefore concentrate on grasping the fundamental ideas instead of the drab details of formatting. Generative AI can provide a great number of practice questions and exercises designed for certain learning goals. This gives the students adequate opportunity for self-assessment and reinforcement. Generative AI might enable students to grasp and recall difficult accounting acronyms and vocabulary by producing explanations, mnemonics, or maybe tests. Generative AI may automate tedious and repetitive tasks, hence releasing students' time to participate in more advanced thinking, including analysis and interpretation, as noted with file creation. Generative AI can help grade objective tests, provide students fast feedback, and let teachers spend more time on individualized teaching by grading them. By examining student performance and developing tailored learning paths, Generative AI may offer focused tools and assistance as required. Generative AI may produce several interpretations of difficult accounting ideas to fit varying degrees of knowledge and learning preferences. Teachers may use artificial intelligence to create simple lesson outlines, quiz questions, or even first drafts of learning resources, which they can later modify and personalise.

Integrating Generative AI into accounting education is not merely about teaching new technologies; it is about fundamentally re-thinking how future accountants will operate amidst Generative AI continuous disruptions. This framework provides a comprehensive roadmap for accounting educational institutions to prepare graduates who are not only technically proficient but also ethically aware, critically thinking, and adaptable to the dynamic landscape of AI in accounting. Importantly, the regular review and adaptation of this framework will be crucial given the rapid advancements in AI technology.

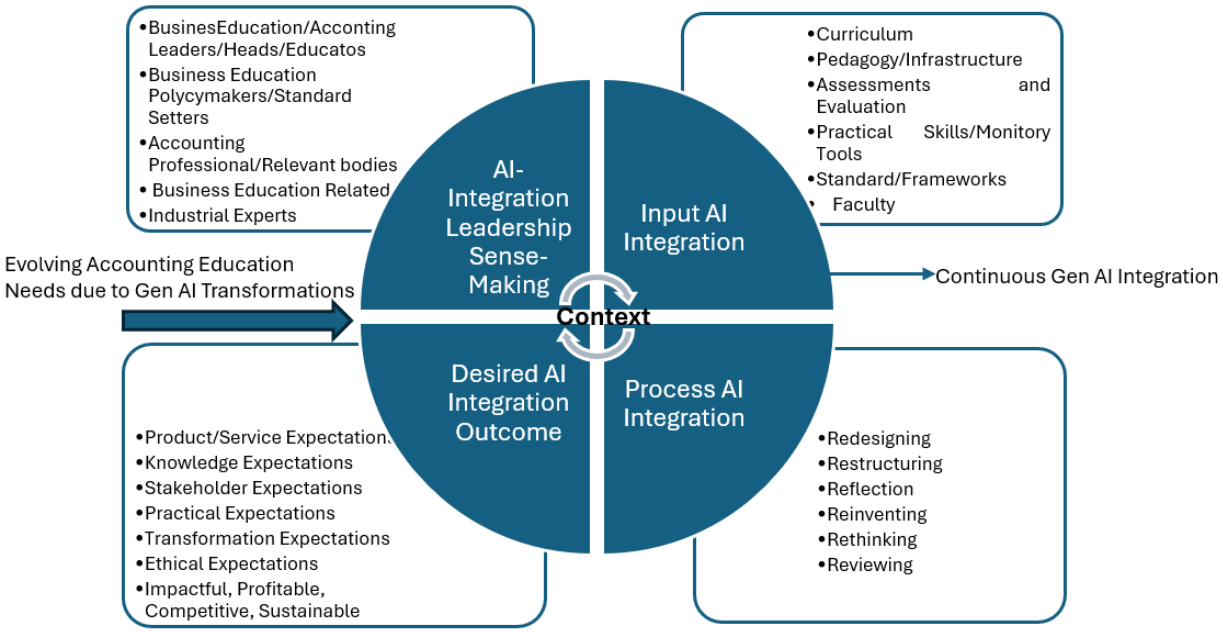


Figure 1: Proposed Framework for integrating GenAI into Accounting Education

4 SUGGESTED FUTURE RESEARCH ON AI IN ACCOUNTING EDUCATION

Based on the findings and issues discussed by the prior literature, we propose the following research areas to help accounting education remain relevant and produce employable-ready graduates:

a) Integrating Gen AI into Accounting Curriculum Design

Gen AI tools like ChatGPT, Microsoft Copilot, and Google Gemini are transforming accountants' tasks like data analysis, report writing, and fraud detection. However, most accounting curricula are still largely traditional. Researching how to embed Gen AI tools into core accounting subjects (e.g., auditing financial reporting) will help redesign syllabi that reflect real-world accounting practices. This ensures students are tech-aware and capable of leveraging AI responsibly and effectively in their future roles.

b) Assessing the Impact of Gen AI on Accounting Skill Requirements

Automation and Gen AI are shifting the demand from routine accounting tasks to analytical, interpretive, and strategic skills. Graduates must now excel in critical thinking, data interpretation, and ethical decision-making. This research can help educators identify the evolving skill sets required by employers in an AI-driven workplace. Findings would guide curriculum enhancements to balance technical and soft skills, hence better aligning graduate competencies with market expectations.

c) Ethical and Professional Implications of Using Gen AI in Accounting Education

Using Gen AI in education raises questions about academic integrity, over-reliance on automation, and ethical decision-making. Students may misuse AI to complete assignments or bypass critical learning. Studying the ethical challenges and setting pedagogical boundaries for Gen AI will guide the creation of ethical guidelines and codes of conduct. This fosters responsible AI use, mirroring the ethical standards expected in professional accounting practice.

d) Effectiveness of AI-Augmented Learning Tools in Teaching Accounting Concepts

AI-powered tutoring systems, feedback generators, and simulation environments offer personalised, scalable learning experiences. Yet, their effectiveness in accounting education is underexplored. Empirical studies on learning outcomes from AI-augmented tools can inform decisions about adopting such technologies. Evidence-based practices can improve concept mastery, especially in complex topics like taxation, consolidation, and auditing procedures.

e) Examining the Readiness of Accounting Educators to Integrate Gen AI in Teaching and Learning

While much attention is given to student preparedness for an AI-driven workplace, the role of accounting educators is equally critical. Many educators may lack the technical skills, confidence, or institutional support needed to effectively adopt Gen AI tools (e.g., ChatGPT, Copilot, or accounting-specific AI platforms) in their teaching practices. This research can assess educators' digital literacy, attitudes toward AI, perceived barriers (e.g., lack of training, ethical concerns), and current usage of AI in pedagogy. Understanding their readiness will help to identify professional development needs and ensure consistent, responsible, and effective use of AI tools in accounting education.

5 CONCLUSION

The inclusion of Generative AI into accounting education represents a major turning point in the way future accountants will be taught, evaluated, and equipped for professional practice. This study of existing research highlighted that Generative AI tools, especially ChatGPT, Gemini, and Claude provide notable educational advantages which include improved student involvement, on-demand coaching, and the development of essential soft skills. They also show great promise in automating simple accounting chores and enabling effective case-based and simulation-driven learning settings. These developments, however, have drawbacks. The studies show significant discrepancies in implementation methods, faculty preparedness, and urgent ethical issues with academic integrity, overreliance, and the usage of Generative AI in professional certification environments. Furthermore, Generative AI improves efficiency but its application in test procedures and academic output must be closely controlled if the accounting profession is to remain trustworthy and responsible. Institutions must utilise unambiguous frameworks stressing ethical usage, digital literacy, and the co-development of Generative AI competences alongside fundamental accounting knowledge if they are to fully appreciate the potential of Generative AI in accounting education. Future studies should seek to examine long-term learning effects, create best practices for instructional usage, and investigate policy-level consequences for curriculum design, evaluation, and accreditation. While not a substitute for human insight, ethical judgment, or professional experience, generative artificial intelligence can, when used properly, be a revolutionary supplement to conventional accounting education.

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Generative AI-Driven Pedagogies for Material Science in Chemical Engineering: Integrating Large Language Models into Chemical Engineering Curricula

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ABSTRACT

Traditional teaching methods, frequently reliant on lectures, textbooks, and static visual aids, may struggle to effectively engage students and provide a comprehensive understanding of intricate topics such as material science for chemical engineering. Improving the teaching and comprehension of this complex course depends on the need for interactive, customized, and adaptable learning approaches using generative artificial intelligence (Generative AI). Generative AI is being employed as a transformative tool to promote pedagogical developments in education. Large language models like ChatGPT have revolutionary power for enhancing the learning environments of students. Thus, it is crucial to study how ChatGPT may change the teaching and learning of materials science for chemical engineering. The main focus of this study is to employ ChatGPT as an interactive platform to engage students in discourse based on social constructivism theory, in order to encourage them to explore themes, pose inquiries, and reflect on their comprehension. In particular, the study examines how students may utilize ChatGPT to formulate a theoretical alloy, assess its properties, and produce a eutectic phase diagram for the proposed alloy components. Students were given a questionnaire survey to evaluate the effect of the Generative AI teaching approach. The survey data indicates that ChatGPT enhanced the overall learning experience, bolstered critical thinking abilities, and deepened comprehension of material science for chemical engineering. While robust ethical governance frameworks and continuous pedagogical advancement are essential for effective integration, generative artificial intelligence technologies such as ChatGPT have the capacity to revolutionize the educational experience in materials science for chemical engineering.

KEYWORDS: Generative Artificial Intelligence; Material Science Education; Chemical Engineering pedagogy; AI-Driven Learning; Interactive Learning System

1 INTRODUCTION

Digital technology's upheaval has greatly changed the teaching and learning of engineering fields. A thorough study by Haleem et al. (2022) underlined the vital roles of digital technology in education, such as improving teaching effectiveness, assisting instruction for outstanding students, and promoting inclusive learning environments. Moreover, digital technology especially the rise of generative artificial intelligence (Generative AI) has revolutionized education. Several studies have investigated how Generative AI has revolutionized education (Aamir et al., 2024; Giannakos et al., 2024; Sharples, 2023). Aamir et al. (2024)

reported that Generative AI technologies, such as learning chatbots, aiding chatbots, and mentoring chatbots, have been used to enable student to get specialized knowledge and improve their grasp of difficult topics. Chatbots have proven advantageous for students by offering administrative support, logistical assistance, guidance, and inspiration in key situations (Laiq & Dieste, 2020).

Several higher education applications have undergone extensive examination utilizing generative AI methodologies grounded in language models such as ChatGPT. Mukarto (2023) investigated how ChatGPT affected language students in higher education. The study revealed that including ChatGPT language model into instructional activities significantly enhanced students' learning capacity. Karakose & Tülübaş (2023) examined how ChatGPT may improve teaching and learning in modern education. The study showed that in modern higher education, ChatGPT improved collaboration, communication, and critical thinking. Bettayeb et al. (2024) explore how conversational AI affects schooling. The authors looked at how conversational AI affected student involvement. The findings revealed that ChatGPT encourages higher education students personalized and varied learning. Safranek et al. (2023) examined how language models affect medical education. The study indicated that the use of language models in medical education improves differential diagnostic ideation and offers interactive practice situations supporting the assessment of multiple-choice questions. Kostka & Toncelli (2023) looked at how ChatGPT was used in English language teaching in higher education. The study showed that including Chat GPT into English language teaching increases learning results and collaboration.

Generative AI application development is quickly changing the teaching and knowledge acquisition in engineering fields (Kumar Yelamarthi et al., 2024). Core subject in chemical engineering, such as material science demands that students grasp complex ideas like material properties, thermodynamics, phase equilibria, and advanced nanomaterials (Engelbrecht, 2015). Conventional pedagogical approaches, frequently dependent on lectures, textbooks, and static visual aids, may find it challenging to effectively engage students and facilitate a profound comprehension of complex subjects like material science for chemical engineering. Enhancing the instruction and comprehension of this intricate subject need interactive, customized, and adaptable learning methodologies utilizing generative AI tools. Therefore, this study seeks to investigate the influence of ChatGPT as a Generative AI tool, on the pedagogy and learning of material science and engineering among chemical engineering students, considering the importance of generative AI in innovative education. Specifically, the study focuses on how ChatGPT can aid the students' understanding of performing specific tasks such as constructing an hypothetical phase diagram from novel alloy materials and predict their properties and applications.

2 AN OVERVIEW OF EDUCATIONAL IDEOLOGIES

Several theories have been investigated to assist the incorporation of ChatGPT into instructional processes s summarized in Table 1 (Batista et al., 2024; Sharples, 2023). The theories that have been investigated include self-regulation theory (Zhou et al., 2024), cognitive load theory (Wu, 2023), connectivism, social constructivism, and constructivism(Liang & Bai, 2024). Constructivism and social constructivism's theories are based on the idea that students create knowledge by means of experiences and interactions with their environment (Thomas et al., 2014). Based on this theory, ChatGPT may be an interactive tool that prompts students to discuss ideas, ask questions, and consider their understanding, hence motivating them to explore the course. Reflecting Vygotsky's idea of the Zone of Proximal Development (ZPD), this interactive conversational model has the AI acting as a "more knowledgeable other" providing scaffolding and support to help students go beyond their current abilities (Newman & Latifi, 2021). As an educational philosophy, connectivism emphasizes the need of connections among people, ideas, and digital resources by seeing learning as a consequence of the dynamic interplay of information across networks (Thomas et al., 2014). Based on connectivism theory, ChatGPT is part of a bigger digital ecosystem that allows access to various ideas and information. ChatGPT's ability to generate and combine content helps students to connect different data, hence supporting a networked approach to understanding and knowledge creation. According to cognitive load theory, learning is improved when instructional strategies lower unnecessary cognitive load, hence allowing students to focus on the

fundamental aspects of the material (Sweller, 2022). Based on this idea, ChatGPT might offer timely explanations, break complex ideas into more digestible parts, and offer customized classifications. This tailored support helps students to learn and absorb new content more quickly by reducing needless cognitive load. According to the self-regulated learning theory, good learning calls for students to actively control their own learning processes including goal setting, monitoring, and reflection (Panadero, 2023). The self-regulated learning idea holds that by offering fast feedback, flexible recommendations, and individualised customisation, ChatGPT might act as a personal teacher. This enables students to take control of their educational path, set goals, and assess their progress, hence promoting self-directed learning. All these theories obviously lay a solid basis for including ChatGPT into material science for chemical engineering. The theories emphasize its ability to offer more interesting, flexible, and personal learning experiences that fit modern educational ideas.

Table 1: Summary of educational ideologies related to the application of ChatGPT in higher eduction

Educational Theories	Core concept	Application of ChatGPT in Instruction	References
Constructivism & Social Constructivism	Students actively construct knowledge through experiences and interactions with their environment. Learning is a social process.	Acts as an interactive tool, prompting students to discuss ideas, ask questions, and reflect on their understanding. It can serve as a "more knowledgeable other" to provide scaffolding and support, aligning with Vygotsky's Zone of Proximal Development (ZPD).	(Thomas et al., 2014; Newman & Latifi, 2021; Liang & Bai, 2024)
Connectivism	Learning is a result of the dynamic interplay of information across networks. It emphasizes connections among people, ideas, and digital resources.	Functions as part of a larger digital ecosystem, helping students connect different data points and access a wide range of ideas and information. It supports a networked approach to knowledge creation.	(Thomas et al., 2014; Sharples, 2023)
Cognitive Load Theory	Learning is optimized when instructional methods reduce extraneous cognitive load, allowing students to focus on essential information.	Provides timely explanations, breaks down complex topics into simpler parts, and offers personalized clarifications. This tailored support helps manage cognitive load and facilitates quicker learning.	(Sweller, 2022; Wu, 2023)

Self-Regulated Learning Theory	Effective learning requires students to actively manage their own learning processes, including setting goals, monitoring progress, and reflecting.	Acts as a personal tutor by offering immediate feedback, adaptable recommendations, and individualized customization. This empowers students to take control of their learning, set goals, and track their progress.	(Panadero, 2023; Zhou et al., 2024; Batista et al., 2024)

3 METHODOLOGY

A cross-sectional survey method adapted from Ajalo et al. (2025) and Daly et al., 2022) was used in this study to investigate the effectiveness, value, and general experience of ChatGPT in enhancing the learning experience of students studying material science for chemical engineering. The survey is to gather statistical data to help the inclusion of Generative AI as an effective educational strategy, hence enhancing teaching and learning and supporting the study on AI-enhanced education. The survey questions were constructed to address three critical points namely usage of ChatGPT, effectiveness and impact, learning experience. The inclusion and exclusion criteria for the study are summarized in Table 2. Following a thorough review of existing literature and conversations with topic area specialists, a methodical questionnaire was developed. The survey tool included usability and experience, efficacy and impact, demographic data, usage patterns and sentiments. The study was targeted at the third-year Chemical Engineering undergraduate students registered in Material Science for Chemical Engineering course for the pertinent semester. The targeted sample size was estimated as 44. All participants got an electronically delivered link for the survey. Linear regression was employed to examine how factors related to "Usage of ChatGPT" and its "Effectiveness and Impact" predict the overall "Learning Experience. “Improved Learning Experience” was treated as the outcome (the dependent variable), and all other factors were grouped into "Usage of ChatGPT" and "Effectiveness" categories to see how they predict this outcome. Third-year chemical engineering students are given a basic course in material science for chemical engineering. The course content comprises of advanced materials, phase diagrams, material selection for chemical processes, and material characterisation, the material science curriculum for chemical engineering gives students fundamental knowledge in material science and engineering. The students receive a thorough multidisciplinary foundation for understanding and controlling the mechanical, thermal, electrical, optical, and magnetic properties of materials. Students are expected to assess different kinds of materials and the important qualities of material properties such as structural, mechanical, electrical, optical, magnetic, and degradation characteristics upon course completion; select suitable materials that meet certain criteria while sufficiently handling environmental and safety concerns.

Table 2: Study eligibility criteria

Inclusion criteria	• Must be a registered student at the university where the study was conducted. • Must have registered for the course (material science for chemical engineering) during the semester under investigation. • Main spoken language coded as English

Exclusion criteria	• Not registered as student at the university where the study was conducted. • Not a registered student for the course (material science for chemical engineering) • Main spoken language not coded as English

4 RESULTS AND DISCUSSION

Students registered for the material science for chemical engineering provided a total of 33 responses which accounted for 75% of the total sample size. The survey analysis is made up of three parts namely: the use of ChatGPT for evaluation, its effectiveness and influence, and the usability and experience. Figure 1 depicts the findings from the ChatGPT use survey. The students' responses suggested that ChatGPT is used weekly, seasonally, and every day (Figure 1 (a)). Most students, on the other hand, said they used ChatGPT daily for different academic activities like case studies, assignments, research projects, essay writing, and quizzes (Figure 1 (b)). Students commonly use ChatGPT for assignments and research papers. Rojas (2024) reported a study on the use of ChatGPT for scientific writing projects. Emphasizing its roles in idea generation, subject validation, proofreading, and editing, the authors investigated student experiences, opinions, and the use of ChatGPT at various stages of the writing process. The evaluation also looked at student views on the ethical consequences of using ChatGPT in academic writing. The findings show positive student experiences and views on the inclusion of ChatGPT for a writing-intensive assignment, hence proving its effectiveness in concept generation, subject verification, proofreading, and editing. Kanabar (2023) empirical investigation on students' views of utilizing ChatGPT for academic tasks revealed that those using Generative AI-based tools for essay writing report worry over real learning and the possible growth of critical thinking skills. The survey shows that student responses range from acceptance to rejection.

The student's assessment of the correctness of the data obtained by ChatGPT varies (Figure 1 (c)). While a few percentages say it is incorrect, most students think the data gathered by ChatGPT is trustworthy. Notably, a significant portion of the students expressed neutrality regarding the accuracy of the data. Al-Ashwal et al. (2023) revealed ChatGPT's sensitivity and accuracy in forecasting drug-drug interactions. The findings showed notable variation in the precision of drug-drug interaction forecasts produced by ChatGPT. An analogous study done by Cappellani et al. (2024) looked into ChatGPT's dependability and accuracy in providing patients with information on eye diseases and their therapy. The study found that ChatGPT by itself provides incorrect, inadequate, and maybe harmful information about common eye disorders. Thus, according to these ideas, it is highly recommended to regularly check the fidelity of information acquired via ChatGPT.

Subsequent analysis of the survey questions indicated that students possess varying perspectives on ChatGPT's comprehension of intricate issues. (Figure 1 (d)). Material science for chemical engineering, as already noted, calls for thorough study for student understanding. Eighty-seven percent of the respondents from the survey believe ChatGPT to be a useful tool for understanding complex problems. The students determined possible uses, built a phase diagram for these materials, and used ChatGPT to design theoretical alloy combinations. Tsai et al. (2023) underlined that the inclusion of large language models, such as ChatGPT, into chemical engineering education can improve the student learning experience and understanding of complex topics.

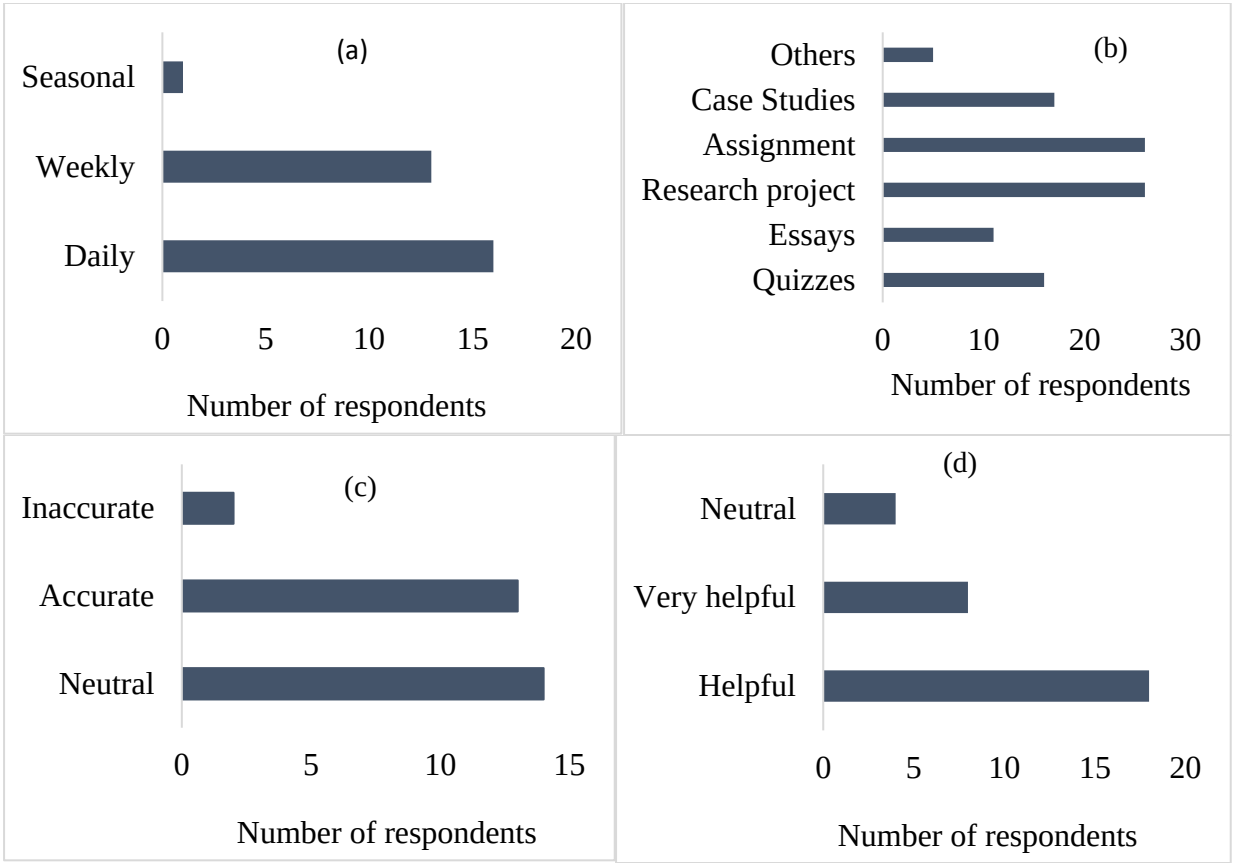


Figure 1: (a) Frequency of ChatGPT usage (b) Type of assessment in which ChatGPT is used for (c) Rating the accuracy of ChatGPT (d) How helpful is ChatGPT in understanding complex problems

The students' views on how ChatGPT affects study habit, critical thinking skills, learning experiences, and the regularity of content verification via ChatGPT are shown in Figure 2. As shown in Figure 2 (a) most of the students believed that the used of ChatGPT improved or significantly improved their study habit. More than 72% of the survey respondents either agreed or strongly agreed that ChatGPT affects critical thinking abilities, as shown in Figure 2 (b). Studies done lately have connected ChatGPT to a decline in critical thinking measurements. Many users of generative AI assign cognitive duties to the machine, which leads to less active participation in autonomous problem-solving. Close monitoring of ChatGPT classroom activities should help students feel more confident in assessing data, creating challenging questions, and honing their arguments. In the end, the whole impact is determined by context and application. Direct integration with human supervision promotes improved intelligence and reasoning; unmonitored use usually compromises analytical skills. Meticulously included into courses, for example, having students evaluate and improve ChatGPT drafts; artificial intelligence may improve critical thinking by encouraging consideration of the correctness of information and the organization of arguments. Pedagogy authorities advocate radical ideas like "Think-Pair-Ask ChatGPT-Pair-Share," which integrate artificial intelligence replies into group conversations, hence improving idea refinement and metacognitive abilities. Studies show that integrating guided artificial intelligence use with Lecturers' comments might help students create and evaluate hypotheses, hence increasing their interaction with the content. Well defined usage restrictions and smart questions let students see artificial intelligence as a tool instead of a need. Its application determines ChatGPT's influence on critical thinking. When guided, reflective integration might improve AI's ability to support reasoning and promote strong critical thinking; nevertheless, uncontrolled and excessive reliance could reduce analytical skills by means of cognitive dumping.

The perception of the students on the impact of ChatGPT on their learning experience is depicted in Figure 2 (c). About 85% of the student either agreed or strongly agreed that that ChatGPT enhances their learning experience. On-demand tutoring and tailored comments have helped ChatGPT to enhance students' educational experience (Javaid et al., 2023). ChatGPT can also enable individualised learning by producing ideas and enhancing accuracy (Elbanna & Armstrong, 2024). Engaged in organized activities such as evaluating ChatGPT's replies or contrasting many AI-generated solutions, students acquire metacognitive awareness and critical evaluation abilities. Reflecting deeper involvement with algorithmic reasoning, students using ChatGPT in programming training have showed notable improvements in self-programming skills and computational thinking(Yilmaz & Karaoglan Yilmaz, 2023). ChatGPT reduces obstacles for students with little access to human teachers or other learning materials.

About 94% of the students in Figure 2 (d) claimed they often or always check the validity of ChatGPT-sourced content. Careful checking of ChatGPT-acquired material against trustworthy sources, subject matter experts, or real documents guarantees correctness and encourages critical interaction with artificial intelligence and constructive doubt. Checking the data obtained by ChatGPT is not optional; it is very necessary. This strategy ensures that artificial intelligence functions as a dependable assistant rather than a distributor of unverified claims, protects reputations, promotes necessary research processes, and limits the spread of false information.

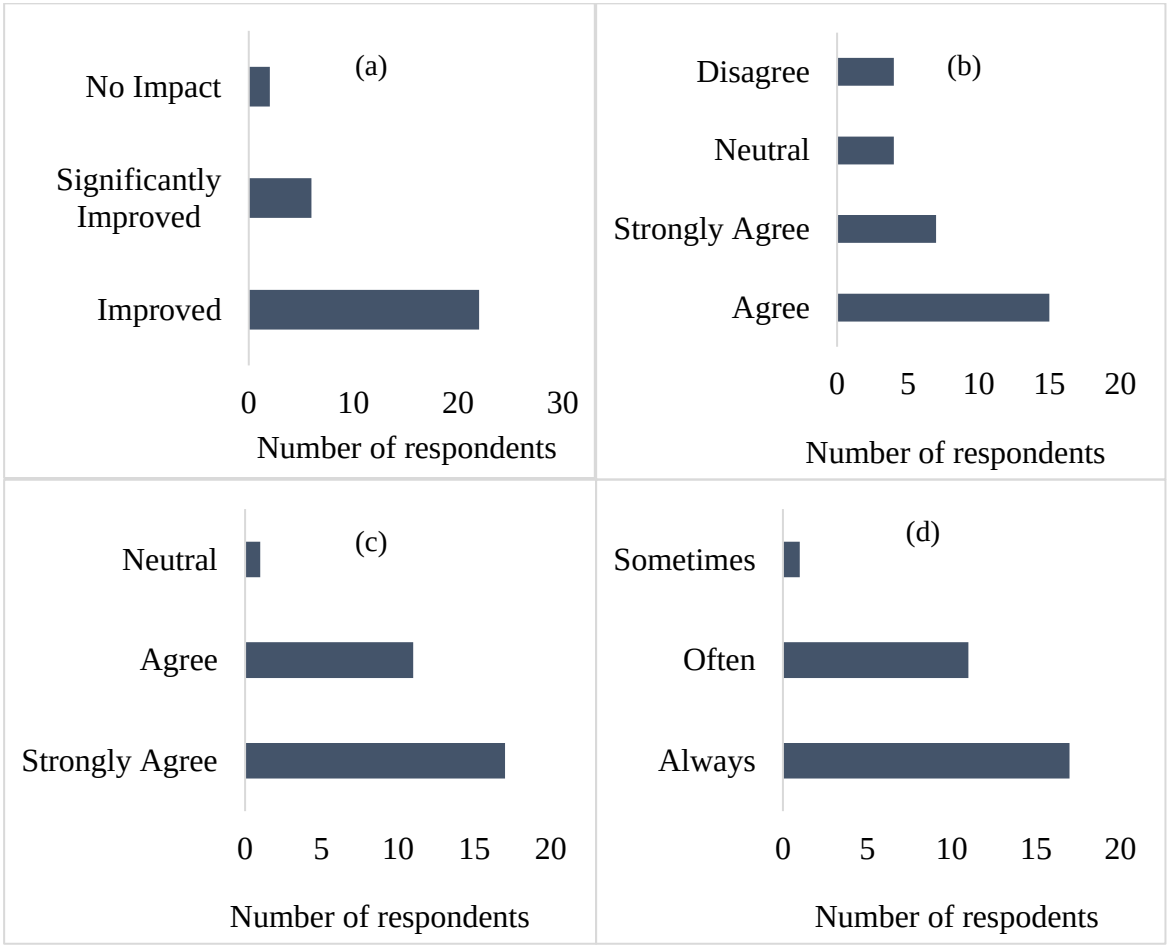
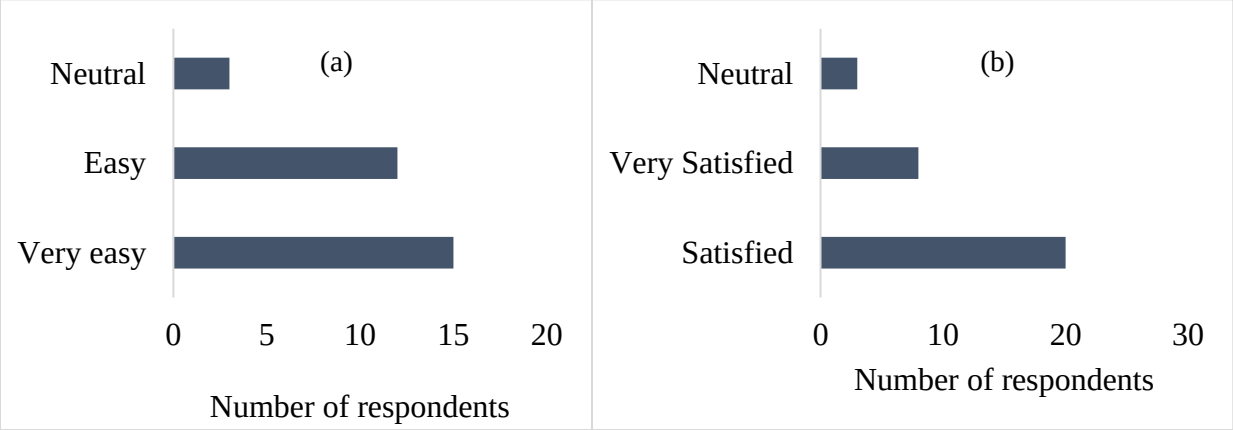


Figure 2: (a) Impact of ChatGPT on study habit (b) Impact of ChatGPT on critical thinking skills (c) Impact of ChatGPT on learning experience (d) Frequency of crosschecking the accuracy of ChatGPT

The responses on the usability of ChatGPT for academic goals, user satisfaction with the ChatGPT interface, and issues experienced when using ChatGPT for academic work are shown in Figure 3. Figure 3 (a) shows that 91% of respondents find ChatGPT easy or very easy to use for academic reasons. ChatGPT's conversational interface, fast feedback, and varied help in writing, research, coding, and language activities promote academic work efficiency. When coupled with efficient academic practices, it acts as a strong partner improving writing quality, learning, and production. Although user-friendly, following ideal criteria like fact checking, crediting AI-generated content, and seeing outputs as early drafts instead of final submissions would guarantee that students gain without sacrificing academic rigor.

Of the 88% of students who responded as shown in Figure 3 (b), most were satisfied or very satisfied with the ChatGPT interface. Although users point out areas for improvement, such as performance with large conversation histories and limited positive feedback choices, the ChatGPT interface is generally well-liked because of its simple chat-based design and strong information-processing capabilities. Key factors affecting satisfaction with the ChatGPT user interface include completeness, accuracy, timeliness, simplicity, and information format (Yu et al., 2024). Particularly commended are the timeliness and structural elements for their support of quick understanding via ChatGPT. The platform's fast feedback system speeds up decision-making and learning gives users a feeling of satisfaction. Its simple design, fast reaction times, and excellent information quality contribute to user satisfaction with the ChatGPT interface, which is especially high given thorough usability testing and independent evaluations. Increasing satisfaction will depend on fixing performance bottlenecks, increasing feedback channels, and providing more personalization.

Figure 3 (c) shows the respondents' views on the issues experienced using ChatGPT for academic goals. While using ChatGPT, respondents underlined several barriers including user interface issues, lack of contextual understanding, and challenges with complex questions. Of those polled, 60% said getting false information was the main problem they had using ChatGPT. On the other hand, 36% of those polled said they struggled with understanding complex questions, user interface issues, and lack of contextual knowledge when using ChatGPT. Though ChatGPT improves accessibility and efficiency, users still encounter several issues including factual errors, out-of-date information, privacy concerns, technical problems, and unintentional biases. Users must handle several issues despite ChatGPT's strong language-generating abilities: fact-checking errors, privacy control, bias reduction, technological dependability, and responsible, critical participation to use artificial intelligence safely and efficiently.



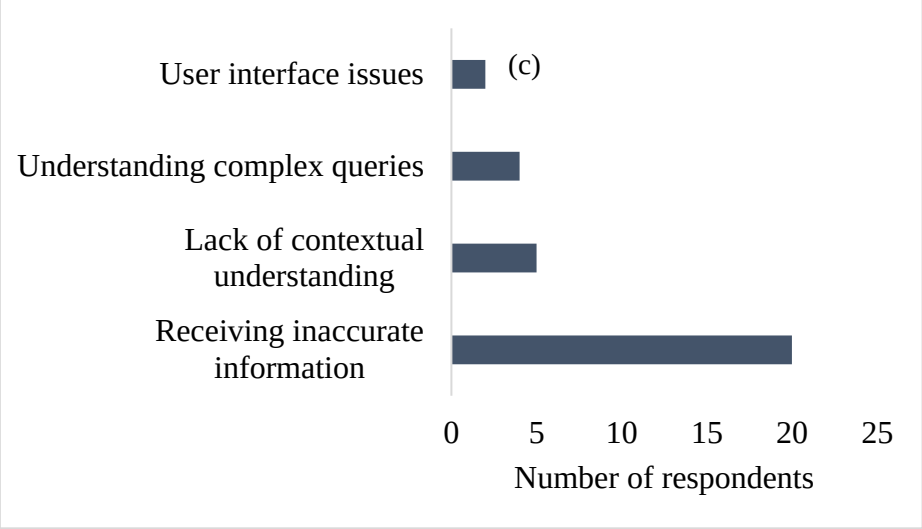


Figure 3: (a) Ease of using ChatGPT for academic work (b) Satisfaction with ChatGPT interface (c) Challenges of using ChatGPT for academic work

The summary of the regression analysis of the survey data is depicted in Table 3. The F value of 4.884 and p value of 0.00115 are indications that the linear regression model is statistically significant. This suggests that the factors effectively explain the learning experience. An R^2 of 0.666 depicts that 66.6% of the variation in the “Improved Learning Experience” is explained by the combined usage and effectiveness variables. The "Enhances Critical Thinking" is the only statistically significant predictor in the model. For every one-point increase in its rating, the learning experience score improves by 0.31 points. "Helpfulness in Understanding" is borderline significant (p=0.063) and has the largest positive coefficient (0.3620), indicating a strong positive relationship with the learning experience. "User Interface Satisfaction" is borderline significant (p=0.089) and positively related to the learning experience. Other core usage factors, such as Frequency of Use, Accuracy Rating, and Ease of Use, were not statistically significant predictors when all factors were considered together. This analysis clearly shows that the perceived effectiveness of ChatGPT is far more important than general usage patterns in predicting a positive learning experience. This analysis has demonstrated that students feel their learning experience is most improved when they believe ChatGPT enhances their critical thinking and helps them understand complex topics. Other aspects, like how often they use the tool or how easy it is to use, do not show a statistically significant impact in this comprehensive analysis.

Table 3: Prediction of Learning Experience

Predictor	Category	Coefficient	p-value	Significance
Enhances Critical Thinking	Effectiveness	0.3108	0.045	Significant
Helpfulness in Understanding	Effectiveness	0.3620	0.063	Borderline significant
User interface satisfaction	Usage	0.3028	0.089	Borderline significant
Frequency of Cross-Checking	Usage	0.2155	0.137	Not significant

Ease of use	Usage	0.1331	6	0.40	Not significant
Challenges Faced	Usage	0.0208	4	0.80	Not significant
Accuracy Rating	Usage	0.0074	8	0.95	Not significant
Impact on Study Habits	Effectivenes s	-0.0363	0	0.85	Not significant
Frequency of use	Usage	-0.0363	7	0.77	Not significant

5 CONCLUSION

The study has shown students' evaluation of ChatGPT as a useful tool for handling assignments in Material Science for chemical engineering, particularly in generating a theoretical alloy material, evaluating its properties, and generating a eutectic phase diagram for the proposed alloy components. The survey results showed that ChatGPT improved the general learning experience, strengthened critical thinking skills, and helped to understand complex engineering topics including material science in chemical engineering. Although proper ethical governance systems and ongoing pedagogical development are necessary for efficient deployment, generative artificial intelligence technologies like ChatGPT have demonstrated the possibility to transform the learning environment in materials science for chemical engineering. ChatGPT's effect on critical thinking depends on its use. When guided, reflective integration might improve Generative AI's ability to support reasoning and promote strong critical thinking; but unconstrained reliance could reduce analytical skills because of cognitive overload. By providing customized coaching, automating the production of materials and code, and enabling interactive simulations linking theoretical ideas with practical applications, generative AI might transform materials science and engineering education in chemical engineering. Generative AI like ChatGPT might relieve teachers from tedious tasks by adapting different learning styles, encourage critical thinking through AI-assisted problem-solving, and enhance accessibility. To maximize efficacy, systematic pedagogical integration and ongoing evaluation are necessary as they guarantee that AI improves basic skills and prepares students for modern material challenges.

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Bridging Theory and Practice in Control Systems Education: A Multimodal Approach for Enhanced Learning

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ABSTRACT

Traditional lecture-based teaching in Control Systems education often focuses on mathematical derivations, making it difficult for students to grasp conceptual understanding, visualise system behaviour, and apply knowledge to real-world scenarios. This gap limits their ability to design and analyse control systems effectively. This paper introduces a multimodal learning approach that integrates theoretical instruction, visual tools, hands-on experimentation, collaborative problem-solving, and reflective learning to address these challenges. The approach is grounded in established learning style models, including VARK, Kolb's experiential learning and Felder-Silverman's learning styles. The study implemented three case studies within a Control Systems course to evaluate the effectiveness of this approach. Results showed a significant improvement in student comprehension, engagement, and confidence. Post-assessment analysis revealed an 85–88% increase in understanding across various activities and enhanced problem-solving abilities. These findings demonstrate that multimodal strategies bridge the gap between theory and practice, improve learning outcomes, and foster greater student engagement in Control Systems education.

KEYWORDS: Multimodal learning, control systems education, learning style models, hands-on experimentation, pedagogy

1 INTRODUCTION

Traditional teaching methods in engineering education, particularly in control systems courses, often rely heavily on lecture-based instruction, mathematical derivations, and textbook learning. While these methods effectively communicate theoretical concepts, they frequently fall short of engaging students with diverse learning preferences. Many learners struggle to visualize system behaviour, apply abstract ideas, and connect theoretical knowledge to real-world applications. Furthermore, these conventional approaches typically do not emphasize hands-on experimentation, which is crucial for mastering control system design and analysis. This passive learning environment can lead to low retention rates, limited student engagement, and a lack of critical thinking skills. Consequently, students may memorize formulas yet struggle to apply control techniques in practical scenarios, leaving them ill-prepared for industry challenges.

To address these limitations, the multimodal learning approach has emerged as a viable solution for teaching control systems. By integrating visual aids, interactive simulations, hands-on experimentation, and collaborative problem-solving, multimodal learning accommodates a range of cognitive preferences. Learning style models, such as VARK, Kolb's Experiential Learning, Felder-Silverman, Honey & Mumford, and Gregorc's Model, highlight the importance of engaging students through multiple sensory modalities and active learning techniques. This approach effectively bridges the gap between theory and practice, enhancing conceptual understanding and improving knowledge retention. Moreover, multimodal learning promotes student engagement and fosters the development of essential skills such as critical thinking, teamwork, and problem-solving, which are vital for future engineering professionals.

Several studies support the effectiveness of multimodal learning in engineering education. El-Saftawy et al., 2024 have found that applying VARK learning styles significantly enhanced students' comprehension and engagement. Conceptual mapping, aligned with learning styles, outperformed traditional lectures in knowledge retention (Amaniyan et al., 2020). (Idkhan & Idris, 2021) highlighted that Kolb's learning cycle improved student performance by integrating theory and active experimentation. The Felder-Silverman model's role in personalised learning shows that students learn better when teaching methods align with their preferences (Nafea et al., 2019). The importance of learning style frameworks in STEM education has been concluded, and a diverse approach enhances theoretical and applied learning outcomes (Childs-Kean et al., n.d.).

Motivated by the above, this paper proposes a multimodal learning framework integrating diverse instructional strategies for effective Control Systems education.

2 LEARNING STYLES

This section offers an overview of three learning styles that classify individual learning preferences. It also presents key components of each model and its implications for effective teaching and learning.

2.1 VARK Learning Style

The VARK learning style model shown in Fig. 1 identifies individual learning preferences based on four primary sensory modalities (El-Saftawy et al., 2024), which are defined as follows:

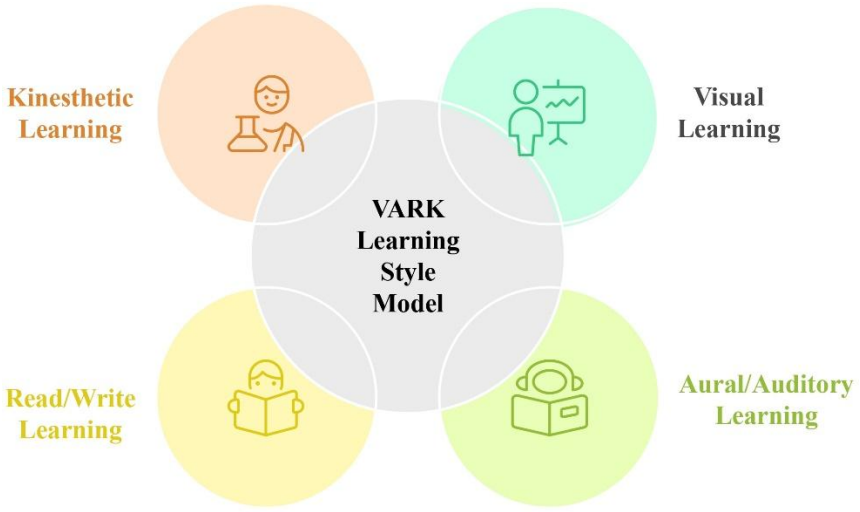


Figure 1: Framework of VARK Learning Style

- Visual (V): Learners prefer understanding concepts using images, videos, and animations. They learn best when information is presented visually.
- Aural/Auditory (A): Learners absorb information best through listening, so they prefer lectures, discussions, and verbal explanations.

- Read/Write (R): Learners learn best through reading and writing. So, they prefer text-based materials like books, lecture notes, and written instructions.
- Kinesthetic (K): Learners retain information best through hands-on experiences and physical activities. So, they prefer practical demonstrations, experiments and real-world examples.

2.2 Kolb's Learning Style

Kolb's learning style model explains how individuals learn from their experiences. It is based on Kolb's experiential learning, which suggests that learning is an ongoing process that consists of four distinct stages, as shown in Fig. 2 (Idkhan & Idris, 2021). Kolb proposed that effective learning occurs when a person progresses through the following stages:

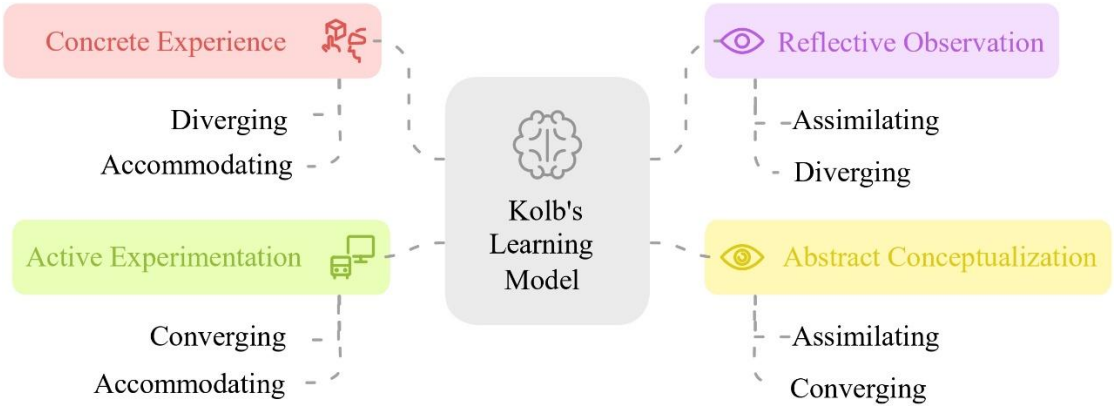


Figure 2: Framework of Kolb's Learning Style

- Concrete Experience (CE): Learning through direct experiences, hands-on activities, or real-world engagement.
- Reflective Observation (RO): Learning through analysing and thinking about the experience from various perspectives.
- Abstract Conceptualisation (AC): Learning through developing theories, concepts, or models based on those reflections.
- Active Experimentation (AE): Learning through applying the learned material to observe the outcomes in new situations.

Based on how individuals prefer to engage with the learning cycle, Kolb's model identified four learning styles:

- Diverging (CE + RO): Imaginative, emotional, and people-oriented individuals enjoy brainstorming, exploring different perspectives, and working in groups.
- Assimilating (RO + AC): Logical, analytical, and detail-oriented individuals prefer structured learning, theories, and abstract concepts.
- Converging (AC + AE): Problem-solvers who are practical and hands-on learners enjoy applying theories to real-world situations and solving technical problems.
- Accommodating (AE + CE): Action-oriented, intuitive, and adaptable individuals who learn best through trial-and-error, hands-on experiences, and gut feelings.

2.3 Felder-Silverman Learning Style

The Felder-Silverman learning style model describes how learners prefer to learn in an academic setting, particularly in engineering and science education. This model classifies learners along four dimensions, each representing a spectrum of learning preferences, as shown in Fig. 3 (Nafea et al., 2019).

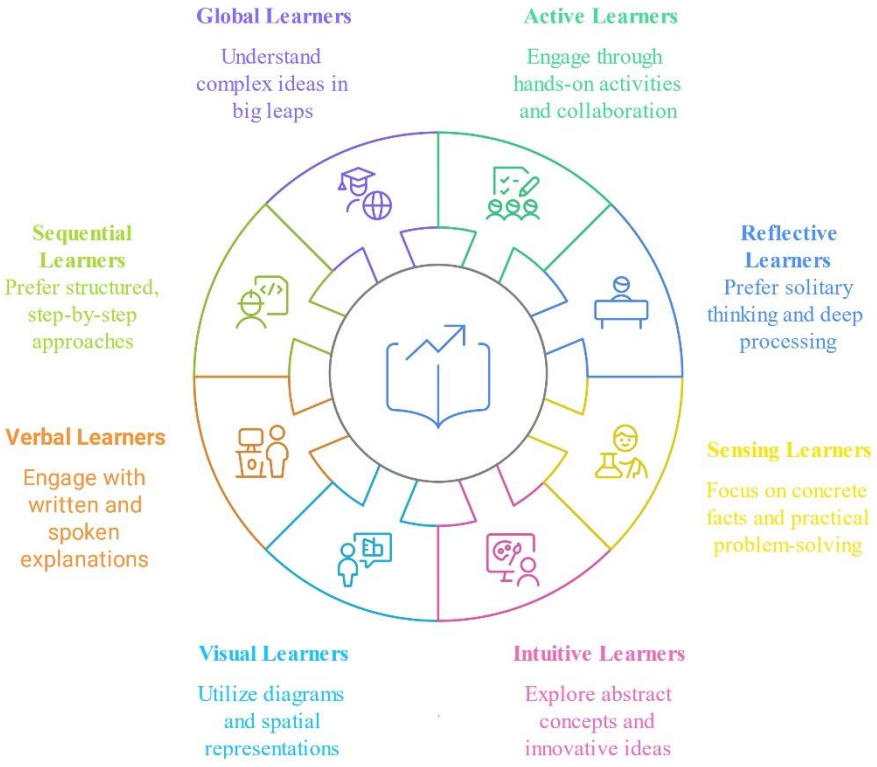


Figure 3: Framework of Felder-Silverman Learning Style

The four dimensions of the Felder-Silverman learning style model are given as

1) Processing: Active vs. Reflective
   - Active: Learners prefer learning through hands-on activities, discussions, and collaboration.
   - Reflective: Learners prefer thinking deeply about concepts before acting, often working alone or taking time to process information.
2) Perception: Sensing vs. Intuitive
   - Sensing: Learners prefer concrete facts, real-world applications, and practical problem-solving.
   - Intuitive: Learners prefer abstract concepts, theories, and discovering patterns.
3) Input: Visual vs. Verbal
   - Visual: Learning through diagrams, images and videos.
   - Verbal: Learners prefer written and spoken explanations, such as reading textbooks, listening to lectures, or engaging in discussions.
4) Understanding: Sequential vs. Global
   - Sequential: Learners prefer logical, step-by-step learning. Need a structured approach to grasp concepts.
   - Global: Learners learn in big leaps, often struggling with step-by-step explanations but understanding complex ideas simultaneously.

3 MULTIMODAL LEARNING APPROACH

This section proposes two multimodal learning activities that integrate multiple learning style models given in Section 2 to enhance learners' understanding of “Control Systems.”

3.1 Activity 1

This activity focuses on an Interactive Workshop on PID Controller Tuning. The main objective is to introduce learners to the Proportional-Integral-Derivative (PID) controller, one of the most widely used control techniques. This activity provides learners hands-on experience tuning PID parameters and understanding their impact on system behaviour. In a conventional approach, PID control is often taught using mathematical derivations alone, making it difficult for learners to understand how tuning parameters affect system behaviour. Without hands-on experience, learners may memorise formulas but struggle to apply PID tuning principles in the real world.

To accommodate various learning styles, this proposed activity integrates multiple learning methods, as follows:

1) Theoretical Foundation (*Felder-Silverman - Sequential Learners, Kolb - Abstract Conceptualization, VARK - Reading/Writing Learners*)
   PID control theory involves a mathematical framework widely used in various industries. It provides a strong conceptual foundation through structured lecture material and written explanations for learners who prefer a logical, step-by-step approach.
2) Visual Learning (*VARK - Visual Learners, Felder-Silverman - Visual Learners*)
   Graphical representations like step response plots and block diagrams help visualise system behaviour. Additionally, animated simulations visualising various parameters' impacts could further enhance conceptual understanding.
3) Hands-on Experimentation (*Kolb - Active Experimentation, Felder-Silverman - Sensing Learners, VARK - Kinesthetic Learners*)
   Learners participate in PID tuning exercises using MATLAB/Simulink simulations. This hands-on experience helps reinforce theoretical concepts through direct application.
4) Collaborative Learning (*Felder-Silverman - Active Learners, Kolb - Concrete Experience*)
   Group discussions and teamwork enable learners to analyse various PID tuning strategies and their effectiveness. This peer-to-peer interaction fosters active engagement and encourages diverse approaches to problem-solving.
5) Reflective Learning (*Kolb - Reflective Observation, Felder-Silverman - Reflective Learners*)
   Learners reflect on their activities by analysing the impact of changes in PID parameters on system behaviour. At the same time, structured self-assessment questions promote deep learning and critical thinking.

This proposed activity will enhance the learners' theoretical and practical understanding of PID controllers. It will also enhance their ability to analyse system responses and adjust parameters for improved performance, strengthening their problem-solving and teamwork skills.

3.2 Activity 2

Similarly, this activity focuses on a Case Study of Control System Failures. This activity bridges the gap between control system theory and real-world applications by analysing engineering failures caused by control system malfunctions. Many learners perceive control systems as theoretical, with little exposure to practical challenges. Traditional teaching methods often focus on mathematical derivations rather than emphasising problem-solving and critical thinking, which are crucial for diagnosing and preventing failures. To address this gap, the proposed learning activity is structured as follows:

1) Case Study Analysis (*Kolb - Reflective Observation, Felder-Silverman - Global Learners*)
   Learners explore real-world failures in control systems, like aircraft autopilot malfunctions and unstable power grids. This hands-on approach enhances their understanding of the practical implications of control system design and stability.
2) Collaborative Problem-Solving (*Felder-Silverman - Active Learners, Kolb - Active Experimentation*)

Teams evaluate failure cases while proposing corrective measures and alternative control strategies. This process encourages brainstorming and discussions, which enhance critical thinking and practical problem-solving skills.

3) Presentation & Report Writing (*VARK - Reading/Writing Learners, Felder-Silverman - Verbal Learners*)

Learners present their case study analysis and proposed solutions in a structured format, enhancing their technical communication skills through written reports. Verbal presentations also cater to auditory and verbal learners.

The proposed activity will enhance critical thinking and problem-solving skills and the ability to apply control system concepts to real-world engineering challenges.

4 CASE STUDIES

This section presents two case studies conducted with 45 undergraduate students in an "EFB3023 - Control Systems" engineering course taught to Bachelor of Electrical and Electronics Engineering with Honours students at Universiti Teknologi PETRONAS to assess the effectiveness of the proposed multimodal learning activities. All the case studies have been evaluated using pre- and post-activity assessments, learner surveys, project evaluations, and observational analysis. Pre-tests were administered before each activity to assess learners' baseline knowledge. Post-tests were conducted afterwards to measure learning improvement. Learner surveys are conducted to evaluate the different learning methods and open-ended feedback to gather insights on challenges, engagement levels, and areas for improvement. Group project evaluations have been conducted with faculty members assessing their presentations based on a structured rubric considering technical accuracy, problem-solving skills, collaboration, and communication. Further, an instructor conducted an observational analysis to monitor learner engagement and problem-solving strategies during activities.

4.1 Case Study 1

This case study assesses the impact of multimodal teaching strategies on students' understanding of PID controllers, focusing on how theoretical instruction, visual tools, hands-on experimentation, and collaboration enhance learning. Activity 1, given in Section 3.1, was implemented in four steps. First, students were randomly grouped into small teams and provided with MATLAB/Simulink for hands-on learning of PID control. Next, a pre-assessment measured their knowledge and confidence in PID theory and tuning methods. The third step involved a multimodal learning approach, combining lectures, visuals, experiments, and discussions. Finally, a post-assessment measured knowledge improvements and confidence in applying PID tuning alongside a feedback questionnaire to gather insights on engagement and challenges faced during the activity.

The case study results in Table 1 indicate significant improvement in students' understanding and confidence in PID controller tuning. Post-tests revealed that 85% of students showed improved comprehension, while 90% preferred hands-on experimentation in MATLAB/Simulink over traditional lectures. Additionally, 80% reported increased confidence in adjusting PID parameters for system stability. Qualitative feedback highlighted the value of interactive simulations and hardware testing, reinforcing theoretical concepts and demonstrating the effectiveness of multimodal learning strategies in control systems education.

Table 1 Summary of Case Study Results for Multimodal Learning Activities

Assessment Criteria	Activity 1	Activity 2
Improvement in Test Scores	85% of students improved post-test scores	82% of students showed a better understanding of real-world failures

Increase in Confidence	80% felt more confident in PID tuning	86% felt more prepared to analyze and prevent failures
Effectiveness of Hands-on Learning	90% found MATLAB/Simulink experimentation beneficial	78% appreciated case-based problem-solving
Engagement & Participation	88% reported high engagement in group discussions	92% actively participated in the case study analysis
Qualitative Feedback	Interactive tuning helped visualize theoretical concepts	Real-world relevance made learning more meaningful

4.2 Case Study 2

This case study evaluates the effectiveness of multimodal learning strategies in enhancing students' ability to apply theoretical control system concepts to real-world failures. The study focuses on how case-based analysis, collaborative problem-solving, and structured technical communication improve critical thinking and practical application skills. Activity 2, given in Section 3.2, was implemented in four steps. First, students were introduced to three real-world control system failures: the Boeing 737 MAX autopilot failure, the 2003 North American blackout, and a failed industrial process control system. Next, teams conducted an in-depth analysis of the failures, identifying control system deficiencies and their root causes. In the third step, students collaborated to propose corrective measures and alternative control strategies, preparing group presentations and technical reports. Finally, assessments were conducted through group presentations and individual reports, evaluating their critical thinking, technical communication, and problem-solving abilities.

The case study results in Table 1 highlight the strong impact of real-world problem-based learning. 92% of students reported that analysing real-world failures helped them bridge the gap between theory and practical applications. 85% of students demonstrated improved problem-solving skills, particularly in diagnosing failures and formulating corrective strategies. Additionally, 78% of students indicated that presenting their findings improved their ability to communicate technical concepts effectively. Qualitative feedback emphasised that case-based learning enhanced engagement and provided a deeper understanding of control system challenges beyond theoretical instruction.

5 CONCLUSIONS

This study highlights the effectiveness of multimodal learning strategies in enhancing students' understanding of control systems through activities focused on PID controller tuning and case studies of control system failures. Traditional teaching methods often emphasise theoretical derivations, which can hinder practical application. The approach engages students with various cognitive preferences by integrating diverse learning models such as VARK and Kolb's Experiential Learning. The findings reveal a significant improvement in comprehension by 85-88%, with students expressing increased confidence in applying control system concepts. Hands-on activities, interactive simulations, and collaborative problem-solving were particularly effective. Additionally, qualitative feedback showed that students valued the material's real-world relevance and found visual tools essential for learning. In conclusion, a multimodal approach enhances conceptual understanding, problem-solving skills, and student engagement. Future research could explore its scalability across other engineering disciplines and its effects on long-term knowledge retention.

6 ACKNOWLEDGEMENTS

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Advancing Solar Energy Education: Assessing the Impact of Virtual Reality Learning Modules on Comprehension with Photovoltaic and Thermal Concepts

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ABSTRACT

Traditional teaching methods in solar energy education often struggle with conveying complex theoretical concepts and providing hands-on learning opportunities. Virtual Reality (VR) learning modules offer an innovative solution by enabling immersive, interactive simulations that enhance visualization and practical understanding in a risk-free environment. This study evaluates the effectiveness of a VR-based learning module in teaching photovoltaic and thermal concepts, assessing its impact through quantitative and qualitative measures. A total of 55 undergraduate students participated in the study, with 67.3% having no prior VR experience. After using the module, the proportion of students feeling confident in their understanding of photovoltaic-thermal (PVT) systems increased from 60% to 94.5%, with those feeling "extremely confident" rising from 20% to 49.09%. The average quiz score of 8.71/10 further supports the effectiveness of VR learning in reinforcing technical knowledge. Student feedback was overwhelmingly positive, with engagement (4.78/5), motivation (4.84/5), and conceptual visualization (4.84/5) rated the highest. The interactive elements significantly increased interest in solar energy concepts (4.78/5), while confidence in applying learned knowledge improved substantially (4.73/5). Additionally, students reported improved retention (4.73/5) and a stronger ability to relate simulations to real-world applications (4.80/5). Despite its strengths, students identified areas for improvement, including minor technical issues such as laggy controls, motion sickness, and challenges for users wearing glasses. Suggestions for enhancement included adding more interactive animations, refining navigation controls, and incorporating adjustable audio features. These findings indicate that VR-based learning significantly enhances comprehension, motivation, and retention in solar energy education. By integrating VR into renewable energy curricula, institutions can bridge learning gaps, improve student engagement, and foster a deeper understanding of photovoltaic and thermal technologies. Future research should explore long-term retention and comparative analyses with traditional teaching methods.

KEYWORDS: Virtual Reality Learning, Solar Energy Education, Photovoltaic-Thermal (PVT) Systems, Immersive Learning, Engineering Education, Technology-Enhanced Learning

1 INTRODUCTION

The global energy landscape is undergoing a profound transformation driven by the urgent need to mitigate climate change and reduce reliance on fossil fuels. Among various renewable energy sources, solar energy stands out for its abundance, scalability, and decreasing cost of deployment. Technologies such as Photovoltaic (PV) systems, Solar Thermal (T) collectors, and integrated Photovoltaic-Thermal (PVT) systems have seen significant advancements over the past decade, contributing to the growing share of solar

power in national and international energy portfolios (Hamid et al., 2014; Herrando et al., 2023; Hosouli et al., 2023).

However, realizing the full potential of solar energy technologies depends not only on research and innovation but also on the quality of education provided to the next generation of engineers and energy professionals. A robust educational foundation is essential for cultivating expertise in solar system design, performance evaluation, integration with building systems, and techno-economic analysis. This requires engineering curricula to evolve beyond traditional pedagogies, which often rely heavily on passive lecture-based instruction and textbook-driven theory (Altassan, 2023).

Despite the importance of solar energy in engineering education, several critical gaps persist in current teaching methodologies. Traditional classroom settings tend to rely heavily on static content delivery through lectures and printed materials, offering limited interactivity and minimal hands-on experience. Laboratory access to functional solar panels, thermal collectors, or hybrid PVT systems is often constrained by cost, maintenance demands, and safety considerations. Field trips to solar farms—while pedagogically valuable—are logistically complex, costly, and typically limited to only a small number of students due to site restrictions and travel constraints. This lack of experiential learning can hinder students' ability to internalize key concepts. For instance, while the influential factors of on PV output is often discussed in lectures, students rarely have the opportunity to test this experimentally or see the real-time impact of their design decisions. Consequently, abstract theoretical knowledge remains disconnected from practical system behavior. This disconnect contributes to reduced engagement, lower retention, and a gap between academic preparation and industry expectations.

To overcome these barriers, innovative, technology-driven teaching methods are being explored to improve learning outcomes. Virtual Reality (VR) represents a promising frontier in engineering education. VR offers the ability to simulate real-world environments and complex systems in an interactive, immersive, and safe setting. Recent educational research indicates that VR-based learning environments shows a positive influence on learning engagement compared to traditional classroom methods (Chen et al., 2024), while also increasing motivation, critical thinking, and cognitive engagement (Allcoat & von Mühlenen, 2018; Xin, 2022). According to Makransky and Lilleholt (2018), immersive learning technologies such as Virtual Reality (VR) significantly enhance learning outcomes by increasing both cognitive engagement and emotional involvement. Salah et al. (2019) also found that a VR-based teaching platform integrating theoretical instruction with hands-on practice significantly improved mechanical engineering graduates' practical skills and multidisciplinary design capabilities.

Moreover, the VR platform integrates principles of experiential learning, where knowledge is constructed through direct experience and reflective observation. Coupled with immersive learning, which emphasizes user engagement through sensory involvement and interactivity, the VR module transforms abstract concepts into tangible experiences. Students can virtually "walk through" a solar facility, inspect components, and experiment with configurations, promoting deeper understanding and higher-order thinking. Beyond pedagogical value, the VR approach also offers practical benefits. It eliminates the need for extensive travel, mitigates safety concerns, and reduces costs associated with conventional lab infrastructure and site visits. As a result, it supports scalable, accessible, and inclusive education, particularly in institutions where physical resources are limited.

This research assesses the effectiveness of the VR module in enhancing student comprehension, engagement, and academic performance in solar energy courses. The findings contribute to the broader discourse on educational innovation in engineering, offering practical insights for integrating immersive technologies into renewable energy curricula. Ultimately, this study aims to establish VR-based solar education as a transformative tool that can elevate the quality of learning, bridge the theory-practice divide, and better prepare future engineers to contribute effectively to the global energy transition.

2 METHODOLOGY

2.1 VR Module Development

The Virtual Reality (VR) learning module was systematically developed to provide a comprehensive and immersive educational experience in solar energy technology. The content was designed to cover the foundational aspects of solar energy, with four key modules: Solar Geometry, Solar Thermal Systems, Photovoltaic (PV) Systems, and Photovoltaic-Thermal (PVT) Systems, with particular emphasis on the influential parameters affecting system performance.

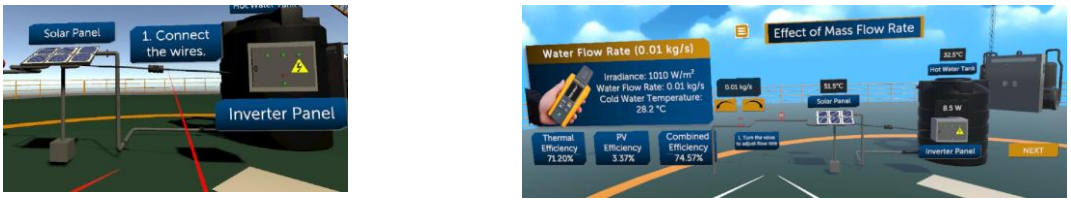
The instructional design of the VR module was grounded in curriculum requirements for undergraduate engineering programs, ensuring alignment with core learning outcomes in renewable energy and energy systems courses. Each module was structured to progress from fundamental principles to more complex system interactions. For instance, as in Figure 4, the Solar Geometry module allows students to explore the movement of the sun relative to Earth. The Solar Thermal and Photovoltaic modules introduce students to system components, operational principles, and applications, supported by interactive visualizations.



(a) (b)

Figure 4: VR Interface (a) Solar geometry simulation (b) Applications of solar thermal system

The most advanced section, the PVT system module, integrates thermal and electrical performance analysis, enabling students to study key influential parameters such as solar irradiance, solar panel temperature, fluid flow rate, and dirt accumulation on solar panel. As shown in Figure 5, the module provides immediate performance feedback through dynamic indicators, reinforcing cause-and-effect relationships in system behavior.



(a) (b)

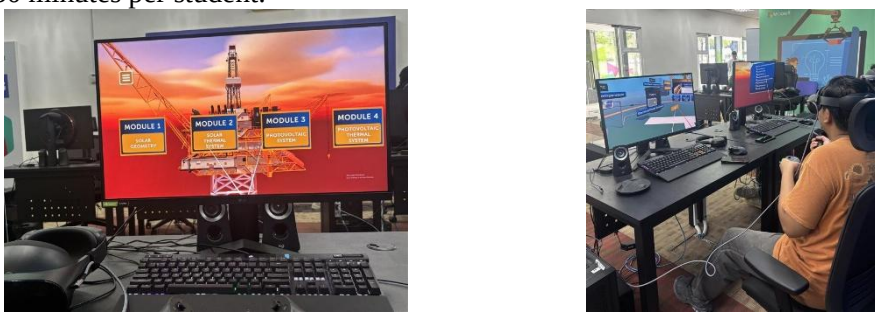
Figure 5: PVT Module Interface (a) System installation (b) Influential parameter study on system performance

All VR content was developed in collaboration with subject matter experts, instructional designers, and software developers to ensure scientific accuracy, pedagogical effectiveness, and technical feasibility. The user interface was optimized for intuitive navigation and accessibility, providing students with a seamless and engaging learning experience.

2.2 VR Module Implementation

The developed Virtual Reality (VR) learning module was implemented as part of a pilot study involving 55 final-year undergraduate students enrolled in the Bachelor of Engineering program. The implementation took place in a VR-compatible laboratory setting, where each student was equipped with

an individual VR headset. Prior to beginning the session, students were given a brief orientation on how to navigate the VR environment and interact with the simulation features. As depicted in Figure 6, the students then engaged with the full module, which included four main components: Solar Geometry, Solar Thermal System, Photovoltaic System, and Photovoltaic-Thermal (PVT) System. The entire VR experience lasted approximately 30 minutes per student.



(a) (b)

Figure 6: VR Module pilot test on students (a) VR module set-up (b) Student's VR experience

To evaluate the effectiveness of the VR module, a two-part assessment was conducted immediately after the VR session:

1. Conceptual Quiz: A quiz with 10 multiple-choice questions was used to assess students' understanding of key concepts introduced in the VR module. The quiz provided a quick and objective measure of the students' cognitive gains after the immersive experience.
2. Student Perception Survey: Following the quiz, students completed a structured survey aimed at capturing their perceptions of the VR-based learning experience. The survey consisted of both closed-ended and open-ended questions, designed to capture multiple dimensions of the learning experience, including prior experience with VR, self-perceived understanding of solar energy systems before and after the module, engagement, motivation, interactivity, and applicability to real-world scenarios. The questions were designed to not only assess the perceived effectiveness of the VR module but also to encourage student reflection, aligned with Gibbs' Reflective Cycle (Gibbs, 1988), promoting deeper metacognitive insights. The data collected provided both quantitative metrics for statistical analysis and qualitative insights for iterative module improvement.

   The closed-ended items included:

- A binary question regarding prior experience with VR-based learning.
- Self-assessment questions on confidence in understanding PVT systems, both before and after using the module, using a 5-point Likert scale ranging from "Extremely Not Confident" to "Extremely Confident."
- 5-star rating items assessing aspects such as engagement, focus, motivation, interest, confidence, visualization of complex concepts, real-world applicability, learning effectiveness, retention, and the impact of interactive elements.

The open-ended section of the survey included reflective questions such as:

- Describing the overall VR experience.
- Emotions and feelings during the use of the VR module (e.g., excited, confused, overwhelmed).
- Most helpful features for learning.
- Challenges or areas for improvement.
- Key takeaways from the module.
- Intended application of the knowledge in future coursework or career.
- Willingness to recommend the module to others and rationale.
- Additional suggestions for improvement

Both the quiz and the survey provided valuable data to assess not only the cognitive impact of the VR learning module but also its effectiveness in fostering motivation, confidence, and deeper conceptual understanding among students.

3 RESULTS AND DISCUSSION

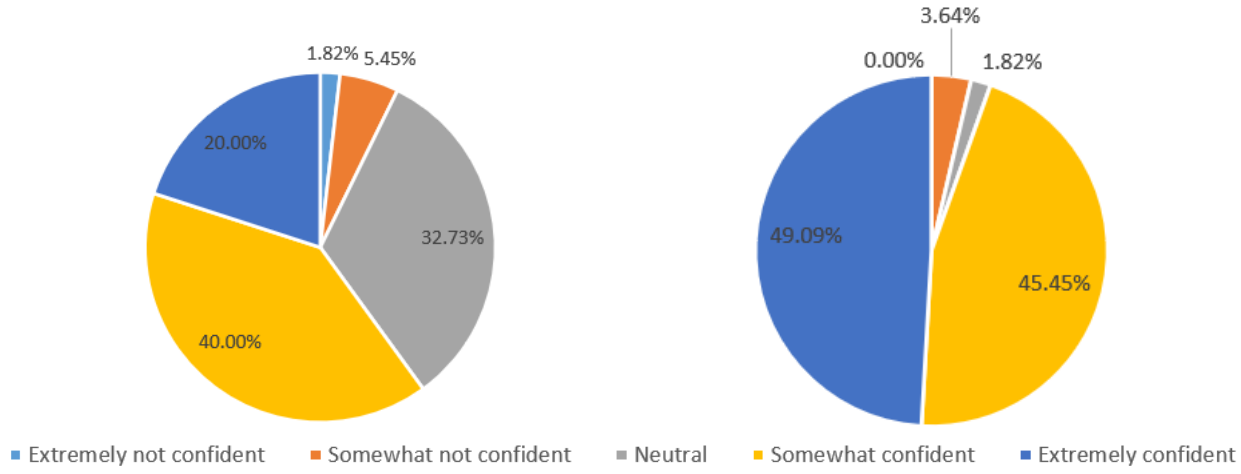
3.1 Student Performance on Conceptual Quiz

To assess students' comprehension of the core concepts taught through the VR module, a quiz with10 multiple-choice questions was administered immediately after the VR session. The average score across all 55 students was 8.71 out of 10, indicating a high level of understanding of photovoltaic, thermal, and PVT systems. The quiz results suggest that the interactive and experiential nature of the VR module successfully facilitated conceptual learning, particularly in areas where students typically struggle using traditional teaching methods—such as interpreting solar geometry and understanding the influence of system parameters like tilt angle and fluid flow on energy performance. This aligns with earlier studies where students using immersive learning platforms outperformed those taught via conventional methods.

3.2 Survey Responses and Engagement Indicators

a. Prior VR Experience and Confidence Shift

Only 32.7 % of students reported prior experience with VR-based learning, indicating that for most participants, this was their first exposure to immersive education. As depicted in Figure 7, before using the VR module, 40% of students rated their confidence in understanding PVT systems as *extremely low to neutral*. After the session, 94.5 % reported *high confidence*, with an increase from 20 % to 49.09 % indicating they felt *extremely confident*. This shift demonstrates that the VR module effectively supported students in building a more solid understanding of complex, integrated energy systems.



(a) (b)

Figure 7: Confidence level in understanding solar energy systems (a) before and (b) after VR module implementation

b. Quantitative Survey Insights

The evaluation of the VR-based learning module in teaching photovoltaic-thermal (PVT) concepts revealed a highly positive impact across multiple dimensions of student learning. Among all assessed aspects, conceptual visualization and motivation received the highest ratings (4.84/5), indicating that students found the VR environment significantly more effective than traditional methods for understanding complex solar energy concepts and inspiring further exploration of the content.

Equally noteworthy were the ratings for focused learning and real-world application relatability (both 4.80/5). Students reported that the immersive nature of the VR experience helped them stay engaged without distractions and made it easier to connect theoretical knowledge with practical, real-world applications—an essential outcome for engineering and technical education.

Engagement and interest enhancement also scored highly (4.78/5), suggesting that the interactive design elements of the module successfully captured students' attention and deepened their interest in solar energy topics. These results support the growing consensus that immersive learning environments can significantly boost curiosity and intrinsic motivation in STEM education.

Furthermore, the module was effective in reinforcing technical understanding, as seen in the strong rating for understanding through quizzes and interactive tasks (4.75/5). Students noted that these components were instrumental in clarifying concepts and testing their comprehension in real-time.

While slightly lower, the ratings for confidence in applying learned knowledge and knowledge retention (both 4.73/5) still indicate substantial learning gains. Students felt more prepared to apply their knowledge in real-life contexts and reported better retention compared to conventional textbook learning.

Table 6 summarizes the 5-star rating section of the survey. These findings collectively affirm the VR module's effectiveness in enhancing learning outcomes in solar energy education. While the results are highly promising, they also point toward the need for ongoing refinement—particularly in addressing minor technical issues—to fully optimize the immersive learning experience.

Table 6 Summary of survey outcome on different learning aspects

Rank	Learning Aspect	Survey Statement	Average Rating (/5)
1	Conceptual Visualization	*The VR module helped me visualize complex concepts better than traditional methods.*	4.84
1	Motivation	*I felt motivated to explore the content further after using the VR module.*	4.84
3	Focused Learning	*The VR module helped me stay focused on learning without distractions.*	4.80
3	Real-World Application Relatability	*I was able to relate the VR simulations to real-world applications of solar energy.*	4.80
5	Engagement	*I found the VR module engaging and enjoyable.*	4.78
5	Interest Enhancement	*The interactive elements increased my interest in solar energy concepts.*	4.78
7	Understanding through Quizzes/Tasks	*The quizzes and interactive tasks in the VR module improved my understanding.*	4.75
8	Confidence in Knowledge Application	*I felt confident in my ability to apply what I learned from the VR module.*	4.73
8	Knowledge Retention	*I was able to retain information better through the VR module compared to textbooks.*	4.73

c. Qualitative Survey Insights

The students highlighted a wide range of features they found most beneficial in the VR module. Chief among them was the visual and interactive experience, particularly the 3D simulations that allowed them to visualize solar photovoltaic and thermal systems in a dynamic, immersive way. Many noted that being

able to see the solar angles clearly in a 3D format significantly enhanced their understanding of solar geometry and PVT system concepts. One student shared, *"Fun and engaging. Gave a better visual aid to understand the angles."*

The realistic animations, high-resolution graphics, and interactive learning environment were repeatedly cited as factors that made the content more engaging and easier to grasp compared to traditional learning methods. Another student commented, *"Very interesting since I never experienced it in my life, as a student who loves video games, I found it so interesting learning using VR"*. Several students appreciated the simplicity of the explanations, the module structure, and how it allowed them to focus solely on the topic without distractions. Module 4, which focused on the PVT system, was mentioned multiple times as especially impactful, with one remarking, *"Using the VR module was a very engaging and informative experience. It helped me visualize complex solar energy concepts, such as how photovoltaic panels work and how PVT systems improve efficiency."*

In terms of learning outcomes, students reported gaining a deeper understanding of solar energy systems, especially the operation, efficiency, and application of PVT systems. The VR module helped them comprehend complex topics such as solar geometry angles, thermal performance, and the integration of photovoltaic and thermal technologies. Many expressed that the hands-on virtual experience greatly improved their retention and made the learning process more enjoyable. *"It's an immersive experience that makes it more memorable than reading a textbook or lecture slide,"* shared one enthusiastic respondent. It was evident that the module bridged the gap between theoretical learning and real-world application, with students able to connect classroom concepts to future projects, assignments, and even career aspirations in renewable energy. *"If I work offshore, I definitely will conduct the maintenance of PVT Thermal system there,"* showing how the module inspired real-world relevance and career linkage.

Despite the overall positive feedback, some areas for improvement were noted. The most common challenge was related to technical usability, such as lag during the drag-and-drop quizzes, difficulty in navigating the module for first-time VR users, and occasional blurriness for glasses wearers. One student mentioned, *"For me, the image was a bit blurry even after turning the dials on top of the lenses. I had to squint to see."*

A few also reported experiencing motion sickness or discomfort during prolonged use. Suggestions included incorporating audio-text syncing, improving controller responsiveness, and adding more animations, quizzes, and adjustable settings like speaker speed or interpupillary distance (IPD). There were also calls to enhance the interactivity of the modules by including more dynamic moving parts, gamified elements, and the ability to manipulate more parameters during simulations. As one student suggested, *"Regulating more parameters and values will be great."*

All respondents stated that they would highly recommend the VR module to other students. They described it as fun, engaging, informative, and a major enhancement over traditional learning methods. Students felt that the module made complex topics more approachable and encouraged deeper understanding through immersive visualization. One student summed it up well: *"Absolutely, I would recommend this VR module to other students. The interactive nature of the module keeps students engaged and motivated, making learning enjoyable."*

Additional suggestions included creating more VR modules, simplifying navigation for beginners, adding more interactive quizzes, and improving hardware quality. *"Simplify the controls and navigation to make the module more user-friendly, especially for beginners who may not be familiar with VR technology,"* shared one student. Some even proposed integrating VR modules into more courses or using them for presentations and self-study. Overall, the feedback reflects that this VR learning experience had a strong positive impact on students' engagement, conceptual understanding, and interest in renewable energy topics.

4 CONCLUSION

This study concludes that Virtual Reality (VR) learning modules offer a powerful and innovative approach to improving education in photovoltaic and thermal systems. Traditional methods often fall short in helping students grasp complex theoretical concepts or providing meaningful hands-on learning. In contrast, the immersive, interactive simulations provided by the VR module significantly enhanced students' understanding, motivation, and retention.

Quantitative analysis revealed substantial learning gains: student confidence in understanding photovoltaic-thermal (PVT) systems rose from 60% to 94.5%, at being "extremely confident". An average quiz score of 8.71 out of 10 supports the module's effectiveness in reinforcing technical content. High ratings in motivation (4.84/5), conceptual visualization (4.84/5), focused learning (4.80/5) and real-world application relatability (4.80/5) further highlight the module's impact on student learning.

Qualitative feedback echoed these findings, with students praising the clarity of visual explanations, realism, and the ability to connect theory with real-world applications. The interactive nature of the module increased interest in solar energy topics and gave students more confidence in applying what they had learned. However, some technical limitations were noted, such as occasional lag, motion sickness, and visual challenges for glasses wearers. Students also suggested improvements, including more animations, enhanced interactivity, better navigation controls, and customizable audio options.

Overall, the VR-based learning module proved to be an effective educational tool that supports deeper conceptual understanding and engagement in solar energy education. Its integration into renewable energy curricula holds strong potential to bridge traditional learning gaps and better prepare students for real-world challenges. Future research should examine long-term retention effects and compare outcomes against conventional teaching approaches to further validate its educational value.

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Transforming Student Engagement in STEM Education with the Metaverse

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ABSTRACT

In our world today, everything is about Science, Technology, Engineering, and Mathematics (STEM). From conducting a simple experiment to applying artificial intelligence, they are all related with STEM. The high demand of this area requires high intelligence students. The challenge for this issue is the students have difficulties to learn STEM in their schools or colleges due to lack of facilities, incompetent facilitators and too crowded classes. This paper brings attention how the metaverse can be applied in order to address the challenges. Metaverse offers virtual simulations of the machines, prototypes or models, allowing students to engage with the hands-on and practical concepts of the subject which are difficult to show in traditional classroom. This will resolve the lack of facilities issues. Metaverse also can give constructing and real-time feedback to the students based on the student's interactivity. This will take care of incompetent facilitators' issue. Since the metaverse is a digital environment, students are able to learn at anytime and anywhere. Thus it will solve the too crowded class's issue. Other than that, metaverse also allows students to learn the theory and concepts at their own pace without disturbing others. At the end of study, it will show that the students' engagement in STEM education can be improved by using metaverse.

KEYWORDS: STEM Education, Metaverse, Immersive Learning, Interactive Learning, Virtual Reality, Virtual Simulation

1 INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) education is one of the important teaching methods initiated by Malaysian Ministry of Education (MOE) and the Ministry of Science, Technology, and Innovation (MOSTI) according to Malaysia Pavillion Official Website (2025). This method not just equipped the student with basic knowledge in science and technology, but also develop critical thinking and problem-solving skills for the students in order to face the modern workforce.

Currently, STEM education is implemented through traditional method, which is teaching and learning in the classroom. Despite of this effort, there are some challenges in faced by the students. The challenges such as lack of practical experiences, limited access to the real equipment, too many students in single classroom resulting the students hard to master the subjects. These challenges cause the students to struggle during the process of learning STEM and will cause them to lose interest in STEM education.

In order to overcome these challenges, the metaverse is introduced. Metaverse is a merely a virtual world that enable the users to interact with each other using avatar according to Ritterbusch, and Teichmann

(2023). In educational area, metaverse can be referred as a digital environment that offer immersive learning experiences through simulation and virtual interaction. This environment may have of more than a single player interacting to each other in virtual world as illustrated by Consultancy-me.com (2023). With this technology, students are able to explore and learning STEM in interactive way. This will make the learning process far more attractive and relevant with current technology. The implementation of metaverse is tally with Sustainable Development Goals number 4: Quality Education.



Figure 1: Illustration of metaverse world

Therefore, the purpose of this paper is to explore how metaverse is able to attract students' interest in STEM education compared to the traditional methods. This paper also will discuss about the benefits, applications. Challenges, and the future of metaverse so that it can be used as a tool for the students to learn about STEM.

2 RESEARCH AIM

The primary aim of this study is to investigate the transformative potential of metaverse technologies in enhancing student engagement in STEM (Science, Technology, Engineering, and Mathematics) education. This research seeks to understand how immersive and interactive features within the metaverse can improve student motivation, participation, and interest in STEM subjects. By integrating simulation-based and virtual learning environments into educational practices, the study aspires to bridge the gap between theoretical STEM content and experiential, hands-on learning. Ultimately, this investigation will inform how digital innovations like the metaverse can contribute to more engaging and inclusive educational experiences, particularly in alignment with Malaysia's national goals for science and technology development.

3 RESEARCH OBJECTIVES

3.1 To explore the effectiveness of the metaverse in increasing student interest and motivation in STEM learning compared to traditional classroom approaches.

3.2 To identify the specific benefits, applications, and challenges of implementing metaverse-based learning tools in STEM education settings.

3.3 To evaluate the role of the metaverse in supporting self paced, personalized learning and its alignment with the goals of inclusive and equitable quality education (SDG 4).

4 METHODOLOGY

This study adopts a qualitative research methodology comprising four major phases as shown in Figure 2. The first phase involves a comprehensive literature exploration focused on current practices and findings related to student engagement in STEM education, as well as existing applications of virtual reality (VR) and metaverse platforms in learning. The second phase includes thematic synthesis, where recurring patterns, themes, and gaps from the literature are identified and categorized. This synthesis helps to construct a knowledge base around effective engagement strategies and technological innovations. In the third phase, a conceptual framework is developed, outlining how core features of the metaverse Such as immersion, interactivity, and personalization can be used to influence cognitive, affective, and psychomotor engagement among STEM learners. Finally, the framework is critically aligned with the principles of SDG 4 to ensure that the proposed educational model supports equitable access to quality education.

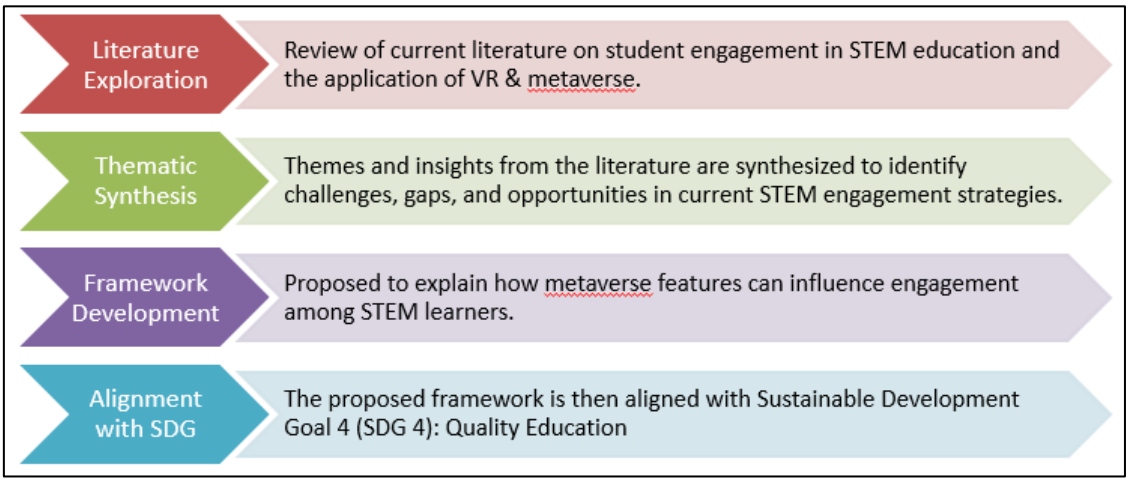


Figure 2: Research methodology for the study

5 PROPOSED FRAMEWORK

The proposed framework introduces a pedagogical model that integrates cognitive, affective, and psychomotor learning domains within the metaverse environment as shown in Figure 3. It leverages key instructional strategies such as problem-based learning and collaborative learning, supported by technological features including immersion, interactivity, gamification, and personalization. These elements work together to foster deep learning and student-centered experiences in STEM subjects. Cognitively, the metaverse facilitates complex problem-solving through simulated real-world scenarios. Affectively, it enhances student motivation and engagement through dynamic and emotionally resonant interactions. Psychomotor skills are developed through virtual manipulation of objects and experimental procedures in science labs or engineering tasks. The framework suggests the metaverse not only as a digital space but also aligns with Sustainable Development Goal (SDG) number 4: Quality Education.

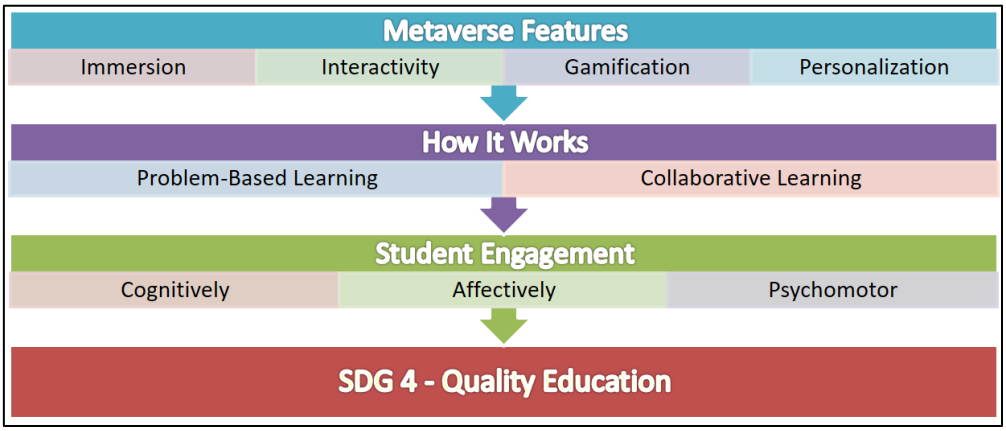


Figure 3: Proposed framework for the study

6 BENEFITS OF THE METAVERSE FOR STEM EDUCATION

The metaverse offers an innovative and immersive approach that allow students to explore complex concepts. By integrating virtual simulations and real-time feedback, it enables hands-on learning and personalized experiences.

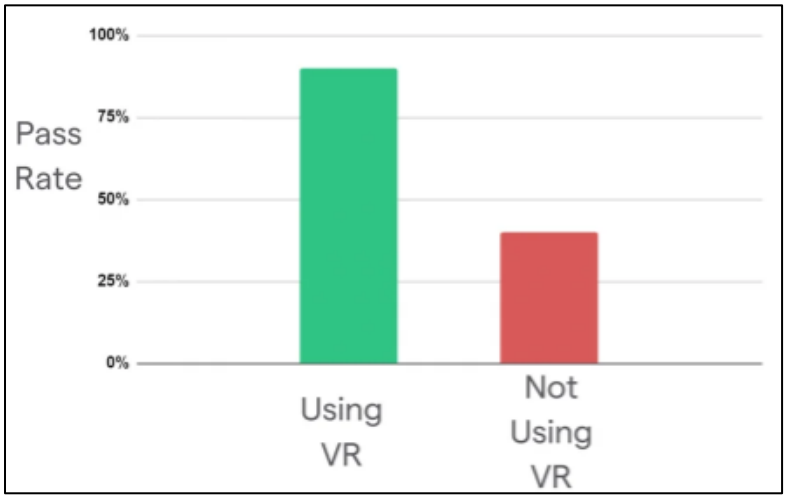


Figure 4: Passing rate comparison between virtual reality and traditional techniques

Figure 4 shows the impact of passing rate by using virtual reality, one of the metaverse component, compared to the traditional classroom. This section explores how the metaverse can be used to increase student engagement in STEM education.

6.1 Immersive Learning Experiences

Metaverse offers students immersive learning experiences through interactive 3D simulation compared to the traditional classroom. This allows students to explore more in depth and interesting way about the concepts of science, technology, engineering and mathematics. This can be implemented in metaverse as walkthrough, game-like approach (Dwivedi, et. al., 2022) or many more techniques. Through

this experience, students are able to master the concepts and elevates their thinking about the theories that are very hard to explain in traditional classroom.

6.2 Provide Safer Environment

The metaverse not only helps students understand complex concepts better, but it also offers a safe way to conduct expensive or high-risk experiments through virtual labs. In these labs, students can achieve their learning goals in a secure environment, without the risk of injury or the need for costly equipment. This study has been conducted by University of Notre Dame (2025). In the study, the researchers had used this method to train the surgeon. This metaverse method is proved to be effective since they are not working with the real patients where a small mistake might resulting in fatality.

6.3 Personalized Learning

The metaverse has the potential to provide personalized learning experiences through self-paced learning. Every student learns at a different speed based on research done by Johnston (2004). To ensure that no one is left behind, the metaverse can be customized to match each student's abilities. This means that students who need more time can learn at their own pace without feeling pressured by others, while faster learners can explore additional material and expand their knowledge within the same learning environment. Students also have the options to repeat the lessons or practical to strengthen their understanding about the concept.

7 APPLICATIONS OF THE METAVERSE IN STEM DISCIPLINES

The following sections will explore how the metaverse can be integrated into each of the STEM disciplines: science, technology, engineering, and mathematics. While the approach may differ across each field, the main goal is to create opportunities for the students to learn at their own pace and according to their individual abilities.

7.1 Science

Learning the terms, keywords, concepts and theory in science discipline could be the challenge for the students. For instance, learning about the gravity in physics, requires the students to understand the gravity concept, the formula and the application of it in the real world. Here, metaverse provide virtual simulation for the students to master the topic of gravity. For example, in this case, students are able to go back to the history where Sir Isaac Newtown discovered the gravity. In there, the students will share the journey on how the gravity is discovered and working together with Isaac Newton virtually to initiate the gravity formula. Then the students will experience the application of gravity in this virtual world.

The same techniques can be applied to other science environments as well such as chemistry and biology. Take a look at another example in chemistry subjects that focusing on molecule as its topic. Students are able to understand the concept of molecule better through the interactive 3D simulation. They can play with the suitable game designed for the topics. Students not only have fun in learning, but they also have learned the concept in better way.

For biology subject, students might able to learn about the digestive system by walkthrough to each of the process involved in the system. Starting from the food entering the mouth until the waste product is leaving the body. This can be done by developing a 3D journey in virtual world for the digestive system. All of these are possible in metaverse. These examples are the learning environment that will attract students more students to learn science compared by just reading the books or notes inside the traditional classroom.

7.2 Technology

In the field of technology, the metaverse offers a platform that allows students to interact directly with various aspects of programming, system architecture, and software development processes. Through virtual simulations, students can experiment with programming languages by writing and editing code in real-time within a 3D environment. This approach enables them to see the impact of their changes in a virtual setting immediately rather than relying on static textbook examples.

The other way of learning is the students can execute the code remotely within the metaverse environment. As described earlier, the metaverse allow virtual team collaborations as proposed by Hendriks (2024). It means the students can work together with the other parties on software development projects, engaging in real-time code sharing and debugging in a shared, simulated workspace.

In addition, students also able to explore different system architectures. For example how software interacts with hardware, networking protocols, or cloud-based systems. They can visualize data flows, test system configurations, and simulate real-world scenarios without the need for physical hardware or a large budget for resources. This offers a cost-effective and safe environment where students can experiment freely and learn from mistakes, something that traditional classrooms might not provide.

7.3 Engineering

The metaverse offers a safe and controlled environment where students can explore and learn complex engineering concepts without physical labs. One of the most effective methods in metaverse is the use of virtual laboratories. It allows the students to design prototypes, test engineering concepts, and solve real-world problems in a risk-free environment.

For example, students can simulate and test the structural integrity of a bridge design by modifying key variables such as material strength, dimensions, and load distribution. They can instantly observe how these changes affect the bridge's performance under different conditions without the costs and risk of physical testing. This type of simulation enables students to learn through trial and error, make design adjustments, and gain hands-on experience in engineering without being at the physical location.

7.4 Mathematics

In mathematics, the metaverse offers a dynamic and interactive way for students to engage with complex concepts like geometrical shapes and algebraic equations. By using virtual 3D models, students can visualize and examine the concepts in a way that traditional classroom cannot provide. For example, students can interact with three-dimensional geometric shapes like spheres, cubes, and pyramids, rotating and scaling them to learn about their properties.

In addition, the metaverse allows students to interact with algebraic equations and see their behavior in real-time. They can manipulate variables and observe how changes affect the graph of an equation, which provides an immediate understanding of mathematical concepts. This interactive learning makes the process of learning more engaging so that the students are able to understand the difficult concepts in a fun and interactive way.

8 CHALLENGES IN METAVERSE IMPLEMENTATION

While the metaverse offers an exciting opportunity for enhancing student learning experiences, there are several challenges that must be addressed before it can be widely used in education especially in Malaysia. Below are some of the key challenges faced in implementing the metaverse.

8.1 Technological Barrier

One of the biggest challenges in implementing the metaverse is access to the necessary platforms and hardware required to support the virtual environment. Many educational institutions, particularly in rural areas, have limited access to the resources such as stable internet connections, modern devices, or advanced

software. Without these essential tools, the full potential of the metaverse cannot be utilized, leaving many students and institutions at a disadvantage.

8.2 Cost and Infrastructure

The metaverse implementation comes with a high cost, especially when it comes to building the necessary infrastructure according to Camilleri (2024). Institutions need to invest in advanced technology, including virtual reality (VR) headsets, high-performance computers, and high-speed internet in order to cater with this requirement. These costs can be a significant barrier for many schools and universities, especially in regions with limited funding. Therefore, finding investors or government support to fund such projects is crucial to make the metaverse available in education.

8.3 Training and Support

For the metaverse to be successfully integrated into educational systems, teachers and instructors need to be properly trained in using this new technology. Most of them, particularly those who are older may struggle to adapt to this technology. That is why specialized training programs are necessary to ensure that they are not only comfortable with the tools but are also able to integrate the metaverse effectively into their teaching methods. Without this support, the objective of metaverse seems impossible and unlikely to happen.

8.4 Equity and Accessibility

Another critical challenge is how to ensure equity and accessibility for all students regardless of their socio-economic background. Although the metaverse has the potential to offer a personalized learning experience, but it could also can bring disaster if not all students have equal access to this technology. It's essential to ensure that students from all economic backgrounds can access metaverse equally.

9 THE FUTURE OF METAVERSE

The metaverse technology is to growth rapidly in the future. The integration between virtual reality (VR), augmented reality (AR), and realistic 3D environments has the potential to enhance students' learning experiences. With artificial intelligence (AI) becoming increasingly embedded in daily life, the metaverse could emerge as a powerful tool to engage students in STEM education. This immersive environment will encourage students to approach problems creatively across the fields of science, technology, engineering, and mathematics. As a result, it could contribute to the development of highly skilled graduates, addressing the growing demand for STEM professionals which is one of the critical issue in Malaysia today.

10 CONCLUSION

The implementation of the metaverse in STEM education offers lots of opportunities, including immersive, interactive, and personalized learning experiences. Through virtual simulations, students can deeply explore the core concepts of science, technology, engineering, and mathematics in methods that they prefer. In order to maximize the potential of this technology, the Malaysian government should invest in the necessary infrastructure, providing high-spec hardware, improving digital infrastructure, and equipping instructors with required training. These steps are crucial to ensuring that the benefits of the metaverse are accessible to all students, regardless of their socio-economic status, geographic location, or educational background.

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Integrating Artificial Intelligence (AI) in Higher Education through Community Service: A Case Study

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ABSTRACT

The rapid advancement of Artificial Intelligence (AI) technologies has transformed various industries, including education. Integrating AI into teaching and learning is crucial in preparing students for utilising emerging technologies, enhancing teaching efficiency, and improving student engagement. However, many educators struggle with AI adoption due to many challenges. Even though students are increasingly exposed to AI tools, their engagement tends to be passive and consumption-based. These challenges point to a critical gap in AI integration in education: the need for a pedagogical model that empowers both educators and learners to use AI as a tool for authentic inquiry. Addressing this gap, the present study proposed and investigated the *"Community AI Resources Employment"* (C.A.R.E.) project, which was aimed at enabling students to analyse real-world community needs, co-create AI-driven solutions, and implement discipline-specific community service initiatives. A total of 49 undergraduate students from various disciplines were introduced to the C.A.R.E. project and guided through an inquiry-based learning cycle. By anchoring AI use in community-based problem solving, the C.A.R.E. project aimed at cultivating students' personal growth. Using a mixed-method design, data were collected through the Students' Attitude Towards AI Questionnaire and student reflection journal. Findings reveal that students developed a positive attitude towards AI, and valued its role in developing their personal growth. The study highlights the potential of structured AI integration in fostering student engagement, interdisciplinary collaboration, and in enhancing societal impact. Insights from this case study offer practical implications for educators and policymakers seeking to embed AI meaningfully in higher education curricula.

KEYWORDS: Artificial Intelligence; Higher Education, Artificial Intelligence in Higher Education; Inquiry-based Learning; Teaching and Learning

1 INTRODUCTION

Artificial Intelligence (AI) refers to technologies such as machine learning, natural language processing and data analytics, which enable machines to mimic human abilities such as learning, problem-

solving, creativity, and decision-making. Since the launch of ChatGPT in 2022, the rapid rise of AI has significantly impacted various industries, including education (Hu, 2023). In classrooms, AI offers powerful tools to enhance learning. For instance, automated grading systems provide immediate, personalised feedback, helping students understand their strengths and areas for improvement in real-time. AI also supports collaborative learning through intelligent tutoring systems and virtual assistants that guide discussions and foster teamwork. Generative AI (GenAI), in particular, is transforming how students learn and create. Text-based tools like ChatGPT help students to generate ideas and improve their writing (Chan & Lee, 2023; Atlas, 2023). Visual AI tools like DALL-E and Stable Diffusion bring new possibilities to arts and design education by supporting the teaching of technical and creative concepts (Dehouche & Dehouche, 2023).

As education adapts to the demands of the future, integrating AI is becoming essential, not just to enhance learning, but to redefine the role of educators as facilitators and mentors in an AI-driven world (Fu, Weng & Wang, 2024). Despite its potential, the integration of AI in education faces challenges, many educators still face challenges in adopting AI due to limited training, exposure, or structured implementation strategies. This study explores a structured AI integration approach, particularly through a community service project - "*Community AI Resources Employment*" (C.A.R.E.). This project provides students with hands-on experience in applying AI to address real-world community challenges, bridging the gap between technology and traditional teaching methods.

An example of a CARE project that was planned and carried out by a Diploma in Culinary Arts students to leverage AI tools to support the stall in branding, marketing, and improving operational efficiency. Students used AI applications to design eye-catching promotional materials such as posters and menu cards, and implemented AI-assisted social media strategies to enhance customer engagement and online presence. Another example is "The Bright Future: Education and Care for Orphans", a project by Bachelor of Early Childhood Education students. The students introduced and guided the orphans in using AI tools, which they could leverage to improve their learning experience.

1.1 Research Problem

Artificial Intelligence (AI) is rapidly changing the world around us, including how we learn, work and solve problems. In education, AI holds exciting possibilities, but the reality in many classrooms is quite different. Teachers often feel unprepared or unsure about how to use AI meaningfully in their teaching. They may not have the training, tools, or support to move beyond surface-level use of technology (Fu, Weng & Wang, 2024). As a result, AI is often used in fragmented ways, more as a gadget than as a meaningful part of learning (Zawacki-Richter et al., 2019).

At the same time, students are surrounded by AI tools in their everyday lives, but their use is mostly passive. They consume information or let AI do the thinking for them, rather than using it to ask questions, solve problems or create something new (Chan & Lee, 2023). This limits their ability to think critically, be creative, or consider the ethical impact of AI. Without the right support and context, they risk becoming dependent on AI, rather than learning how to use it as a tool for innovation (Dehouche & Dehouche, 2023). This disconnect shows us there is a real need for change. What if we could help students use AI to make a difference in the real world, starting with their own communities? This study explores that idea through the *Community AI Resources Employment (C.A.R.E.)* project. C.A.R.E. is designed to help students identify real community needs, use AI to design creative solutions, and carry out community service projects based on their academic disciplines. By anchoring AI use in community-based problem solving, the C.A.R.E. project aims to cultivate students' attitudes towards AI and personal growth.

1.2 Research Objectives

(a) To investigate the impact of the C.A.R.E. project on students' attitudes towards Artificial Intelligence (AI).

(b) To examine how the C.A.R.E. project supports the development of students' personal growth.

1.3 Research Questions

(a) How does participation in the C.A.R.E. project influence students' attitudes towards AI?

(b) In what ways does the C.A.R.E. project support the development of students' personal growth?

1.4 Significance of the Study

This study contributes significantly to the evolving field of AI integration in higher education by providing a practical framework for embedding Artificial Intelligence (AI) in a way that fosters active learning, interdisciplinary collaboration, and social responsibility. While many higher education institutions have started to explore AI tools, this research takes a step further by positioning AI as a catalyst for *authentic inquiry* and *community-driven problem solving*. The "*Community AI Resources Employment" (C.A.R.E.)* project highlights the power of using AI not just as a technological tool, but as a means for students to engage meaningfully with their communities and apply their learning in real-world contexts.

The significance of this study lies in its capacity to address the growing need for a structured and scalable model that goes beyond the passive consumption of AI. By integrating AI with community service and inquiry-based learning, the study showcases how students can develop essential skills that are necessary for thriving in an increasingly AI-driven world. This hands-on, socially relevant approach helps students move from mere users of AI tools to active, thoughtful participants who can use AI to solve complex, real-world problems.

For educators, the study offers valuable insights into how AI can be integrated into diverse curricula in ways that enhance student knowledge and higher-order thinking. It provides a roadmap for educators to guide students through AI-focused learning experiences that are grounded in social issues and community needs. Furthermore, this study encourages educators to reconsider the role of AI in the classroom, not just as a subject of study but as a powerful tool for fostering interdisciplinary learning and societal impact.

2 LITERATURE REVIEW

2.1 Artificial Intelligence (AI) in Higher Education

In recent years, the use of Artificial Intelligence (AI) in higher education has sparked significant scholarly interest in various aspects, and its impact has been widely investigated (Fu, 2024; Kim & Adlof, 2024). Scholars from diverse fields, including education, computer science, psychology, and ethics, have explored various facets of AI implementation in higher education settings. Researchers have examined the implications of AI on pedagogy, assessment, student support, professional development, and ethical considerations. Key areas of AI-related research in higher education include pedagogical innovations, learning analytics and student support, assessment and grading, educators' professional development, and ethical and social implications (Al-Zahrani & Alasmari, 2024).

2.1.1 AI's Impact on Student Learning

AI technologies have significantly reshaped how students learn. Tools such as intelligent tutoring systems and adaptive learning platforms dynamically tailor content based on individual student performance. These technologies personalise the learning experience, foster student engagement, and contribute to improved academic outcomes (Daoudi, 2022). Kochmar et al. (2022) demonstrated that students using AI-driven tutoring systems show significant improvements in academic performance.

A prominent area of AI-driven innovation is learning analytics and student support. There is a growing shift towards using student data to enhance learning experiences and outcomes (Zheng et al., 2023). AI-powered learning analytics offer educators actionable insights, allowing them to identify at-risk students and personalise interventions. AI is also revolutionising assessment and grading practices. Automated assessment systems, particularly in online learning environments, provide real-time evaluations and immediate feedback (Ouyang et al., 2022). Xu and Ouyang (2022) further highlighted that AI can improve fairness and consistency by reducing human bias in grading. Additionally, Rice and Dunn (2023) noted that AI-generated constructive reinforcement can enhance students' confidence and motivation.

Traditional feedback methods, such as manual grading, are often time-consuming and labour-intensive (Gao et al., 2024). In contrast, AI-enabled tools streamline the feedback process, freeing educators to focus on more meaningful instructional tasks. For example, Zhao et al. (2023) argued that AI can assess complex tasks, such as essays, effectively and at scale. These tools not only enhance efficiency but also promote self-directed learning by encouraging reflection and continuous improvement.

AI also supports students' emotional and motivational needs. Features like personalised goal-setting, real-time encouragement, and tailored challenges help create more engaging learning environments. As noted by Rice and Dunn (2023), such features significantly boost learner confidence and enthusiasm.

2.1.2 AI's Impact on Teaching

AI is reshaping the teaching profession by transforming instructional practices, curriculum design, and teacher development. The rise of AI necessitates a redefinition of traditional teaching roles. According to Yue et al. (2022), AI enables innovative pedagogies, including active learning, gamification, personalised instruction, and collaborative learning. Consequently, instructors are evolving into facilitators, content curators, and mentors, guiding students through individualised learning pathways.

In curriculum design, AI tools provide insights derived from large-scale data analysis. These tools help identify instructional gaps, highlight learning trends, and suggest curriculum adjustments to align with evolving student needs. Blumenstein (2020) emphasised that such data-driven approaches enable educators to make informed and strategic decisions in curriculum development. Despite growing enthusiasm for AI in education, limited attention has been given to equipping educators with the skills needed for effective AI integration. Sanusi et al. (2023) stressed the importance of continuous professional development tailored to AI use in teaching. AI-supported training platforms that evaluate teaching performance and provide targeted feedback are becoming increasingly common.

2.2 Inquiry-based Learning (IBL)

Inquiry-Based Learning (IBL) is widely recognised as a pedagogical approach that shifts the focus of learning from teacher-led instruction to student-led exploration. It is a student-centred approach that encourages learning to begin with curiosity through questions, which encourages students to be active participants in their learning process. Meanwhile, teachers act as a guide rather than a provider of knowledge (Justice et al., 2007).

IBL is rooted in constructivist theory, in which learners build knowledge through experience and reflection. Students learn best when they are engaged in meaningful inquiry (Bruner, 1961; Vygotsky, 1978). Rather than receiving information passively, students in an IBL environment are engaged in exploring topics that matter to them, thereby fostering ownership, deeper understanding, and transferable skills (Mikhail & Moresoli, 2024).

2.2.1 Types of Inquiry

Inquiry-based learning is often structured around varying levels of student autonomy and teacher involvement, and these different levels reflect distinct types of inquiry. Banchi and Bell (2008) identified four types of inquiry:

(a) **Confirmation Inquiry**: Students are provided with the question and procedure, and the outcome is already known. This type of inquiry is often used for reinforcement and to build students' confidence in the process of inquiry.

(b) **Structured Inquiry**: Students are provided with the question, follow a prescribed procedure to investigate the answer, and then generate their explanations based on the data collected.

(c) **Guided Inquiry**: Students are provided with the question, but they design their own investigation and procedures. Teachers provide guidance and support but allow for greater student autonomy.

(d) **Open Inquiry**: Students formulate their own questions, design their investigations, and communicate their findings. This type closely mirrors authentic scientific research and is often used to develop higher-order thinking and problem-solving skills.

Trevor MacKenzie, in his book *Dive into Inquiry* (2016), presented a similar framework but emphasises the importance of a scaffolded approach to inquiry. His framework emphasised that not all students are immediately ready to dive into fully open inquiry; instead, they benefit from progressing through a continuum of inquiry types - from structured to guided, and finally to open inquiry. This intentional progression helps students build essential competencies such as questioning, researching, critical thinking, and reflection, all within a supportive environment.

2.2.2 Framework for Inquiry-Based Learning (IBL)

IBL is supported by several instructional frameworks that offer structured, intentional pathways for both teaching and learning. These frameworks provide educators with tools to guide students through the inquiry process while promoting active participation, reflection, and continuous growth. One widely recognised framework is proposed is the 5E Instructional Model developed by Bybee et al. (2006), which expands the inquiry process into five interconnected phases: Engagement, Exploration, Explanation, Elaboration, and Evaluation. This framework encourages students to build on prior knowledge, delve into new ideas, articulate their understanding, apply their learning in new contexts, and reflect on their progress. Each phase is designed to reinforce conceptual understanding while nurturing curiosity and critical thinking.

Another influential model was proposed by Marshall (2013), who outlined four key phases: Engage, Explore, Explain, and Extend. It emphasises formative assessment and reflective practice. Throughout each phase, students are encouraged to pause and consider, *"What now?"*, fostering a sense of ownership and self-direction. At the same time, teachers use ongoing check-ins to monitor progress and adapt instruction in real-time, ensuring learning remains responsive and student-centred.

A third prominent framework is Kath Murdoch's Inquiry Cycle, extensively used in primary and secondary education, particularly within International Baccalaureate (IB) programmes. In her book *The Power of Inquiry* (2015), Murdoch presented a learner-friendly, cyclical model consisting of six interconnected phases:

(a) **Tuning In** – Students connect with prior knowledge and develop an interest in the topic.

(b) **Finding Out** – Students actively research, gather data, and explore new ideas.

(c) **Sorting Out** – Students begin organising information, identifying patterns, and clarifying understanding.

(d) **Going Further** – Students investigate new questions or dive deeper into areas of interest.

(e) **Making Conclusions** – Students synthesise learning and form their own conclusions.

(f) **Taking Action** – Students apply what they've learned in meaningful, often real-world contexts.

Murdoch underscored that inquiry is not a fixed methodology but a way of teaching and learning that values curiosity, student voice, and co-construction of meaning. She cautioned against viewing inquiry as unstructured discovery learning, emphasising instead the need for intentional teaching and scaffolded support to deepen understanding. Her approach aligns closely with constructivist and social-constructivist theories, fostering not only knowledge acquisition but also the development of agency, critical thinking, and a sense of purpose in learning (Murdoch, 2018; 2021). For this study, Kath Murdoch's inquiry cycle has been adopted as the guiding IBL framework.

3 METHODOLOGY

3.1 Participants

In this study, 49 undergraduates from different disciplines (e.g., education, computer science, business, health sciences) in one private university were involved.

Table 1. Demographic Profile of Respondents (n = 46)

Variables		Number (n)	Percentage
Gender	Male	16	32.7%
	Female	33	67.3%

3.2 Research Instruments

3.2.1 Students' Attitude towards AI (SATAI)

In this study, the Student Attitudes Toward Artificial Intelligence (SATAI) scale by Suh and Ahn (2022) was used as the primary research instrument to measure students' attitudes toward AI. It was developed to assess learners' cognitive, affective and behavioural attitudes toward AI, offers a standardised and validated tool rooted in both the Theory of Planned Behavior and the Technology Acceptance Model (TAM). Its development was grounded in a comprehensive literature review that emphasized the novelty of AI education and the importance of fostering positive student attitudes to support effective curriculum design.

SATAI consists of 26 items on a five-point Likert scale; 1 for Strongly Disagree, 2 for Disagree, 3 for Neutral, 4 for Agree and 5 for Strongly Agree. In this study, the overall reliability of the instrument was reported to be excellent, with a Cronbach's alpha coefficient of 0.972.

Table 1. *Reliability Analysis: SATAI*

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Students' Attitude towards AI	.972	.972	26

3.2.2 Student Reflective Journal

Student Reflective Journal was used as a key tool for capturing students' experiences and insights throughout the *Community AI Resources Employment (C.A.R.E.)* project. The journal gave students a chance to reflect on their learning journey and how they applied AI to real-world community challenges. To guide this reflection, a reflective journal template was created using the STARR Reflection model. This model is designed to help students break down their experiences and think critically about each stage of the project. The model includes the following components:

(a) **Situation**: Students began by describing the context of their project. This included the community issue they were addressing and the role AI played in solving it.

(b) **Task**: Students reflected on the challenges they faced and what they were expected to accomplish. At this stage, students are encouraged to think about the purpose of the project and the steps they need to take.

(c) **Action**: Students detailed the actions they took during the project. They explained how they used AI to develop solutions, including the specific steps and methods they employed.

(d) **Result**: At this stage, students described the outcomes of their work, including what they achieved, any recognition they received, and the overall impact of their solutions on the community.

(e) **Reflection**: Finally, students reflected on what they learned from the experience. This section allowed them to think about what worked well, what they might do differently next time, and how they grew through the process.

After completing their C.A.R.E. projects, students were given two weeks to write and submit their journals individually. The reflective journal was not only a way for students to document their learning but also an opportunity for them to think about their personal growth and challenges.

4 FINDINGS

4.1 Students' Attitudes towards AI

The descriptive analysis shown in Table 2 revealed that the mean score of Students' Attitudes towards AI is 3.8310, derived from a 5-point Likert scale, indicating a high level of agreement among respondents, suggesting positive attitudes towards AI (Md Sham, Azizan & Ismail, 2015).

Table 2. *Descriptive Statistics: Students' Attitude towards AI*

Trait	N	Mean	
	Statistic	Statistic	SD
Students' Attitude towards AI	49	3.8310	.72887
Valid N (listwise)	49		

The descriptive analysis presented in **Table 3** reveals the mean scores of students' attitudes toward AI for male and female students. The mean score for male students is 4.18, while the mean score for female students is 3.66, resulting in a mean difference of 0.51. Levene's Test for Equality of Variances showed p

= .629, which is greater than 0.05, indicating equal variances. Consequently, an independent samples t-test was conducted, with t(47) = 2.418. The significance value was p = .020, which is less than 0.05, indicating a statistically significant difference in students' attitudes toward AI between male and female students. Specifically, male students demonstrated a significantly more positive attitude than female students.

Table 3. *Descriptive Statistics: Students' Attitude towards AI (by Gender) & Independent Samples t-Test*

Trait		N Statistic	Mean Statistic	Mean SD
Students' Attitude towards AI	Male	16	4.1756	.7138
	Female	33	3.6639	.6855
Valid N (listwise)		49		

Independent Samples t-Test

		Levene's Test for Equality Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Students' Attitude towards AI	Equal variances assumed	.236	.629	2.418	47	.020	.51169	.21161	.08597	.93740
	Equal variances not assumed			2.384	.024	.024	.51169	.21467	.07245	.95092

4.2 Students' Personal Growth

The reflective journals provided rich insights into the students' experiences throughout the *Community AI Resources Employment (C.A.R.E.)* project. By examining the data, several key themes emerged that highlight the development of students' personal growth as follows:

(a) A Shift in Attitudes Toward AI

One of the most significant changes observed in the journals was the shift in students' attitudes toward AI. At the start of the project, many students viewed AI as something complex and difficult to understand. As they worked on real-world problems, their perceptions began to change. They became more confident in using AI and began to see it as a tool they could use in their own lives to address practical issues.

(b) Greater Engagement with Learning

Another key theme was the increased engagement students felt as they worked with AI. Many expressed how much more involved they felt in the learning process compared to traditional methods. The opportunity to apply what they were learning to real-world community problems made the experience more meaningful and hands-on.

(c) Strengthened Critical Thinking and Problem-Solving Skills

Students also reported that the project helped them develop critical thinking and problem-solving skills. The inquiry-based approach encouraged them to think through problems systematically and find creative solutions. This process of breaking down complex challenges and applying AI tools made students more confident in their ability to approach problems in the future.

(d) Collaborative Learning Across Disciplines

The theme of collaborative learning stood out, as students worked alongside peers from different disciplines. Many appreciated the opportunity to learn from others and see how AI could be applied from multiple perspectives. Working in teams allowed them to combine their unique skills and ideas, leading to richer, more innovative solutions.

(e) A Sense of Purpose and Social Impact

One of the most powerful themes was the students' sense of purpose and the social impact of their work. Many students expressed a deeper connection to the community after realising how their AI-driven solutions could benefit real people. The experience made them feel that technology could be a force for good and that their work had tangible, positive effects.

(f) Self-Improvement

Many students reflected on their self-improvement throughout the project. They acknowledged how the project challenged them, both academically and personally, and helped them realise their potential. Some students noted how they overcame obstacles and how the experience pushed them to be more proactive in their learning and development.

5 DISCUSSION AND CONCLUSION

The findings of this study reveal that integrating Artificial Intelligence (AI) through a structured, inquiry-based community service model has a positive impact on students' attitudes toward AI. By engaging with real-world problems, students transitioned from passive users to active, purposeful agents of technology. This shift, from viewing AI as abstract and intimidating to seeing it as practical and relevant, reflects the power of experiential learning, as supported by Suh & Ahn (2022) and Kochmar et al. (2022), who noted that hands-on exposure to AI enhances both cognitive and emotional engagement.

Notably, gender differences emerged in students' responses. Male students generally exhibited more positive attitudes towards AI than female students. This mirrors findings by Chan and Lee (2023), who highlighted gender-based disparities in technological confidence. These results underscore the importance of designing more inclusive AI education strategies that actively support and empower female students to engage with emerging technologies.

Beyond attitudes toward AI, the C.A.R.E. project also played a significant role in students' personal growth. Tackling authentic community challenges pushed students out of their comfort zones and into meaningful collaboration. As a result, they developed essential skills like communication, leadership, empathy, and self-direction. These shifts were reflected in their journal entries, where many shared how the experience helped them discover a stronger sense of self, purpose, and confidence.

The project was grounded in inquiry-based learning (Bruner, 1961; Banchi & Bell, 2008) and constructivist theory (Vygotsky, 1978), giving students not just problems to solve, but meaningful social contexts in which to solve them. This depth of engagement made learning more authentic and impactful. The interdisciplinary nature of the project also encouraged students to work across different perspectives, preparing them for the complexities of today's interconnected world.

Critical thinking and problem-solving were at the heart of the experience. Students faced open-ended, often ambiguous challenges, requiring them to explore, select, and apply AI tools in ways that had

real-world consequences. Such rich opportunities for higher-order thinking are rare in conventional classroom settings but flourished here through the C.A.R.E. model. These findings resonate with the work of Murdoch (2015) and Justice et al. (2007), who argue that meaningful growth happens when students are immersed in authentic, inquiry-rich environments.

The experience also changed how students viewed learning itself. Many spoke about transitioning from passive learners to active creators of knowledge. While Chan & Lee (2023) warned that students may sometimes rely too heavily on AI without proper guidance, the C.A.R.E. project turned AI into a tool for curiosity, creativity, and community impact. This helped students stay in charge of their learning journeys. The motivational boost students experienced aligns with Daoudi's (2022) research, which found that real-world applications of AI foster higher engagement and self-efficacy. Students' reflections showed a growing sense of responsibility—not just for their own development, but for the communities they were trying to support.

In conclusion, the C.A.R.E. project offers a promising model for integrating AI into higher education in a way that is meaningful, ethical, and transformative. It demonstrates that when AI is embedded in inquiry-based, socially impactful learning environments, it can demystify technology, inspire agency, and foster holistic student growth. Future research should explore longitudinal effects and strategies to enhance gender inclusivity, ensuring broader access to the benefits of AI-integrated education.

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Exploring Artificial Intelligence (AI) Integrating in Common European Framework Reference (CEFR)-Based Language Instruction: A Survey of its Impact on Lesson Planning

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ABSTRACT

An effective lesson planning is essential for students' language progress in any educational setting. Teaching English as a Second Language (TESL) undergraduate students have been exposed to lesson planning when they started taking Teaching Methodology Classes (TCH). With technological advancement, lesson planning has significantly improved with the help of artificial intelligence (AI). Therefore, the present study aimed to assess the instructional effectiveness of AI-assisted lesson plans as perceived by pre-service teachers who used AI and to examine the alignment of AI-assisted lesson plans with the Common European Framework Reference (CEFR)-based language teaching requirements. This research applied a descriptive quantitative method by distributing surveys. The sample for this study was TESL undergraduate students who had taken at least one TCH class from University Poly Tech Malaysia (UPTM). The results showed the significant impact of AI-integration lesson planning by the pre-service teachers as they had explored this method through their Teaching Methodology Classes. Based on the findings, it showed that many pre-service teachers used AI integration into their CEFR-based lesson planning accordingly. The conclusion for the overall study was it can be said that pre-service teachers should have the necessary skills for AI integration lesson planning to align their teaching methodology with CEFR-based language instructions.

KEYWORDS: Artificial Intelligence (AI), Common European Framework Reference (CEFR), Lesson Planning, pre-service teachers, impact, English language learning.

1 INTRODUCTION

The Common European Framework of Reference for Languages (CEFR) has been adopted in Malaysia since 2013 by the collaboration of The English Language Standards and Quality Council (ELSQC) and the Ministry of Education (MOE). The initiative was implemented alongside the introduction of the Malaysian Education Blueprint which is expected to be completed in 2025 and English Language Education Reforms. The Council of Europe developed CEFR during the mid-19th century and later on extended it as part of the language syllabuses and curriculum guidelines, designing of teaching and learning materials and references across all education levels. These roadmaps and efforts align with the Sustainable Development Goal (SDG) 4 which intends to ensure an inclusive and equitable education all across the globe with CEFR providing a structured framework to guide language learning and teaching across educational systems. Hence, the advocates for inclusive and equitable learning opportunity do not only require pedagogical approaches like CEFR but also necessitates the need for innovative teaching approaches to enhance the quality of language learning. In this regard, artificial intelligence (AI) has emerged as a transformative tool to support language learning and assist the overall lesson planning and assessment process. Thus, the integration of AI into CEFR-based instructions for language learning classes presents a promising pathway towards achieving SDG 5 by equipping educators with intelligent tools that enhance the efficiency, accessibility and quality of language teaching.

In Malaysia, The Fourth Industrial Revolution (4IR) is progressively reshaping current civilisation into modernity by propelling the nation into the digital age to foster overall growth. In response, the government introduced the National 4IR Policy to guide the country's socioeconomic transformation through ethical use of 4IR technologies. Among these foundational technologies, AI stands out as the most effective tool to build technological capabilities. Recognising the importance, Prime Minister Datuk Seri Anwar Ibrahim launched the programme "*AI untuk Rakyat*" as an effort to promote AI literacy among Malaysians across all ages. Complementing this vision, the National Artificial Intelligence Office (NAIO) under MyDigital Corporation coordinates AI adoption, innovation and governance across all sectors. Thus, the initiative supports the integration of AI into key sectors, including education, to enhance efficiency, accessibility, and the overall quality of education, in alignment with the goals of SDG 4.

While considerable research has been conducted on the effectiveness of artificial intelligence in various educational contexts, it remains a notable gap concerning its application in lesson planning. Moreover, existing literature offers limited insights into how pre-service teachers engage with AI tools in crafting lesson plans that align with established instructional frameworks such as CEFR. Thus, the study seeks to address the gap in current literature by exploring how pre-service teachers can integrate AI into CEFR-based lesson planning and perceived outcomes of such instructional practices.

2 RESEARCH OBJECTIVES

The objectives of this research are:

i) To explore the instructional effectiveness of AI-assisted lesson plans as perceived by pre-service teachers who use AI in terms of students' engagement, comprehension and learning outcomes.

ii) To examine the alignment of AI-assisted lesson plans with CEFR-based language teaching requirements.

3 RESEARCH QUESTIONS

Therefore, two research questions are addressed as follows:

i) How do pre-service teachers perceive the instructional effectiveness of AI-assisted lesson plans in terms of students' engagement, comprehension, and learning outcomes?

ii) To what extent do AI-assisted lesson plans align with CEFR guidelines for language learning?

iii) What are the biggest strengths of AI-assisted lesson plans in terms of instructional effectiveness and CEFR-alignment?

iv) What are the biggest challenges of AI-assisted lesson plans in terms of instructional effectiveness and CEFR-alignment?

4 LITERATURE REVIEW

4.1 AI in Education and Lesson Planning

AI applications such as ChatGPT, Google Gemini, and other generative AI tools have emerged as effective assistants for instructional design. Baytak (2024) conducted a content analysis of AI-generated lesson plans using ChatGPT and Gemini, finding that both platforms produced pedagogically sound outputs comparable to human-written plans. These lesson plans included learning objectives, teacher roles, and assessments aligned with recognised instructional theories, including behaviourism, constructivism, and the Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivation. However, ChatGPT demonstrated stronger alignment with constructivist pedagogy by incorporating collaborative activities and reflective exercises, suggesting a potential fit with CEFR's communicative and learner-centred goals.

Kanvaria and Ritika (2024) extended this inquiry by focusing on pre-service teachers' perceptions of AI in lesson planning. In their mixed-methods study, 91.8% of pre-service teachers reported familiarity with AI, and 67.3% had used AI tools for lesson planning. Despite this high adoption rate, only 40.8% viewed AI as highly effective in enhancing learning outcomes. Notably, 83.0% observed increased student engagement, aligning with CEFR's emphasis on active, contextualised learning. However, a lack of training (reported by 73.5% of participants) and concerns about data privacy (expressed by 53.0%) emerged as significant barriers to effective AI use.

Baytak (2024) also noted that while AI-generated lesson plans adhered to general instructional standards, they often lacked deep integration of technology-enhanced learning tools or CEFR-specific descriptors such as "Can Do" statements. This is a key consideration in CEFR-based instruction, where lesson plans must align with granular language proficiency targets across listening, speaking, reading, and writing skills.

4.2 Benefits and Challenges of AI Integration

Across the reviewed studies, the most commonly cited benefits of AI integration in lesson planning include increased efficiency, improved differentiation, and enhanced student's engagement (Baytak, 2024; Kanvaria & Ritika, 2024). AI tools such as ChatGPT and Gemini can generate structured lessons within seconds, suggesting creative activities and personalised content based on student's needs that could support CEFR's functional approach to language teaching.

However, challenges persist. For example, Gemini's lesson plans often lacked formative assessment strategies, and both AI tools showed limited integration of digital tools or multimedia, critical components of modern language education (Baytak, 2024). Furthermore, pre-service teachers expressed scepticism about AI's pedagogical value and a need for better training and ethical guidance (Kanvaria & Ritika, 2024).

These concerns are echoed in studies cited within the primary articles (e.g., Tlili et al., 2023; Pratiwi et al., 2020), which emphasise that while AI is a powerful tool, its effectiveness depends on user expertise, context alignment and ongoing evaluation. Teachers must be trained not only to use AI but to critically assess and adapt its outputs for pedagogical rigour and curricular alignment.

4.3 Implications for CEFR-based Language Learning

Given CEFR's structured progression and learner-centred design, the integration of AI requires careful adaptation. The reviewed literature suggests that AI can assist in generating CEFR-aligned lesson plans, particularly when prompts include explicit learning goals (e.g., "A2 speaking task: describing past events"). However, due to AI's generalist design, its outputs must be supplemented with teacher judgment to ensure fidelity to CEFR descriptors, assessment rubrics, and communicative objectives.

Moreover, AI may support formative assessment practices aligned with CEFR, such as self-assessment checklists or performance-based tasks, but only if users explicitly request such features in their prompts. As Baytak (2024) and Kanvaria and Ritika (2024) cautioned, without proper training and critical engagement, teachers risk underutilising AI's potential or relying on it in ways that dilute instructional quality.

5 CONCEPTUAL FRAMEWORK

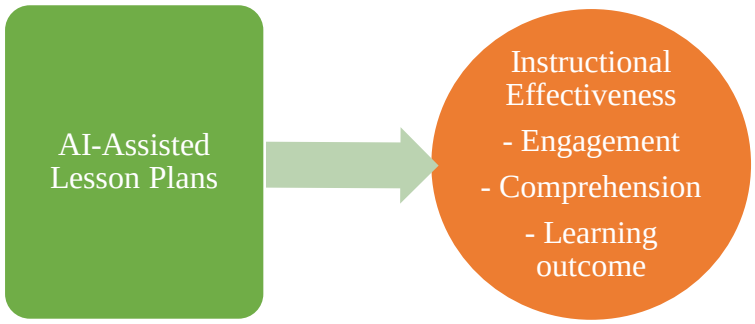


Figure 5.1: Conceptual Framework

Figure 5.1 presents the conceptual framework highlighting the relationship the independent variable, which is AI-assisted lesson plans, and the dependent variable, which is instructional effectiveness on engagement, comprehension, and learning outcomes. The researchers aimed to investigate the instructional effectiveness of AI-assisted lesson plans aligned with CEFR for language learning. This study aims to evaluate the effectiveness of AI-assisted lesson planning for pre-service teachers with a particular focus on instructional effectiveness, specifically on engagement, comprehension and learning outcome.

6 METHODOLOGY

This study, titled Exploring AI Integration in CEFR-Based Language Instruction: A Survey on Its Impact on Lesson Planning, used a quantitative research approach with a descriptive design to examine whether AI can improve lesson planning in CEFR-based language teaching. The target population were TESL students from University Poly-Tech Malaysia (UPTM). A purposive sampling method was used to select 36 students who had taken at least one teaching-related course. Data were collected through an online questionnaire distributed via Google Forms. The questionnaire consisted of four sections: 1) demographic information, 2) pre-service teachers' experiences with AI-assisted tools for lesson planning, 3) instructional effectiveness of AI-assisted lesson plans designed in accordance with CEFR guidelines for language learning and 4) strengths and limitations of AI integration in lesson planning. The data collected through the questionnaire were analysed using Statistical Package for the Social Sciences (SPSS). A five-point Likert scale was employed to measure participants' responses, ranging from "Strongly Disagree" to "Strongly Agree." The responses were first coded and entered into SPSS, where descriptive statistics such as frequencies, percentages, means and standard deviations were calculated. Additionally, a Cronbach's Alpha test was conducted to measure the internal consistency and reliability of the questionnaire items, particularly between the independent variable (IV) and the dependent variable (DV). The test yielded a reliability coefficient of $\alpha = 0.891$, indicating a high level of internal consistency. The results were then

converted into tables and charts for easier interpretation and visual representation. This method was chosen because it provided a systematic approach to analyse quantitative data, allowing the researcher to present clear, measurable and generalisable insights into pre-service teachers' views on the use of AI in lesson planning.

7 RESULTS AND DISCUSSIONS

Research Question 1: How do pre-service teachers perceive the instructional effectiveness of AI-assisted lesson plans in terms of students' engagement, comprehension, and learning outcomes?

No	Items	Mean	Standard Deviation	Strongly Agree Frequency / %	Agree Frequency / %
	Pre-services Teachers' Experiences with AI-assisted lessen plans:				
1	I have experience using AI-assisted tools for lesson planning.	3.97	1.055	12 (33.3%)	16 (44.4%)
2	I am confident in integrating technology into my lesson planning.	3.97	0.910	10 (27.8%)	18 (50.0%)
3	I believe AI-assisted lesson plans can be beneficial in my teaching practice.	4.08	1.025	15 (41.7%)	14 (38.9%)
4	I am familiar with the Common European Framework of Reference for Languages (CEFR).	3.58	0.996	8 (22.2%)	10 (27.8%)
5	I have received formal training on how to use AI-assisted lesson plans.	3.06	1.013	4 (11.1%)	6 (16.7%)
6	I believe traditional lesson planning is more effective than AI-assisted lesson planning.	3.36	1.046	7 (19.4%)	6 (19.4%)
7	AI-assisted lesson plans reduce the time I spend on lesson preparation.	4.11	0.708	12 (33.3%)	18 (50.0%)
8	I am open to using AI-assisted lesson plans in my future teaching career.	4.22	0.832	14 (38.9%)	18 (50.0%)
9	AI-assisted lesson planning can improve my overall teaching efficiency.	4.14	0.990	14 (38.9%)	17 (47.2%)
10	I believe AI-assisted lesson planning should be part of teacher's education syllabus.	4.08	0.937	14 (38.9%)	13 (36.1%)
11	AI-assisted lesson plans provide innovative teaching strategies that I would not have considered otherwise.	3.94	0.984	12 (33.3%)	13 (36.1%)
12	AI-assisted lesson plans make it easier to incorporate multimedia and interactive elements into teaching.	4.19	0.668	12 (33.3%)	19 (51.4%)

13	AI-assisted lesson plans make lesson delivery more efficient and structured.	4.06	0.924	10 (37.0%)	13 (48.1%)
14	AI-assisted lesson plans help pre-service teachers develop CEFR-appropriate speaking skills lesson.	4.06	0.893	11 (30.6%)	19 (52.8%)
15	AI-assisted lesson plans help pre-service teachers generated interactive and engaging classroom activities.	4.15	0.821	11 (32.4%)	20 (58.8%)

N = 36

Table 7.1: Pre-Service Teachers' Experiences with AI-Assisted Tools for Lesson Planning Data

The analysis of Table 7.1 revealed that pre-service teachers generally hold positive attitudes toward AI-assisted lesson planning. A combined 77.7% of respondents (12 strongly agree, 16 agree) reported having experience using such tools and 77.8% felt confident in integrating technology into their lesson plans. Furthermore, 80.6% (15 strongly agree, 14 agree) believed AI-assisted planning could benefit their teaching practice while 88.9% (14 strongly agree, 18 agree) expressed openness to using these tools in their future careers. These findings align with prior research highlighting AI's potential to enhance teaching efficiency and reduce cognitive load in lesson planning (Wang et al., 2024). Although only 27.8% (4 strongly agree, 6 agree) had received formal training, 75.0% of the respondents (14 strongly agree, 13 agree) supported the inclusion of AI-assisted lesson planning in teacher education syllabus hence suggesting a strong interest in professional development. Respondents also agreed that AI tools reduce preparation time (83.3%;) in which could improve overall teaching efficiency (86.1%) and enhance structured delivery (85.1%;). AI's ability to support multimedia integration (84.7%), generating engaging content (91.2%) and assist in CEFR-aligned speaking tasks (83.4%) was also affirmed. However, familiarity with the CEFR was only moderate, with 50.0% (8 strongly agree, 10 agree) expressing confidence. Opinions were more divided on whether traditional lesson planning was more effective than AI-assisted planning with 38.8% agreement. Hence, it is also reflecting an ongoing need to balance technological innovation with pedagogical understanding. These results reflect growing recognition of AI's value in teaching, while also affirming calls for enhanced teacher training and curriculum alignment (Hardaker & Glenn, 2025; Yerbabuena Torres et al., 2024).

Research Question 2: To what extent do AI-assisted lesson plans align with CEFR guidelines for language learning?

No	Items	Mean	Standard Deviation	Strongly Agree Frequency / %	Agree Frequency / %
	AI-assisted lesson plans:				
1	Improve students' engagement in the learning process.	4.03	0.845	10 (27.8%)	20 (55.6%)
2	Improve students' comprehension of the subject matter.	4.00	0.894	11 (30.6%)	17 (47.2%)

3	Increase students' motivation and participation.	4.00	0.828	9 (25.0%)	21 (58.3%)
4	Allow for students' personalised learning experiences.	3.97	0.810	8 (22.2%)	22 (61.1%)
5	Effectively incorporate communicative language teaching principles in line with CEFR.	3.97	0.736	8 (22.2%)	21 (58.3%)
6	Provide adequate scaffolding for students at different CEFR levels.	3.97	0.845	9 (25.0%)	20 (55.6%)
7	Contribute to better students' learning outcomes.	3.94	0.893	10 (27.8%)	17 (47.2%)
8	Provide structured grammar and vocabulary activities suited to CEFR levels.	3.94	0.826	8 (22.2%)	20 (55.6%)
9	Accommodate students with different learning needs.	3.92	0.937	8 (22.2%)	22 (61.1%)
10	Align well with CEFR language proficiency levels by provide appropriate activities for developing CEFR-based language skills.	3.89	0.747	7 (19.4%)	20 (55.6%)
11	Encourage student interaction and collaboration in alignment with CEFR guidelines.	3.89	0.919	11 (30.6%)	14 (38.9%)
12	Provide suitable reading comprehension exercises based on CEFR levels.	3.87	0.961	8 (22.2%)	20 (55.6%)
13	Encourage critical thinking and problem-solving among students.	3.86	0.931	9 (25.0%)	17 (47.2%)
14	Generate meaningful writing tasks that align with CEFR standards.	3.86	0.899	9 (25.0%)	16 (44.4%)

N = 36

Table 7.2: Instructional Effectiveness of AI-Assisted Lesson Plans' designed in accordance with CEFR Guidelines for Language Learning

Table 7.2 depicted the results for the mean, frequency and percentage for the instructional effectiveness of AI-assisted lesson plans with CEFR guidelines. Based on the table, the mean calculated for all items involved were grouped into three quartiles: the highest group, the moderate group and the lowest group with each range different from each other. The range for the highest group was 4.03 to 4.00, meanwhile the range for the moderate group was around 3.97 to 3.92. Furthermore, the range of mean for the lowest group was 3.89 to 3.86. As for the first group, the highest mean indicated AI-assisted lesson

plans improved students' engagement and students' comprehension of the subject matter with 27.8% and 30.6% responded strongly agreed respectively. It also helped to increase students' motivation and participation with 58.3% who responded agreed. These notions aligned with Baytak (2024) who concluded that AI-generated lesson plans demonstrated stronger alignment with CEFR guidelines. As for the second group, the moderate range of mean, the findings showed that AI-assisted lesson plans incorporated students' personalised learning experiences, communicative language teaching and adequate scaffolding based on CEFR guidelines. These results aligned with how AI integration in lesson planning allowed creative activities and personalised content based on students' needs (Baytak, 2024). AI-assisted lesson plans also provided appropriate activities suited to CEFR-based language skills and accommodate students with different learning needs with better learning outcomes. 55.6% and 61.2% responded agreed to this statement. This notion was supported by Baytak (2024) when AI can assist in generating CEFR-aligned lesson plans that could increase efficiency for the pre-service teachers. With this benefit, pre-service teachers could provide structured grammar and vocabulary activities suited to CEFR levels more effective as 40.8% of them viewed AI tools as highly effective in enhancing learning outcomes (Kanvaria and Ritika, 2024). Last but not least, for the third group, which was the lowest range of mean, indicated that AI-assisted lesson plans encourage student interaction and collaboration with 38.9% agreed. It also provided suitable reading comprehension exercises and meaningful writing tasks based on CEFR levels as 55.6% and 44.4% responded agreed. Additionally, AI-assisted lesson plans also encouraged critical thinking and problem-solving activities. These notions have the lowest mean because AI-generated lesson plans lacked deep integration of technology-enhanced learning tools. Plus, AI-generated lesson plans would support CEFR-aligned lesson plans when prompts included explicit learning goals (Baytak, 2024).

Research Question 3: What are the biggest strengths of AI-assisted lesson plans in terms of instructional effectiveness and CEFR alignment?

Key Themes	Representative Raw Response
Efficiency / Time-Saving	*"AI reduces the time teachers spend on repetitive tasks like planning and resource creation, allowing them to focus more on teaching."*
CEFR Alignment	*"They align well with CEFR by targeting specific language levels and skills accurately."*
Personalised Learning	*"AI can tailor lesson content to students' proficiency levels, learning styles, and pace."*
Instant Feedback	*"AI lessons give you feedback right away and help teachers identify and address gaps quickly."*
Interactivity / Engagement	*"Interactive and multimedia resources increase retention and motivation."*
Creativity Encouragement	*"Encourage us to be more creative."*
Grammar and Language Support	*"Can improve my grammar and provide complex sentence."*
Structured Planning Aid	*"AI helps create tools like templates that may be beneficial to the teachers."*
Supports Various Levels	*"AI-assisted lesson plans offer content that can assist students' different level of proficiency."*

Insight Generation	*"Can provide many insights that we want based on the information given."*
Student-Centred Approach	*"It is able to help create a lesson that focuses on student needs or weaknesses."*
Adaptability / Real-Time Response	*"By personalising content to student needs and adapting in real time."*
Efficiency / Time-Saving	*"AI reduces the time teachers spend on repetitive tasks like planning and resource creation, allowing them to focus more on teaching."*
N = 36	

Table 7.3: Major strengths of AI-assisted lesson plans

The integration of Artificial Intelligence (AI) in educational settings has become increasingly prominent, particularly in language instruction. As AI continues to support teachers in automating lesson planning and personalizing instruction, it raises both opportunities and concerns. The findings from Table 7.3 and Table 7.4 are presented based on thematic analysis of AI-assisted lesson planning with respect to its instructional effectiveness and alignment with the Common European Framework of Reference for Languages (CEFR). The research identifies nine major themes that reflect the benefits and challenges associated with the implementation of AI in educational contexts in table 7.3 and table 7.4 respectively.

The findings from Table 7.3 showed an insightful strengths of artificial intelligence (AI) integration in lesson planning. One of the most consistent strengths emerging from the data is AI's ability to enhance instructional efficiency. Participants noted that AI significantly reduces the time teachers spend on repetitive tasks such as lesson planning and resource creation, thereby allowing more time for direct instruction and student engagement. This finding is supported by Holmes, Bialik, and Fadel (2019), who argue that AI tools in education are effective in managing administrative burdens and streamlining workflows, making teaching practices more productive and focused. Secondly, the findings suggest the accuracy of AI in aligning lesson content with CEFR levels. Respondents indicated that AI-generated lessons often effectively target specific linguistic competencies and proficiency levels. According to Vuorikari and Punie (2019), AI could map learning activities to curriculum standards such as the CEFR with remarkable consistency, offering scalable solutions for language instruction that meet international benchmarks. This capability enhances the credibility and usability of AI tools in language education contexts.

Next, AI-assisted lesson plans helped in terms of personalised instructions also emerged prominently. AI's ability to tailor lesson content based on individual learners' language proficiency, pace, and preferred learning styles was cited as a major advantage. This aligns with the argument made by Luckin et al. (2016) that AI fosters learner autonomy and differentiated instruction, both of which are central to student-centred pedagogical approaches. Personalized content not only improves engagement but also supports more effective learning trajectories for diverse learners. Furthermore, the findings recorded with the concerns of the real-time feedback mechanisms provided by AI tools. Participants noted that AI allows teachers and students to receive instant feedback, facilitating timely interventions and adaptive instruction. Shute (2008) emphasizes the importance of formative feedback in promoting learning, suggesting that AI can significantly enhance assessment for learning by delivering immediate, actionable insights.

In addition to logistical and cognitive support, AI was credited with encouraging creativity and providing resources that promote innovative lesson design. The generation of templates, multimedia integration, and data-driven insights enables teachers to explore creative approaches in their pedagogy. Zawacki-Richter et al. (2019) describe AI as a co-designer in the educational process, capable of expanding educators' professional capabilities through supportive, rather than directive and functions.

Research Question 4: What are the biggest challenges of AI-assisted lesson plans in terms of instructional effectiveness and CEFR-alignment?

Key Themes	Representative Raw Response
Lack of Human Touch	*"AI can't replace a real teacher's help and understanding."*
Over-Reliance on Technology	*"Over-reliance on AI can reduce teacher input and lead to generic or less engaging lessons."*
Limited Creativity & Engagement	*"AI may lack the creative touch and human intuition required to make lessons engaging and culturally relevant."*
Contextual & Cultural Insensitivity	*"They may lack context, cultural sensitivity, and creativity."*
Inaccuracy / Outdated Content	*"AI tools may offer outdated, inaccurate or fabricated content."*
Shallow CEFR Interpretation	*"AI may misinterpret descriptors or oversimplify progression, leading to misalignment with authentic CEFR standards."*
Lack of Critical Thinking Tasks	*"AI-generated tasks may struggle to consistently promote higher-order thinking."*
Limited Adaptability in Classrooms	*"AI may not fully understand students' real needs and the lesson ideas that may not fit all learners."*
Technology Accessibility Issues	*"Limited 100% or 90% free AI platform. And slow internet connection."*
Generic / Repetitive Content	*"Same answer if my friends also use AI."*
Does Not Suit All Learners	*"Sometimes it is not suitable and not align with what we actually want."*
Neutral / Uncertain Responses	*"I'm not sure.", "neutral", "ok."*
N = 36	

Table 7.4: Major limitations of AI-assisted lesson plans

Despite its benefits, the findings in Table 7.4 revealed a notable limitation of AI integration in lesson planning. One of them is its inability to replicate the emotional intelligence and intuition of human educators. Participants reported that AI lacks the human touch necessary to respond to students' social-emotional needs. Selwyn (2019) asserts that while AI may support the technical aspects of education, it cannot substitute for the relational dynamics and empathy that are essential to effective teaching. Plus, having AI-assisted lesson plan would generate cultural and contextual insensitivity. Respondents pointed out that AI-generated content may lack relevance or cultural appropriateness, particularly in linguistically and culturally diverse classrooms. Prinsloo (2020) warns that algorithmic systems often reflect dominant cultural narratives, which can marginalize alternative voices and reduce the inclusivity of educational materials.

Concerns regarding the reliability of AI-generated content also emerged from the findings. Participants mentioned that AI sometimes provides inaccurate or outdated information and may oversimplify complex educational standards like the CEFR. Popenici and Kerr (2017) argue that the epistemological limitations of AI stem from its dependence on data-driven logic, which can produce flawed

interpretations, especially when handling nuanced or subjective content. Lastly, the analysis revealed technological and accessibility barriers. Several participants cited issues such as limited access to free AI platforms and unreliable internet connections, particularly in under-resourced regions. According to van Deursen and Helsper (2015), digital inequality continues to pose a major obstacle to the equitable implementation of educational technology, thereby exacerbating existing disparities in access to quality instruction.

These findings highlight the multifaceted role of AI-assisted lesson planning in enhancing instructional effectiveness and aligning with CEFR standards. While concerns of efficiency, personalization, and immediate feedback underscore the pedagogical potential of AI, themes related to cultural insensitivity, lack of human empathy, and infrastructural limitations illustrate its current shortcomings. The findings suggested that AI should not be viewed as a replacement for teachers but as a complementary tool that, when used thoughtfully, can augment the teaching and learning experience. Future research and implementation strategies should focus on integrating AI in ways that preserve teacher agency and address issues of equity and contextual relevance.

8 RECOMMENDATIONS

Future research on AI-assisted lesson plans should explore their long-term impact on student learning outcomes through longitudinal and comparative studies. Investigations into the precision of CEFR alignment and the effectiveness of AI in developing specific language skills are particularly warranted. Additionally, examining the cultural and contextual adaptability of the AI-generated content can help ensure inclusivity and relevance across diverse learning environments. Research should also address teachers' perceptions, training needs, and the implications of AI use on their professional agency. Ethical concerns, such as algorithmic bias, students' data privacy, and equitable access which require urgent attention, especially in under-resourced settings, should be explored. Furthermore, studies focusing on offline or low-bandwidth AI solutions can enhance accessibility needs to be addressed in the educational context. Finally, co-design approaches involving educators and learners, along with interdisciplinary applications of AI in non-language subjects, can broaden the scope and practical relevance of AI in education should be assessed.

9 CONCLUSION

In exploring the integration of artificial intelligence (AI) into CEFR-based language instruction, it is not necessary to perform as a tool but rather a shift in pedagogical culture. The findings of this survey highlight not only AI's benefits to streamline lesson planning process and offering real-time feedback, but it assesses the effectiveness of developed lesson plans generated from AI. However, while the pedagogical value of AI is undeniable, this integration brings forward challenges that cannot be overlooked. While AI-assisted lesson plans offer structural clarity and enhance students' engagement through adaptive learning experience, it often results in generic lesson plans that lack contextual relevance. Moreover, excessive reliance on AI may diminish teachers' input and creativity, leading to a dependency on technology that could undermine the development of critical thinking and innovative teaching strategies. Thus, AI should not yet replicate the role of a teacher but rather a reinvention of what it means to plan a lesson. It assists teachers providing learning content and material resources that require a delicate balance which AI should be seen as a tool that amplifies rather than replaces the educators. To make the best use of AI, it should be seen as a supporting tool within CEFR-based language instruction and lesson planning, where its capabilities can streamline content creation, adapt learning materials to individual proficiency levels, and reinforce the pedagogical standards established by the CEFR.

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Beyond Passive Learning: Leveraging Digital Simulations to Enhance Active Learning in IoT Education

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ABSTRACT

In the era of Industry 4.0, engineering education must go beyond lectures to develop hands-on, problem-solving skills—especially in Internet of Things (IoT) courses. This paper presents an active learning framework integrating Wokwi, a virtual microcontroller simulator, and Blynk, a cloud-based IoT dashboard, into the undergraduate curriculum. Guided by constructivist principles, students engaged in six weeks of progressively challenging lab activities, culminating in open-ended mini projects addressing real-world problems. Quantitative and qualitative feedback from 42 participants revealed high engagement, improved self-efficacy, and enhanced technical competencies in programming, system design, and cloud integration. Projects such as smart posture monitors and gas leak detectors showcased creativity and contextual application. Peer learning, reflection prompts, and scaffolded tool use further supported learner autonomy. This study demonstrates that digital simulations, when thoughtfully embedded in a structured pedagogical design, can overcome resource constraints while enabling authentic, scalable, and learner-centered IoT education.

KEYWORDS: Active learning, Digital Simulations Tools, Engineering Pedagogy, Student Engagement, IoT Education

1 INTRODUCTION

Engineering education is evolving rapidly to meet the challenges of Industry 4.0, characterized by the fusion of cyber-physical systems, the Internet of Things (IoT), and real-time data processing. In this new paradigm, engineering graduates must not only grasp foundational theories but also demonstrate problem-solving skills, adaptability, and proficiency in emerging technologies. Consequently, there is a pedagogical shift from traditional lecture-driven instruction to more dynamic, student-centered learning models (Prince, 2004; Freeman et al., 2014).

One approach gaining traction is active learning, where students engage with content through discussion, experimentation, and self-reflection. This approach is closely tied to constructivist learning theory, which asserts that knowledge is constructed through interaction with one's environment rather than passively absorbed (Piaget, 1952; Vygotsky, 1978). Constructivism encourages learners to explore, make

decisions, and apply prior knowledge to solve new problems—processes that are especially valuable in the context of IoT systems that require hands-on, iterative development (Bruner, 1966; Dewey, 1938).

A constructivist classroom provides opportunities for learners to take ownership of their learning through open-ended challenges and real-world applications. It supports cognitive engagement by encouraging students to test hypotheses, reflect on feedback, and revise their mental models (Chi, 2009). This is particularly crucial for IoT education, where learners must develop competencies in embedded programming, network protocols, data acquisition, and cloud integration—all of which demand an iterative, exploratory learning process.

However, the implementation of hands-on IoT activities is often constrained by limited access to hardware components, especially in large, resource-limited, or remote classrooms (Zhou & Brown, 2015). This challenge creates a need for scalable digital tools that can replicate authentic hardware experiences without the associated logistical burdens.

Platforms like Wokwi, an online simulator for microcontroller systems, and Blynk, a mobile-based IoT dashboard, provide learners with virtual environments to build and test IoT applications in real time (Web-1; Web-2). These tools support asynchronous and self-paced learning, allowing students to experiment freely without fear of damaging equipment. More importantly, they reinforce constructivist principles by enabling learning through doing, debugging, and continuous improvement (Tam, 2000; Laurillard, 2002).

To address these challenges and explore the pedagogical value of digital simulation in IoT education, this study investigates the integration of Wokwi and Blynk within the EDB4713 Ubiquitous Computing course at Universiti Teknologi PETRONAS. Specifically, we aim to assess how these tools support student engagement, hands-on learning, and the development of practical IoT competencies. By embedding simulation platforms in a constructivist-aligned, problem-based learning framework, this research contributes to scalable, accessible strategies for improving technical education in resource-constrained or hybrid learning environments.

2 METHODOLOGY

This study adopted a Design-Based Research (DBR) approach to iteratively design, implement, and refine an active learning framework within the *EDB4713 Ubiquitous Computing* course. DBR is especially suitable for educational technology interventions, as it integrates real-world practice with ongoing evaluation and theory building (Laurillard, 2002). The methodology was structured across three phases: planning, implementation, and evaluation.

2.1 Instructional Design and Tool Integration

The instructional design was guided by constructivist principles, aiming to foster experiential, student-centered learning through active engagement with simulated IoT systems. The approach emphasized autonomy, problem-solving, and feedback loops, allowing learners to iteratively construct understanding through hands-on digital experimentation.

To support this, two primary tools were integrated:

- Wokwi: A browser-based simulator for microcontrollers (including ESP32), allowing real-time code testing with virtual sensors and actuators. It enabled safe, repeatable experimentation without the logistical constraints of hardware procurement, thus lowering barriers for beginners and promoting self-paced learning.
- Blynk: A cloud-based IoT dashboard application that allowed students to remotely control devices and visualize data in real time. It emphasized connectivity and system-level thinking by enabling learners to simulate end-to-end IoT workflows—from device logic to cloud interaction.

These tools were selected based on their accessibility, pedagogical alignment, and ease of use in resource-constrained or hybrid learning environments. The instructional design also incorporated modular tutorials, scaffolded lab exercises, and peer discussion prompts to accommodate diverse technical

backgrounds. Tool usage was tightly integrated into a six-week activity plan detailed in Section 2.2, with each session targeting specific cognitive and technical learning outcomes (Kolb, 1984; Mayer, 2004).

2.2 Learning Activities Framework

To translate constructivist learning principles into practice, the course was organized into a six-week modular framework. Each week scaffolded progressively complex IoT concepts, integrating simulations, cloud control, and reflective practice to support both cognitive and metacognitive development.

Each session included the following components:

- Concept Briefing: Short instructor-led walkthroughs to activate prior knowledge and frame the week's focus.
- Hands-on Simulation (Wokwi): Allowed learners to test embedded code in a risk-free environment, promoting experimentation and debugging.
- Cloud Integration (Blynk): Introduced real-time device-cloud interaction, reinforcing systems thinking and data literacy.
- Mini-Challenges: Short, goal-oriented tasks (e.g., cloud-controlled LED) to encourage independent problem-solving and application of new knowledge.
- Reflection Task: Guided questions prompted students to articulate what they learned, identify errors, and plan improvements—supporting self-regulation and critical thinking.

Collaborative peer demos were also encouraged during open-ended project phases to foster peer learning and design idea sharing.

This activity structure emphasized exploration, iterative learning, and learner autonomy while providing consistent scaffolding and support. As shown in Table 1, the weekly progression ensured that students developed foundational knowledge before advancing toward integrative project design and communication.

Table 1: Weekly Activity Plan and Intended Learning Outcomes

Week	**Focus Topic**	**Tools Used**	**Learning Outcome**
1	Intro to IoT & Simulation	Wokwi	Understand embedded systems architecture
2	Sensor Input	Wokwi	Interface analog and digital sensors
3	Cloud Communication	Blynk	Send/receive data via cloud
4	Control Systems	Wokwi + Blynk	Control actuators using Blynk app
5	Mini-Project Planning	Wokwi + Blynk	Design custom IoT solution based on real-world problems
6	Project Presentation	Wokwi + Blynk	Demonstrate integrated IoT system; communicate technical ideas

2.3 Data Collection

The study adopted a mixed-methods approach to evaluate the effectiveness of the active learning framework. Data were collected from 42 undergraduate students enrolled in the EDB4713 Ubiquitous Computing course during a 6-week instructional period.

Quantitative data were gathered using a post-course survey comprising 5-point Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree) that assessed student engagement, perceived learning gains, tool usability, and confidence in problem-solving. Example items included: "*I felt more confident in programming embedded systems*" and "*The simulation tools helped me understand IoT concepts more clearly*."

Qualitative data included:

- Open-ended survey responses reflecting on learning preferences, challenges, and tool experiences.
- Project deliverables, assessed using a structured rubric that evaluated system functionality, code quality, innovation, use of Blynk, and overall relevance to real-world problems.

Qualitative responses were thematically coded using inductive content analysis. Two researchers independently identified themes related to cognitive engagement, autonomy, and motivation, and resolved discrepancies through discussion.

This triangulated approach ensured both breadth and depth in evaluating the instructional intervention, allowing insights into both outcomes and underlying learning processes. The findings are presented and analysed in Section 3.

3 RESULTS AND DISCUSSION

3.1 Student Feedback

Post-intervention feedback was collected from 42 participants using a Likert-scale survey and open-ended reflections. The results revealed consistently high levels of engagement, tool usability, and learner autonomy. As shown in Table 2, students strongly agreed that Wokwi enhanced their understanding of microcontroller programming (85.7%) and that Blynk improved their grasp of IoT communication and control (90.5%).

Table 2: Summary of Student Feedback on Active Learning with Wokwi & Blynk.

Feedback Item	**Agree or Strongly Agree (%)**
Wokwi helped me understand microcontroller programming	85.7%
Blynk helped me visualize IoT communication and control	90.5%
I prefer using virtual tools before moving to hardware	83.3%
I felt more motivated when the task was problem-based and open-ended	78.6%
I was able to work independently and troubleshoot my system	81.0%

These findings highlight the effectiveness of combining digital simulation with real-time cloud interaction to build foundational IoT skills. Notably, 83.3% of students preferred using virtual tools before transitioning to hardware, reinforcing the value of safe, exploratory environments in building learner confidence. In line with constructivist learning principles, 78.6% reported greater motivation when tasks were problem-based and open-ended, and 81.0% felt capable of independently troubleshooting their system—reflecting increased self-efficacy and metacognitive awareness.

One student reflected:
"*I used to be afraid of programming. But Wokwi helped me break things down and see what each line did. It made trial and error less scary*."

These responses affirm existing research on the benefits of active, simulation-enhanced learning in technical education (Chi, 2009; Zhao & Yu, 2022). The tools and task design empowered students to experiment, reflect, and persist through challenges—key tenets of constructivist pedagogy. These positive perceptions set the stage for deeper cognitive engagement and successful project execution, as explored in the following section.

3.2 Project Outcomes and Cognitive Depth

Analysis of student submissions and observational notes during the mini-project phase revealed substantial growth in technical fluency and cognitive engagement. Using the previously defined rubric, the majority of teams demonstrated strong system functionality, effective use of cloud-based control (via Blynk), and innovative, context-relevant applications.

Approximately 90% of student groups achieved full integration of sensor input, cloud communication, and dashboard-based control. These outcomes suggest mastery of essential IoT competencies and reflect students' ability to apply knowledge in authentic, problem-based scenarios. The diversity of project themes and the depth of design choices indicate that students were operating at the higher levels of Bloom's taxonomy—particularly in applying, analyzing, and creating.

To provide further context and documentation, selected student project samples are illustrated in the Appendix:

- Figure A.1: ShadowPulse Intelligence (Spintel) – A compact, IoT-enabled covert communication system aimed at enhancing situational awareness and coordination for field agents. This project exemplifies abstraction and transfer, as students reimagined traditional IoT components for a unique, mission-critical application.
- Figure A.2: IoT-Based Gas Leak Detection System – A safety-oriented prototype integrating an MQ-2 sensor and ESP32 microcontroller to detect flammable gases and trigger real-time alerts. This project reflects technical precision, clear problem definition, and practical relevance to environmental safety.
- Figure A.3: SPYNE Chair – Smart Posture Monitoring System – An intelligent ergonomic solution equipped with pressure sensors and cloud alerts to promote proper sitting posture. The project highlights user-centric design and demonstrates integration of sensor feedback, cloud analytics, and corrective intervention.

These projects not only fulfilled the learning outcomes outlined for Weeks 5 and 6 (see Table 1), but also displayed a strong degree of student agency, as learners selected project themes aligned with their interests or community relevance. The open-ended nature of the tasks fostered ownership, intrinsic motivation, and authentic problem-solving—key indicators of cognitive depth in constructivist learning environments.

In sum, these outcomes affirm that a digital-first, simulation-enhanced instructional model can enable students to transition from basic conceptual understanding to higher-order thinking and real-world application, even in resource-constrained settings.

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3.3 Comparison with Traditional Teaching Approaches

Compared to previous iterations of the course, which primarily relied on lecture-based delivery and limited use of physical hardware kits, the blended digital-first strategy adopted in this study produced notable improvements in student outcomes. These included higher assignment completion rates, more innovative project ideas, and increased learner satisfaction.

Traditional approaches were often constrained by logistical issues—such as limited hardware availability, inconsistent kit functionality, and student hesitancy in experimenting with real components

due to fear of damaging them. In contrast, Wokwi and Blynk provided a safe, flexible, and scalable environment, enabling students to iterate freely and engage deeply with IoT design processes regardless of their prior experience.

> As noted by one student:
> "*I felt more confident trying new things with the simulator first. Before, we waited in line for the kits and rushed through the lab. This time, I understood what I was doing*."

Survey findings also support this shift: 83.3% of students indicated a preference for using virtual tools before transitioning to hardware (Section 3.1), reinforcing the confidence-building role of simulation. Moreover, peer demo sessions and self-paced exploration were rarely present in the traditional model but became integral to this redesigned framework.

These findings align with literature on active learning efficacy in STEM (Freeman et al., 2014; Michael, 2006), and affirm that constructivist-aligned instructional models, when coupled with accessible simulation tools, can significantly enhance learning outcomes in technical domains like IoT education.

4 CONCLUSION

This study demonstrated that embedding digital simulation tools—specifically Wokwi and Blynk—into a constructivist-aligned instructional design significantly enhanced active learning in an undergraduate IoT course. Students engaged in iterative problem-solving, developed confidence in coding and system integration, and applied their knowledge to authentic, creative projects.

Quantitative and qualitative findings indicate high student engagement, with over 85% reporting improved understanding of microcontroller programming, and over 90% successfully implementing cloud-based control in their mini-projects. The integration of guided reflection, peer interaction, and problem-based tasks contributed to deeper cognitive engagement and learner autonomy.

By lowering barriers to experimentation and providing a structured yet exploratory environment, this approach addressed common challenges in technical education—such as hardware limitations, varied technical backgrounds, and passive learning habits. It also encouraged broader participation and creative thinking among students.

Educators in IoT and related fields are encouraged to adopt simulation-first, problem-driven models as scalable and inclusive alternatives to traditional lab-based instruction. This framework is particularly valuable for hybrid, remote, or resource-constrained learning contexts.

Future work may explore blending digital simulations with physical hardware once foundational skills are achieved, or extending this model into interdisciplinary, real-world challenges such as smart city design or environmental monitoring. Ultimately, this approach reinforces the role of the instructor as a learning facilitator, guiding students from conceptual understanding to authentic application through reflective, technology-enhanced pedagogy.

5 ACKNOWLEDGEMENTS

The author thanks Universiti Teknologi PETRONAS and the students of EDB4713 for their enthusiasm and feedback.

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APPENDIX

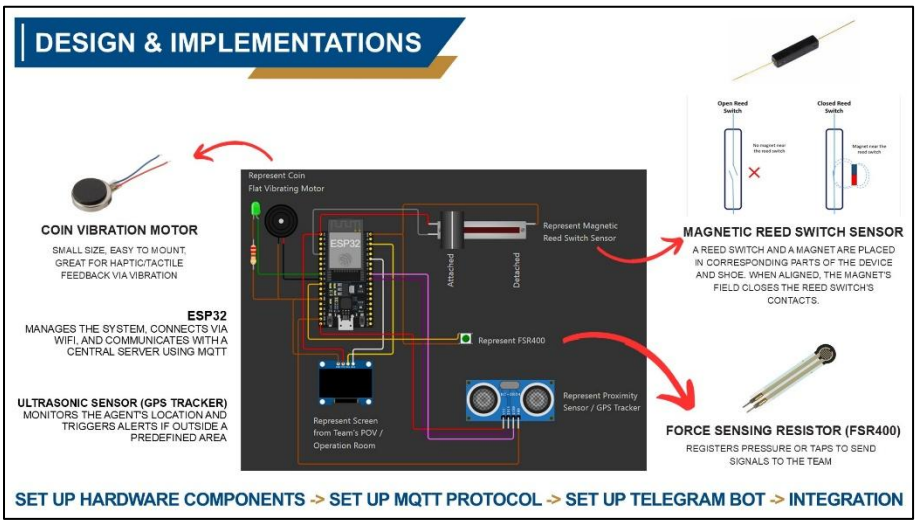


Figure A.8: ShadowPulse Intelligence (Spintel) – A compact IoT-enabled system designed to improve situational awareness, safety, and coordination for undercover agents during covert operations through real-time data communication and alerting mechanisms.

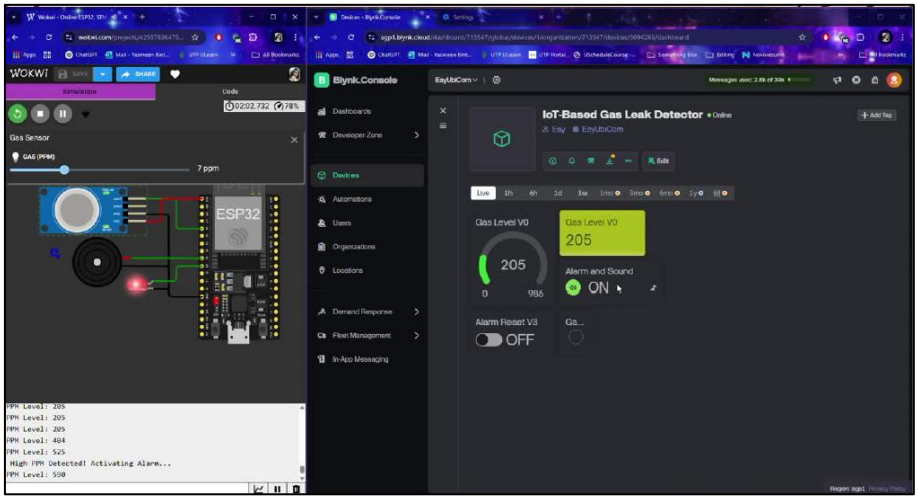


Figure A.9: IoT-Based Gas Leak Detection System – A real-time gas monitoring prototype utilizing an ESP32 microcontroller and MQ-2 sensor to detect flammable gases and trigger alerts, aimed at enhancing environmental safety and hazard prevention.

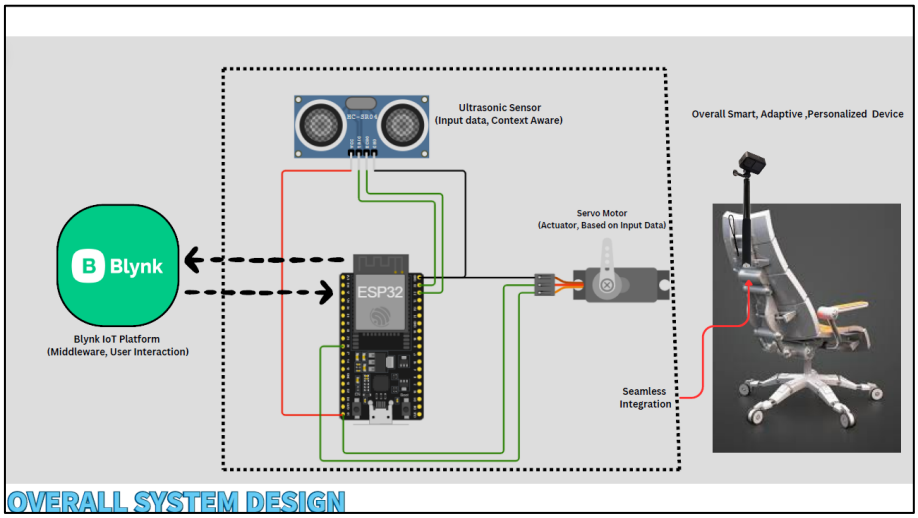


Figure A.10: SPYNE Chair: Smart Posture Monitoring System – An intelligent IoT chair equipped with pressure sensors and cloud connectivity to continuously monitor sitting posture and provide corrective feedback to promote ergonomic well-being.

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Revolutionizing Academic Work in Higher Education: A Systematic Review of Technology-Driven Productivity Tools Using Bibliometric Analysis

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ABSTRACT

In recent years, digital tools have become deeply embedded in the daily operations of higher education, reshaping how academic tasks are approached. This study explores the growing body of research on technology-driven tools through a systematic review and bibliometric analysis of 341 journal articles published between 2007 and 2024. Drawing data from Scopus database and using Biblioshiny platform, the study identifies key trends, influential contributors, and emerging areas of focus within this evolving field. The findings show a noticeable rise in publications after 2020, largely influenced by the global shift to remote and hybrid learning during the COVID-19 pandemic. Scholars from countries like United Stated, China, and the United Kingdom stand out in terms of research output, with institutions such as University of North Carolina and Boston university playing prominent roles. Recruiting themes across the literature include e-learning, digital literacy, academic performance, and artificial intelligence. Newer areas, such as personalized learning technologies and multimodal platforms, are also beginning to take shape. This review highlights the growing relevance of digital tools in improving academic productivity and institutional workflows. It also emphasizes the need for ongoing support in digital training and infrastructure. For educators, researchers, and decision-makers, the study offers a broad overview of where the field stands and where it may be heading in the years to come.

KEYWORD

Academic Work, Higher Education, Technology tools, productivity, systematic review, bibliometric analysis

1 INTRODUCTION

Technology in higher education has dramatically altered the work of academics and provided new opportunities and challenges to enhance productivity in the institution (Johnson et al., 2022; W. Liu et al., 2022). This ranges from learning management systems (LMS) to high-end research tools that work towards improving students' work efficiency. To be more specific, according to (Wang et al., 2024), technology-driven productivity tools in academia can be defined as systems that are developed to enable teaching, research, administrative functions, and institutional management. They ultimately improve students' academic outcomes (Wang et al., 2024). In particular, digital tools for research management (reference managers, data visualization platforms) have greatly enhanced student output and academic collaboration (Tabatadze B., 2023). Administrative workflow tools (automation systems, data analytics software, etc.) play an important role in managing university operations (Kissinger, 2000)

Technology-based productivity tools therefore have become an increasingly important part of academic success and therefore require constant innovation and adaption to suit the changing demands of higher education institutions. As illustrated by (Allen & Seaman, 2014) the evolution towards incorporation of digital solutions into educational contexts has mirrored developments in broader society, especially in terms of the increasingly reliance on digital platforms in professional and personal life (Brynjolfsson et al., n.d.). However, even though technology is becoming more integrated into academic systems, it still remains a gaping hole of understanding what proportion of the implications of these tools for academic productivity, particularly in terms of their adoption in different academic systems.

The challenges of quantifying the impact of such tools have enabled systematic bibliometric analysis, a method best suited for the general purpose of synthesizing large amounts of academic data, to be undertaken. Bibliometric analysis is therefore capable of determining the growth of publications over time, identify influential authors and institutions, and detect the development of notable research themes and topics (Liu et al., 2022). Concomitantly, despite its potential, the application of bibliometric analysis to technology-driven productivity tools in higher education remains inadequately explored. Little work has been performed with this technique to track the development of technology in academia, primarily for the assessment of its influence on productivity and the production of academic outputs (Singh et al., 2024). The lack of progress shows the need for systematic review and bibliometric analysis to determine what are the major trends, influential contributors, and emerging topics in this field.

Therefore, the purpose of this research is to undertake a systematic review of the literature on technology-based productivity tools in higher education through a bibliometric analysis with the aim of exploring the intellectual geography of this field to gain insight into the most significant studies, authors, institutions, and themes that have determined research within this field. Working on an academic context where technology intersects with productivity, the purpose of this research is to provide a sense for the state of research in this area and identify areas for further study. The research will address the following questions:

R.Q 1: What are publication trends of research in technology driven productivity tools for higher education?
RQ 2: Who are the most influential authors/institutions/country contributors to the academic productivity tool field?
RQ 3: What are the major issues and research domains addressed in technology-based productivity tools for higher education?
R Q. 4: What are the future research directions and emerging areas in this area?

The findings of this bibliometric analysis are expected to provide a comprehensive overview of the landscape of academic work in higher education, shedding light on both well-established and emerging trends in the use of technology to drive productivity. Additionally, the study will offer valuable insights for researchers, educators, and policymakers looking to stay abreast of developments in this rapidly evolving field. By doing so, it will facilitate more informed decision-making about the integration of technological tools into academic environments, helping to shape the future trajectory of higher education.

The bibliometric analysis findings would provide a comprehensive overview of the landscape of academic work and performance in higher education, while revealing well established and new technology-

driven productivity trends. This research will provide valuable insights that will benefit researchers, educators, and policymakers looking to stay abreast of developments in this rapidly evolving field. This initiative will enable stakeholders to make better decisions concerning the adoption of technological solutions in educational settings which will influence future developments in higher education.

2 BACKGROUNDS OF TECHNOLOGICAL -DRIVEN TOOLS IN HIGHER EDUCATION

Technological advancements have dramatically transformed productivity in higher education institutions during recent decades by changing academic workflows and research approaches. Early academic activities depended largely on manual operations through paper-based systems before technology began to integrate into these processes. Technology use in academic settings began during the mid-20th century as computers started entering educational institutions. Higher education first applied technology to administrative functions like record and data management instead of directly improving teaching, learning, and research processes (Schrum, 2023). The swift advancement of computer technology through the 1970s and 1980s allowed the emergence of transformative applications.

The emergence of personal computers during the 1980s started a new era of technological advancement along with early software tools that began to aid academics in their everyday work. Word processors and spreadsheet programs served as essential tools for faculty and researchers to optimize academic work creation and evaluation because they introduced automation capabilities that did not exist before. Universities started to recognize improved productivity possibilities in research and publishing as they adopted these tools more widely. The Internet revolution during the 1990s enhanced academic productivity by developing online databases and digital libraries which allowed researchers to access extensive scholarly information through simple web-based access (Moore, 2018).

During the early 2000s, the technological development within the realm of education was stimulated by powerful digital learning resources such as the learning management systems (LMSs), which made teaching and learning more organized, flexible, and efficient (Prahani et al., 2022; Shahdat et al., 2024). The offline to online shift of classrooms made it possible for asynchronous learning, where students could self-pace their engagement with the course materials, thus improving the level of access and flexibility in education. Systems like Blackboard and Moodle along with Canvas turned into basic utilities of teaching in universities and change the delivery, assessment, and engagement of academic content dramatically (Swerzenski, 2021)

The beginning of the 2010s marked the surge of productivity in academic work by the introduction of cloud-based and collaborative tools (introduction of cloud-based and collaborative tools (Diaz, V. (2011). Google Drive, Dropbox, and Microsoft Office 365 enabled faculty, researchers, and students to access, contribute, and edit academic documents from various devices and locations, thus improving collaboration and efficiency across the whole system. This period also featured the implementation of data analytics and machine learning within academic research as they enabled scholars to analyze large datasets very quickly and accurately. These tools not only provided improvements in productivity; they also increased the sophistication of methodologies employed in research from data collection to analysis, which changed the nature of research (Bykov & Shyshkina, 2018)

The modern world has seen the adoption of Artificial Intelligence (AI), big data analytics, and other advanced digital tools in higher educational institutions with the vision of maximizing teaching and research productivity. Academics and researchers are using AI-powered writing aids and research management tools to streamline content creation and enhance data processing and automate repetitive skills. With the adoption of these technologies, scholars are more empowered to focus more on advanced intellectual tasks by automating administrative and technical aspects of academic work. Likewise, bibliometric analysis tools like VOSviewer and CiteSpace aid researchers in mapping scientific networks, analysing publication trends and measuring the impact of publications across disciplines.

The evolution of these technological tools for enhanced productivity go hand in hand with the advancement of technology. The shift in academic frameworks and the needs of academia also play a role.

Constructivist Learning Theory together with Social Learning Theory stimulated the creation of collaborative learning tools, and the development of open access policies as well as Open Educational Resources (OER) led to the creation of tools for knowledge creation and dissemination that are accessible and democratized (Anderson & Elloumi, 2004; Singh et al., 2024).

In addition, technology integrates and transforms human experience as posited in the Theory of Technological Mediation (Z. Liu, 2023) This theory, along with others, has been instrumental in driving the development and implementation of tools driven by technology which aims to improve participation through collaboration and remove barriers to learning and also make learning accessible. These frameworks are not developed in a vacuum but respond to societal and organizational demands. The growing demand for accountability in education has spurred the development of monitoring, assessment, and productivity enhancement tools for individuals and institutions. Similarly, the competency-based education model has driven the creation of tools for tracking and evaluating student learning progress, to ensure that the learning objectives meet target goals and aligned with industry standards.

3 METHODOLOGY

This study uses a more complex approach of bibliometric analysis to systematically examine literature concerning technology-based tools for productivity in higher education. A bibliometric analysis is a type of quantitative research which assesses the structure, performance, and growth of scholarly work in a specific area of research by analyzing data such as publications, citations, and co-authorship networks (Donthu et al., 2021). This method is particularly effective for mapping out research trends within a field, including research patterns, hotspots, major authors and institutions, and collaboration networks (Aria & Cuccurullo, 2017). The present study follows a multi-stage approach designed to create a thorough and reliable bibliometric investigation.

3.1 Data Source Selection

Given the extensive coverage and peer-reviewed academic publications contained in the Scopus database, it was selected as the main source for data retrieval because of its advanced analytical capabilities. Scopus is well known for having extensive coverage of social sciences, education, and technology, which is essential to this research. To promote replicability as well as transparency, only articles from peer-reviewed journals were included, thus excluding conference papers, editorials, and book chapters to maintain quality and coherence.

3.2 Search Strategy and Keywords

The most-relevant literature for this bibliometric study was found by an extensive search of Scopus database as previously highlighted. A sensibly organized search query was developed based on specific keywords and Boolean operations to achieve a balance of precision and comprehensiveness. Key words were some of the combinations of “digital tools,” “technological tools,” “technology-driven,” “academic work,” “higher education,” “faculty productivity,” and “academic performance.” These words were used in the titles, abstracts and keywords to increase the coverage. *See table I*

3.3 Inclusion and Exclusion Criteria

In order to ensure the focus and relevance of this bibliometric study, we employed well-defined inclusion and exclusion criteria. We extracted peer-reviewed journal publications from the Scopus database, scoped down to articles from the period between 2007 and 2024, so as to capture the recent literature on technology-driven productivity tools for higher education. 999 documents were initially found. We excluded 133 papers which were off-topic for the study as well as not in accordance with its objective. In

addition, 55 non-English records were removed. For consistency of document type, only reviews and articles were included, and 381 records were removed as a result of this exclusion. 89 studies regarding primary or secondary education were excluded as well in order to maintain a higher education focus. 341 documents were retained after applying all the criteria, maintaining a high-quality and thematically relevant dataset for analysis. *See table I*

Table 1: Methods involved in the Inclusion and Exclusion of searched documents

Search Date: 15th March, 2025
Database: Scopus
Search term: “digital tools,” “technological tools,” “technology-driven,” “academic work,” “higher education,” “faculty productivity,” and “academic performance
Language: English only
Document category: Only articles and reviews
Excluded records: focus other than higher education, unrelated, non-English, conference proceedings

3.4 Bibliometric Analysis

In order to systematically examine the scholarly landscape surrounding technology-facilitated productivity tools in higher education, a bibliometric analysis was conducted utilizing data extracted from the Scopus database. Bibliometrics provide quantitative data on patterns of publication, intellectual landscapes, and thematic trends within a field of research. Bibliometric analysis is particularly useful for mapping research productivity, co-authorship networks, and new topic areas within a specified period.

As mentioned earlier, 999 documents published between 2007 and 2024 were extracted and pre-processed. The quality of metadata was evaluated before analysis to ensure the integrity and analytical power of the dataset. The most important bibliographic fields such as author, affiliation, abstract, year, journal, and citations were 100% complete and graded as "Excellent." Cited references, keywords, and DOI had minimal missingness (0.59%–4.11%), which is within an acceptable limit. However, higher missing values were found in "Corresponding Author" (19.65%), "Keywords Plus" (66.86%), and "Science Categories" (100%), which limited the depth of some analyses (e.g., co-word clustering based on Keywords Plus or disciplinary classification). Despite these limitations, the dataset was still high in analytical value for principal pattern and scholarly contribution identification in the field.

4 RESULTS AND DISCUSSION

4.1 Publication Trends in Research on Technology-Driven Productivity Tools

Figure I illustrate the annual scientific production on technology-based productivity tools in higher education from 2007 to 2024. The publication timing distribution of documents indicates a rapidly increasing trend in recent years, which implies increased academic attention in the field. A remarkable spike appears in 2024, with 111 articles published, indicating the peak academic output during the period under review. This figure is nearing twice the number of 2022 (57 articles) and nearly four times the number of 2020 (27 articles), revealing an exponential expansion of research attention. The data reflect a gradual rise beginning in 2016, with a steep acceleration from 2019 onward. Prior to 2015, scholarly output within this area remained low, with only sporadic publications between 2007 and 2014, lending credence to the fact that this is a relatively new but rapidly emerging research area.

The sharp incline in output from 2019 to 2024 corresponds with broader digital transformations in higher education, particularly during and after the COVID-19 pandemic, which compelled institutions worldwide to re-evaluate and optimize academic workflows through technological means. This aligns with recent literature noting the pandemic as a catalyst for the adoption of educational technology and digital productivity solutions (Daugherty et al., 2018.; Johnson et al., 2022). Moreover, the steep rise in 2023 and 2024 coincides with the integration of advanced AI-driven tools (e.g., ChatGPT, Notion AI, Elicit) into academic workflows, further reflecting the subject-matter novelty and urgency of scholarly inquiry in this area.

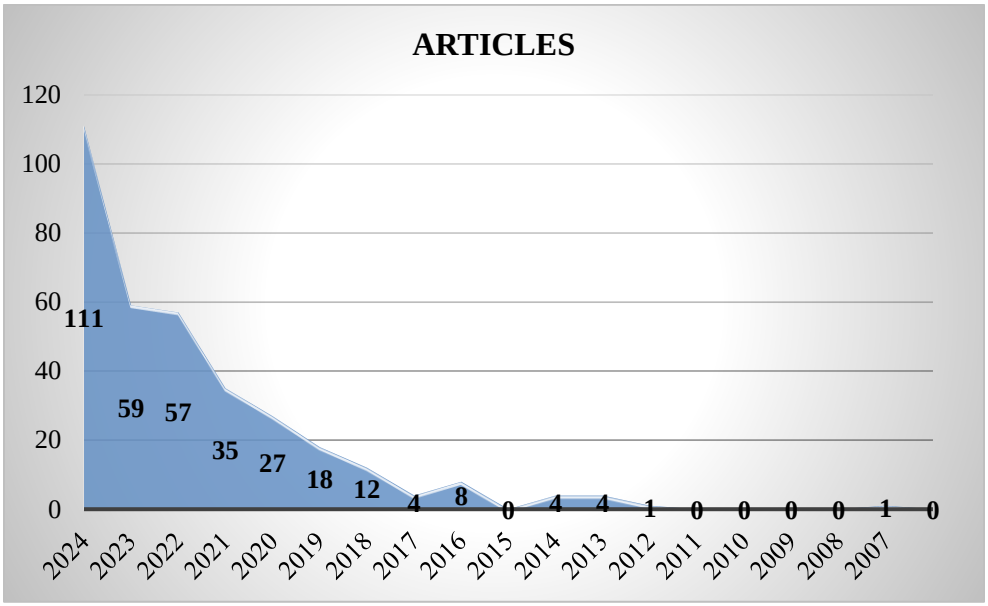


Figure 1: Annual Scientific Production

Figure II illustrates the trends of average citation per publication year between 2007 and 2024 in the field of technology-based productivity tools in higher education. This metric provides critical insights on the academic impact and dissemination of research outputs over the years, complementing publication number analysis. The graph shows the steady increase of citations between 2007 and 2016, with a clearer inflection point in 2017. In 2018, there is a sharp increase, which leads to a spike in 2020, where average publication citations are more than 4 citations per publication, the highest over the recorded period. This peak suggests that 2020 research articles achieved substantial academic visibility and were highly cited within a short time, likely due to their relevance during the COVID-19-induced digital revolution in higher education.

Post-2020, while a degree of fluctuation is observable, the general trend is one of continued scholarly interest. The relatively high averages for 2021 and 2022 attest to the continued applicability of research in the field of academic productivity and technology. The seeming decline in 2023 and 2024 is methodologically expected, as more recent publications have had limited opportunity to accrue citations. This citation lag effect is a common bibliometric effect and does not necessarily indicate decreased relevance. The sharp increase in 2020 correlates with a global shift towards remote and digitally mediated academic work and a consequent urgent desire to investigate tools such as AI writing assistants, collaboration software, and digital task management systems.

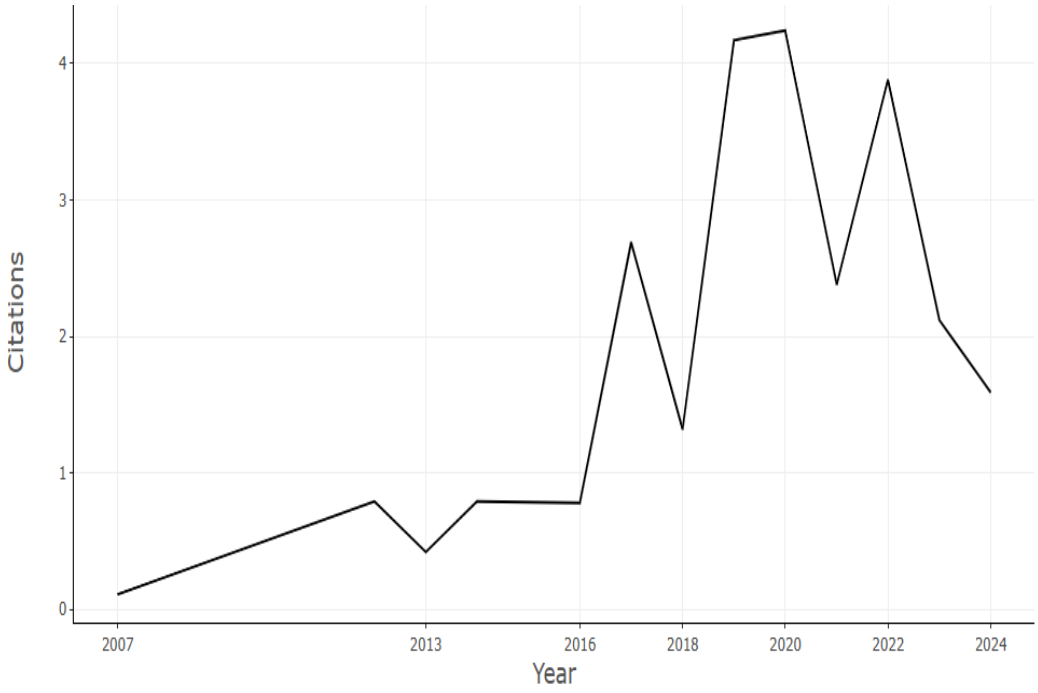


Figure II: Average Citations per year

4.2 Influential Contributors: Authors, Institutions, and Countries

Figure III presents the top contributing authors in the topic of technology-based productivity tools in education at the higher education level based on the quantity of their published articles. Three authors, M.L. Bernacki, J.A. Greene, and R.D. Plumley, lead the list with three publications each, positioning them as key voices in the academic discussion surrounding digital tools and academic productivity. Their consistent engagement with this research area suggests a sustained scholarly interest in understanding how educational technologies influence teaching, learning and institutional effectiveness.

Following closely are K. Ahmad, I. Cantón-Mayo, and S. García-Martín, each with two published contributions. These authors have established a visible presence in the field, particularly through research that explores the role of digital innovation in educational environments. Their inclusion reflects both the interdisciplinary nature and the international scope of the discourse.

Additional contributors such as M. Gottlieb, K.A. Hogan, G.J. Hwang, and L. Khamlichi have also published two papers each, indicating a growing base of scholarship contributing to the technological transformation of higher education, while these authors may have slightly fewer publications, their work supports the broader development of this emerging field and provides diverse perspectives across regional and institutional contexts.

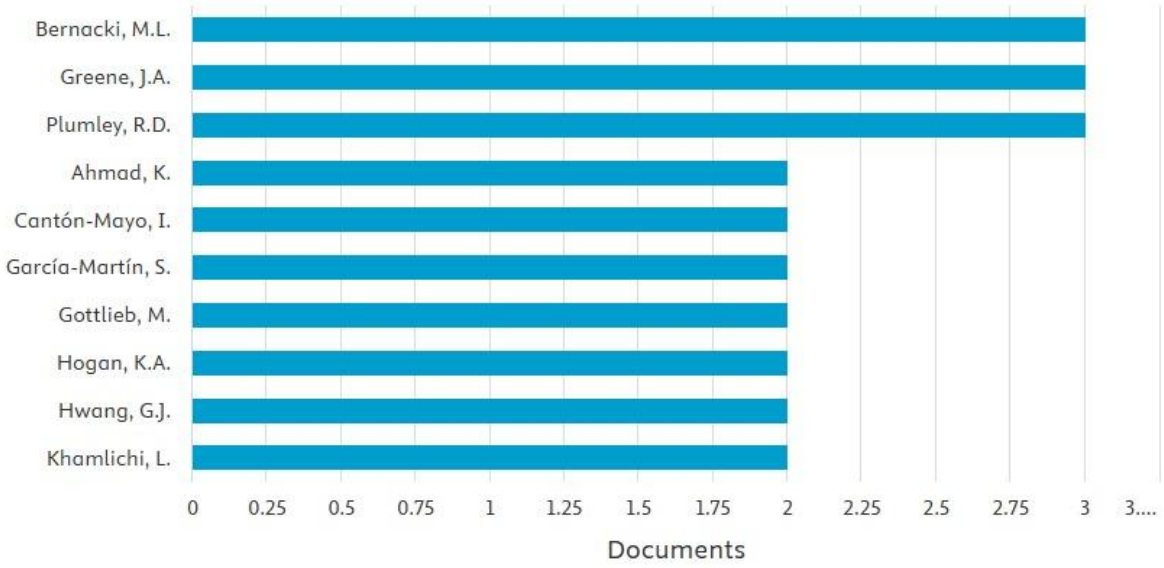


Figure III: Most Prolific Authors

Table III highlights the most influential institutions contributing to the filed of technology tools in higher education. Table II presents the number of articles published by each institution, which reflects the institutional engagement in advancing digital tools that enhance academic and educational productivity

Table II: Most Relevant Affiliations

Affiliations	Country	Articles
University of North Carolina at Chapel Hill	USA	`15
University of Oklahoma	USA	14
Boston University	USA	13
Nanjing University	China	9
School of Engineering and Sciences	Spain	9
IRCCS Istituto Nazionale Tumori Fondazione	Italy	8
Ulster University	UK	8
University of Parma	Italy	8
University of Queensland	Australia	8
Guru Nanak Dev University	India	7

As one may note from the table, University of North Carolina at Chapel Hill is at the forefront in this category with 15 papers. Following closely are University of Oklahoma and Boston University, which also rank prominently with 14 and 13 papers, respectively. These institutions are at the forefront of research in technological tools and their uses in academic productivity and are key in moving the discipline forward. Some of the universities based outside North America, like University of Queensland and Nanjing University, also figure high on the list, indicating internationalization of the research environment. Such widespread geographical distribution bears witness to the common interest and innovation regarding digital tools for higher education, demonstrating the universal relevance of the topic.

Further, the fact that institutions like IRCCS Istituto Nazionale Tumori Fondazione "G. Pascali" and School of Engineering and Sciences are represented shows the interdisciplinary nature of the research

with contributions from both academic and specialized research institutes. That the research output is focused in leading universities not only suggests their dominance in the area but also suggests that large academic huns are driving forward the use of technology in education and productivity processes. This is evidence that leadership in educational technology innovation is being championed by leading institutions globally.

Figure 1V is a global map of scientific production of articles on technology-based productivity enhancement tools in higher education by country. The map displays the relative number of articles published by intensity of color, with darker colors corresponding to higher volumes of publication. It can be observed from the map that the United States contributes the most, followed by China, the United Kingdom, and other countries in Europe. The United States leads with the highest research density, indicating its dominance in higher education research and high investment in learning technologies. China also features prominently, especially in recent years, indicating its increasing interest in developing digital learning and research technologies. The United Kingdom and Germany come next, indicating steady production in the field. India, Australia, and Italy are also significant players, and the international character of the discipline is indicated by this.

South America and most of Africa have lower numbers of publications, however, indicating where research involvement may be weaker, and where it may be enhanced by the establishment of academic networks and by improved access to research resources and technology. The map not only reveals top-performing countries in this analysis but also provides a geographic context for understanding the global landscape of productivity tools in higher education. Increasing production from countries like China and India is an indicator of the globalization of educational technology, while the continued leadership of the US and the UK shows their central role in driving innovation.

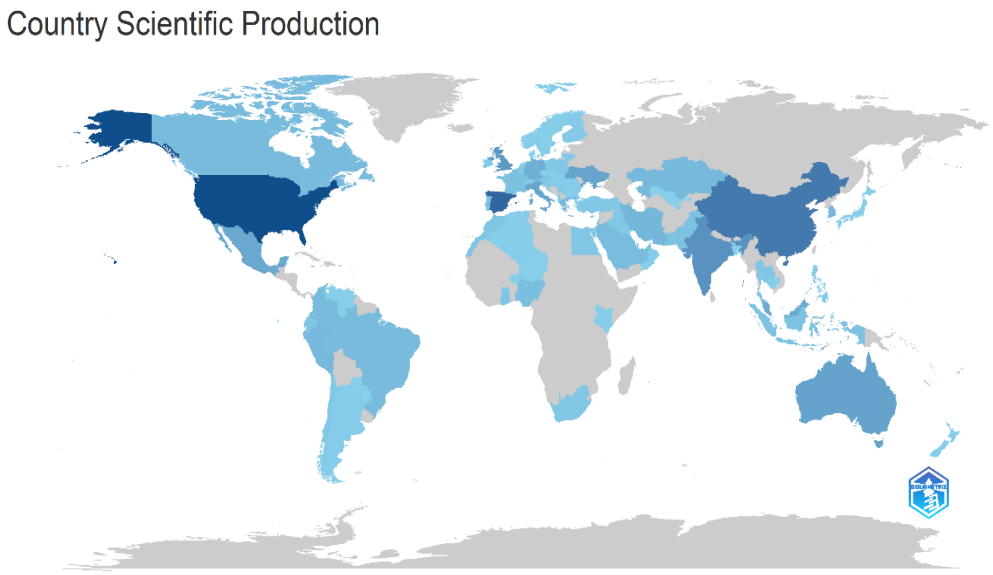


Figure IV: Country Scientific Production

4.3 Themes and research areas explored in technology-driven productivity tools for higher education

Figures V show the most common keywords in technology tools literatures in higher education. It highlights terms like learning, students, academic performance, teaching, and human as prominent themes. These keywords suggest that academic achievement and student success are the primary concern in studies of productivity tools in education. AI, e-learning, and digital technologies also appear as prominent terms, highlighting technology drivers underlying these innovations. The word cloud (figure VI) also spreads out

to include more precise terms such as academic performance, artificial intelligence, and e-learning that add more meaning to the function performed by online tools in facilitating learning and teaching processes. What is highlighted here is that the convergence of AI-based tools and e-learning platforms is at the center of the contemporary discussion, which is in tune with online learning and personalized learning movements. Collectively, these word clouds indicate that the field is strongly concerned with maximizing academic performance, optimizing learning environments, and aligning education with the age of the digital era.

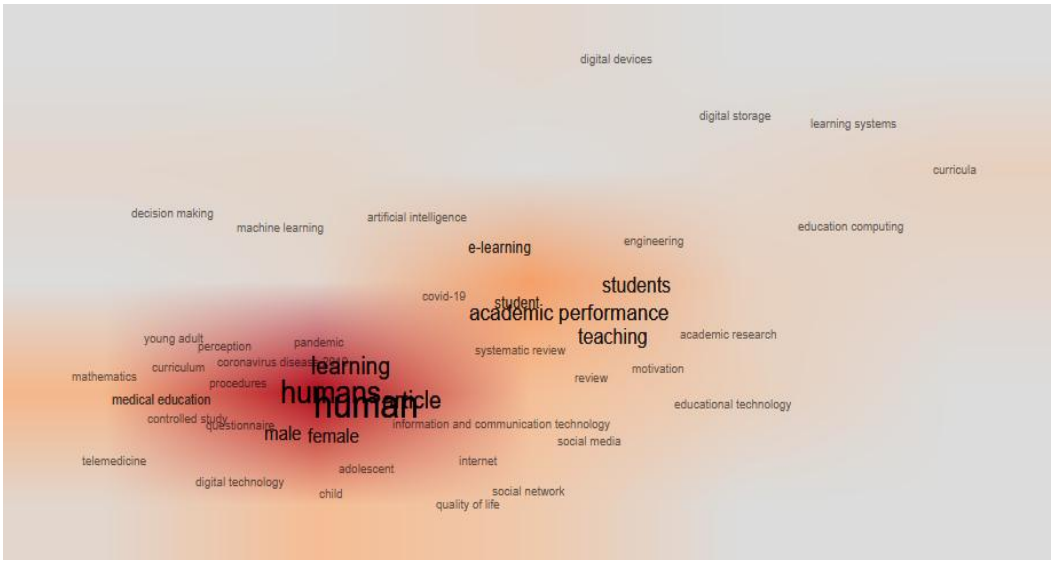


Figure V: Most Frequent Keywords

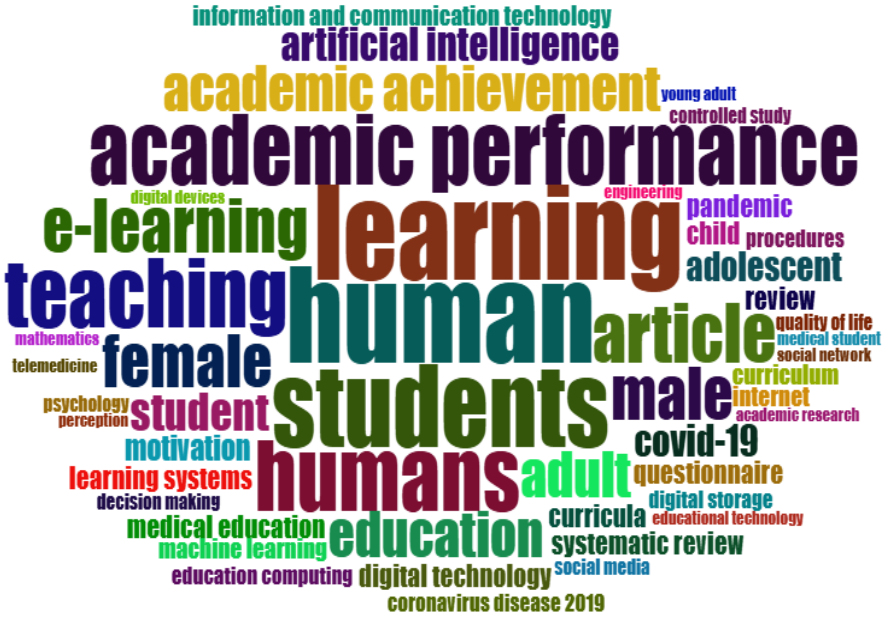


Figure VI: Word Clouds

The thematic development plot **(Figure VII)** is a more structured plot of the development and relevance of themes over time. On this plot, the "Motor Themes" like human, learning, and academic performance are located centrally, reflecting that these themes are not only well developed but also very relevant to the contemporary research agenda. These are the focal areas of research interest today and the main areas where technology-based tools are being utilized for improving academic productivity and performance.

Conversely, the "Basic Themes" such as e-learning, students, and artificial intelligence demonstrate a considerable increase in their salience and evolution, particularly in the recent years. This would suggest that even though these themes continue to evolve, they are quickly becoming the central point of the discourse in higher education technology. This is especially noticeable in the heightened interest in AI and e-learning, which have gained popularity as schools resort to using these sites to boost productivity and learning absorption. The "Emerging or Declining Themes" quadrant reflects topics like sustainable development, smart manufacturing, and industry 4.0, which, although significant in their own areas, are less directly related to the dominant themes of scholarly productivity in higher education. These themes may reflect interdisciplinary applications of digital technologies in education but are less visible in the particular domain of higher education.

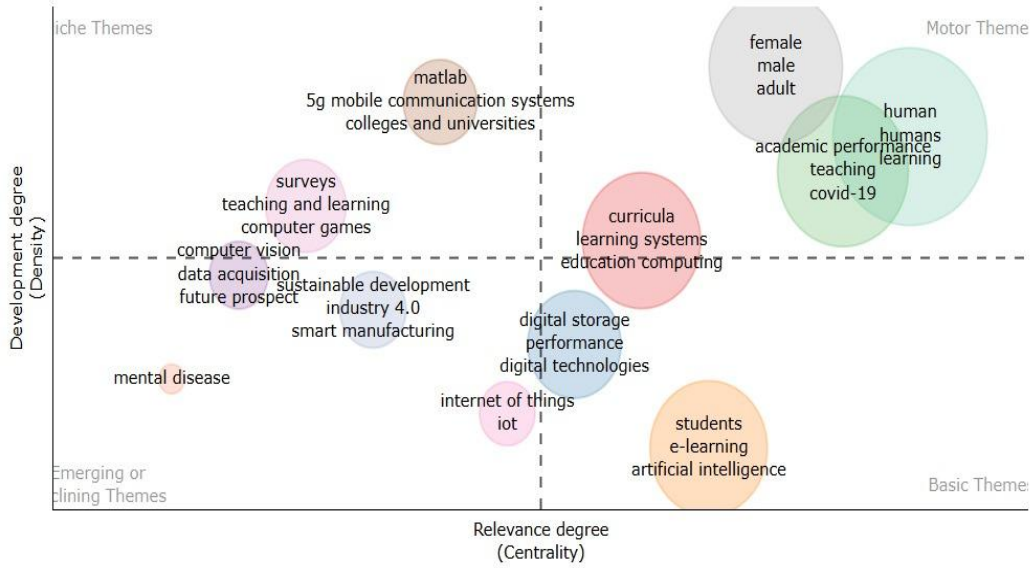


Figure VII: Thematic Network Map

4.5 Future Research Directions and Emerging Areas

4.5.1 Analysis of Recent Publications

Table III offers an illustration of recent publication over the past few years (2016–2024), demonstrating the progress of research conducted on digital tools and their adoption in higher education. The table shows the broad themes and keywords discussed in such publications, in addition to clustering them into broader research areas.

Table III: Analysis of Recent Publications

Paper	**Title**	**Authors Keywords**	**DOI**
Ukwoma SC, 2016	Digital literacy skills possessed by Students of UNN, implications for effective learning and performance: A study of the MTN universities connect library	Academic performance, digital literacy, digital literacy skills, effective learning, library, Nigeria	10.1108/NLW-08-2016-0061
Öncul G, 2020	Defining the need: Digital skills for first -year university students	Digital literacy skills, first-year students, need assessment	10.1108/JARHE-06-2020-0179
Kim Y**,** 2020	Multimodal composing and traditional essays: Linguistic performance and learner perceptions	Complexity and accuracy, English as a foreign language, multimodal composing, student perception, writing instruction	10.1177/0033688220906943
Maulana AE, 2022	Contextualizing lecturer performance indicators to online teaching and learning activities: insights for application during the COVID 19 pandemic and beyond	Contextual COVID 19, lecturer performance indicators, online learning, student satisfaction	10.34190/ejel.20.5.2644
Pusey K, 2023	Investigating the ecological validity of second language writing assessment tasks	Digital tools. Ecological validity, English for academic purposes, L2 writing assessment, self-assessment	10.1016/j.system.2023.103174

Rodafinos A, 2024	Exploring the impact of digital competence and technology acceptance on academic performance in physical education and sports science students	Academic performance, digital competence, physical education, sport science, technology acceptance	10.28945/5309
Sahni S, 2024	Understanding digital transformation challenges for online learning and teaching in higher education institutions: A review and research framework	Bibliometrics digital transformation, HEIs, online learning, teaching sustainable higher education, TCM framework	10.1108/BIJ-04-2022-0245

The table above indicates significant trends within the literature, and especially in terms of digital literacy, e-learning, and digital transformation. The digital literacy skills and their impact on academic performance remain the priority for the majority of studies, and this indicates that the way these skills are cultivated will be a key component of future research. Also, multimodal learning, online learning, and digital competence are also coming to the fore, indicating that digital learning tools are being utilized beyond conventional applications. These topics are concurrent with the greater incorporation of AI-powered learning platforms and personalized learning systems.

4.5.2 Emerging Research Areas

The recent literature review demonstrates several new lines of research within the field of technology-driven productivity tools in higher education. At its centre focus remains on digital literacy and digital skills. These remain developing fields with increased emphasis on building digital competencies among educators and students. Digital literacy has also become one of the most important predictors of academic performance and productivity, as students and academicians who have good digital competencies are more capable of working with and exploiting educational technologies. This is a trend that has been uncovered in various studies (e.g., Ukwoma SC, 2016; O'Connor C, 2020) and underlines the necessity to prepare students for the ever-more digitalized study environment.

One more highly visible new field is the usage of artificial intelligence (AI) in education. Recent literature such as Rodafios A, (2024) highlights the enhanced utilization of AI-based driven tools, which personalize learning for students by reacting to their learning tendencies and progress. These technologies not only offer tailored learning processes but also boost productivity through the streamlining of administrative tasks and the facilitation of real-time feedback. Likewise, e-learning remains another highest priority area, particularly with the rapid shift to online learning due to the COVID-19 pandemic. The ongoing evolution of learning management systems (LMS) and other online platforms offers enormous potential in shaping the future of education.

In addition to this, there is a growing body of research in the area of multimodal learning, a practice of combining conventional modes of academic writing with electronic media. This is becoming more popular, especially in the area of language learning and writing skill acquisition, as in the case of Kim Y's

(2022) research. By incorporating multimedia elements, including videos, pictures, and interactive elements, multimodal learning resources aim to advance student engagement and learning performance.

4.5.3 Future Directions

Looking ahead, the landscape of technology-driven productivity tools in the sphere of higher education will undergo changes, with several key future research directions emerging. One of the primary concerns will be the integration of AI in varied spheres of higher education. As AI tools continue to improve, further research would look at how these technologies can be further integrated into learning environments creating more adaptive and efficient learning systems. For instance, future studies could consider the use of AI to create personalized learning experiences, particularly for students who have diverse learning needs.

Another promising area for future research is the continuous development of digital tools to enhance administrative efficiency. As higher education institutions embrace digital tools transformation, there is bound to be an increasing imperative to understand how digital tools can alleviate the pressure on processes such as grading, assessment, and communication between educators and their students. This area becomes crucial for improving productivity in administrative activities and subsequently affording more time for lecturers and student interactions. Furthermore, research into the effectiveness of online learning platforms will continue to be crucial, especially in light of the ongoing expansion of hybrid learning models. While certain studies have focused on the efficacies of conventional online learning platforms, there remains a gap in understanding how hybrid models, which combine both face to face and online learning, impact student engagement, academic performance and overall productivity. As these models become more mainstream, future research will need to address these challenges and opportunities they present.

Finally, multimodal learning and its application in various academic discipline will likely remain a key area of interest. Researchers may explore how to optimize the integration of digital media into curriculum, developing new assessment, methods that account for the diversity of learning formats. This research will be essential for ensuring that multimodal learning environments are inclusive, fostering learning for students with different educational background and leaning styles.

5 CONCLUSION

The bibliometric analysis highlights the rapid growth of research in technology-driven productivity tools for higher education, particularly since 2020, reflecting a growing integration of AI and digital tools in academic settings. The central themes identified include digital literacy, AI-powered tools, and e-learning platforms, with emerging interest in multimodal learning and personalized education. Leading contributors like M.L. Bernacki and J.A. Greene continue to shape the discourse, emphasizing the importance of digital competence, both for students and for educators. The implication of these findings suggest that higher education institutions must priorities investments in AI technologies as well as digital literacy initiatives so that both students and lecturers/educators are well-equipped for the evolving digital landscape. Furthermore, research into the long-term impact of AI-driven educational tools impact learning outcomes and institutional productivity is crucial for guiding future developments in this area.

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The Impact of Sandbox Padlet on Classroom Management and Student Engagement

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ABSTRACT

Although digital tools in education have attracted a lot of interest, empirical studies on their effects, especially on student involvement and classroom management remain few. This study looks at how well Sandbox Padlet might improve classroom management, encourage student involvement, and raise secondary school learning results in North Malaysia. This study intends to close the knowledge vacuum on the pedagogical consequences of using cooperative digital platforms in the classroom by compiling quantitative insights from teachers and students. The objective of this research is to investigate the link between Sandbox Padlet use and student involvement, spotting possibilities and difficulties in its integration, and evaluating the part teacher training plays in besting its application. With data gathered from 100–150 teachers and 300–500 students using a structured questionnaire, a survey-based quantitative research design was used. The poll gauged perceived learning results, classroom management effectiveness, and degrees of participation. SPSS was used for statistical analyses including descriptive statistics, correlation and multiple regression analysis. With students showing higher motivation, involvement, and knowledge retention, the results showed a clear, strong positive correlation between Sandbox Padlet use and student engagement. Teachers also claimed that Sandbox Padlet improved lesson organization and student teamwork, so strengthening classroom control. Sandbox Padlet's effectiveness in the classroom was much influenced, according to regression analysis, by teacher training and digital literacy. Technical constraints, restricted access to digital devices, and the necessity of professional growth were nevertheless also noted, though. This paper adds empirical data on the function of Sandbox Padlet in digital learning environments, so advancing educational research. Unlike earlier studies, it stresses the junction of classroom management, student involvement, and teacher readiness, so providing useful advice for legislators and teachers to improve technology integration in education.

Keywords: *Classroom Management, Student Engagement, Digital Learning, Teacher Training, Educational Technology*

1 INTRODUCTION

Effective teaching and learning depend on classroom management and student involvement. Tools like Padlet have become well-known for their capacity to promote teamwork, creativity, and organization as technology is progressively being included in classrooms. Padlet's Sandbox tool presents special chances to improve classroom dynamics by letting open-ended exploration and experimentation. This study seeks to investigate the effects of

Sandbox Padlet on classroom management and student involvement in secondary school. Technology integration into learning environments provides fresh ways to improve classroom management and raise student involvement, so addressing common educational issues experienced by teachers and students. According to Sato et al. (2023), Sandbox Padlet offers effects on student involvement and classroom management; Padlet distinguishes among digital technologies as a flexible online platform allowing users to share knowledge by means of cooperation and interactive learning events. Padlet lets students post notes and multimedia materials supporting cooperative learning outside of traditional classroom limits (Uspayanti et al., 2022) operate like a dynamic digital canvas. Padlet modifies student communication and classroom management when teachers provide their pupils with an interactive environment for material involvement (Rivera, 2019). The dynamic effects of globalization have accelerated the development of information and communication technologies, so changing education and training and generating more expectations on teachers to equip their students for social and technological challenges (Apergi et al., 2015).

1.1 Research Objectives:

1.1.1. To examine the impact of Sandbox Padlet on classroom management and student engagement.
1.1.2. To explore how educators integrate Sandbox Padlet into their instructional practices
1.1.3. To analyze the challenges and opportunities associated with using Sandbox Padlet in the classroom
1.1.4. To investigate the potential influence of Sandbox Padlet on student learning outcomes, including motivation, participation, and knowledge retention.
1.1.5. To assess the role of professional development in supporting teachers' effective use of Sandbox Padlet and ensuring its alignment with pedagogical goals.

2 LITERATURE REVIEW

An efficient learning environment is mostly dependent on good classroom management; thus, Padlet offers many instruments to significantly contribute to this aim. Padlet provides neat and orderly surroundings for activities, group projects, and conversation, so it helps to lower disruptive behavior and keep students concentrated on the work. By helping teachers to precisely express the expectations of student behavior and participation, Padlet strengthens the sense of structure, responsibility, and accountability inside the classroom (Spiteri & Rundgren, 2018). The Padlet cooperative approach promotes student collaboration, changes education into a group effort, and allows active participation with course materials so fostering an interactive learning community.

Technology integration that is, using Padlet must be intentional and controlled inside the curriculum to transition from a sporadic tool to a required component (Ullery, 2002). Pedagogical practices, learners' learning process, and general school administration are much affected by the adaptability and flexibility of web-based learning tools like Padlet (Li et al., 2020). Computer technologies improve academic performance, access to instructional materials, communication and information distribution, and help to modernize and simplify administrative tasks. Padlet can create a more inclusive and interactive learning environment whereby every student can have the chance to succeed and engage actively in their own education by means of several learning styles and preferences. Including Padlet and other digital collaboration tools into the classroom allows one to explore new avenues towards enhanced classroom management, student involvement, and general better academic performance.

Academic success drives student involvement mostly; thus, the interactive character of Padlet can be quite important in grabbing the interest of students and involving them in active participation. The capacity of the tool to fit multimedia components including images, videos, and audio files lets one be flexible enough to fit different

learning environments and personal preferences, so enhancing the interactive and inclusive character of the learning process for every student. Padlet supports active participation and ownership of learning experience by letting students create and share their own material, so raising their degree of involvement in the learning process (Venugopal et al., 2023). Including technology and multimedia tools into the curriculum will help to increase student involvement and equip students with required skills for success in the age of the digital era (Ayas & Charles, 2024). Moreover, it has been demonstrated that student-centered pedagogical strategies backed by digital tools increase students' involvement by means of creative opportunities for information consumption and modification to new learning strategies (Vázquez, 2022). Padlet's cooperative features support peer-to-peer learning and teamwork, so strengthening the sense of shared goal and school affiliation. Group projects, shared ideas, and comments help students to grow in critical thinking, communication, and teamwork skills. Subject content presented multimodally allows one to access the subject and build cognitive structures for knowledge acquisition and understanding (Mhlongo et al., 2023). Sensibly used, technology can enhance relationships between teachers and among students, so improving the whole learning environment. Padlet's interactive and cooperative aspects could possibly change the educational scene by letting students actively participate, inspire motivation, and empower themselves to take charge of their own developmental paths (Kaewunruen, 2019). New technology acceptance not only reflects good technological integration but also a methodical approach addressing the needs and conditions of the classroom reflects efficient technological integration. teachers must choose carefully how to include Padlet into their lessons so that it enhances present teaching strategies and fits the learning goals (Tomei, 2013). From conventional, teacher-centered methods and towards more student-centered pedagogies supporting active learning and interaction, more intellectually involved teachers approach their work with more energy Methodical adjustments meant to support teachers in their integration initiatives will enable the classroom to show actual development. Teachers must change and use digital tools to enhance the learning environment since the paradigm shift towards digital learning stresses the use of technology in current education (Sharma & Sharma, 2021). Thus, efforts for teacher preparation must give the development of pedagogical content knowledge top priority so that pre-service teachers may effectively use Padlet to fit different learning environments and improve inclusive educational practices (Tuzahra et al., 2021).

Padlet's capacity to customize activities and content also fits every student's unique needs, so improving the value of education and learning (Rueda et al., 2023). It also makes it easier to compile homework and write comments, so freeing teachers to concentrate on particularly targeted student support (Taylor, 2017). By offering real-time comments and encouragement, Padlet can enable students to keep on their target and overcome challenges, so improving their academic performance. By providing a centralized platform for communication and cooperation, Padlet can guarantee that everyone agrees and simplify the data flow between parents, teachers, and children. Padlet supplies, homework, and announcements for parents and children to let teachers be open and cooperative. By means of study notes, mind maps, and other digital technologies, students can interact with learning materials so promoting self-directed research and group projects (Chen & Yang, 2021).

Since mostly academic success depends on student involvement, Padlet offers many options to boost student motivation and interest (Rice et al., 2018). Especially crucial since disengagement from education can reduce learning results and cause isolation from society, Padlet's interactive approach can grab students' attention and inspire them to actively participate in the learning process (Dimitriadou & Lanitis, 2023). Students who show disengagement from their study could lose interest and attentiveness, so reducing the value of the educational process (Dimitriadou & Lanitis, 2023). Padlet guarantees that every student could shine and actively participate in their own education by letting teachers design interesting activities fit for different learning environments and preferences.

Moreover, Padlet's cooperative character could enable students to develop a feeling of community and shared objectives by means of which they might inspire one another's learning (Zitha et al., 2023). Effective learning follows from students actively participating, interacting, and co-construction of knowledge (O-Enwerem & Chuks-Enwerem, 2022), so inspiring a feeling of common involvement, harmonic involvement, and co-construction of knowledge. Including actual, group projects and letting students turn in their work on e-folios helps teachers to create a relevant and interesting classroom so enabling students to take responsibility for their education and investigate further subjects of interest (Herring & Friery, 2007). The arrangement of instructional resources and scheduled activities, that is, the design of the curriculum—defines student success and mostly determines such learner-content engagement. Students who actively engage in the learning process and are highly involved with the materials usually remember what they learn more effectively and develop more curiosity and drive outside of the classroom. Padlet encourages active participation in debates and group activities, homework and course completion, and search of extra learning opportunities outside of the official curriculum (Cao, 2023; Lu et al., 2023). All of which are necessary for future success in both academic and professional activities, this proactive approach to education not only improves critical thinking, problem-solving, and good communication but also raises academic performance (Eden et al., 2024).

Usually inside settings connected to their employment, the great professional development gives teachers opportunity to share ideas and collaborate in their learning environments—by means of their experiences (Darling-Hammond et al., 2017). By providing opportunities for choice, teamwork, and self-expression, Padlet can enable students to take ownership for their education and get more involved in their own success (Kalantzis & Cope, 2004). Clearly, participatory strategies including planned professional development opportunities and peer tutoring programs help teachers to become more autonomous, so improving their sense of commitment and investment in reaching the educational goals of the institution. Using cooperative platforms advances the curriculum and lets teachers implement more innovative ideas (Alrajeh, 2021).

By allowing students own their education and investigate topics closely, Padlet can inspire an enthusiasm and interest outside of the classroom. Project-based learning and cooperative tools are two accepted effective strategies for immersing students, encouraging teamwork, and sharping communication and critical thinking skills (Taylor, 2017). Teachers can also apply technology to support accepted theories of engagement including defining goals inside the classroom, describing expected performance, giving instantaneous feedback, rewarding success, and measuring performance over time (Stroud, 2019). Students who engage in classroom activities usually remember what they learn (Burch et al., 2015). Good education is essentially focused on participation in learning, which generates major learning possibilities and increases capacities in all spheres of education (Ismail & Groccia, 2018). Interactive slides help students to purposefully explore materials in a playful manner, so promoting more natural drive to study (Pakpour et al., 2021). To Padlet, a dynamic digital canvas, students can add comments, images, videos, links, so fostering a cooperative environment free from the constraints of traditional classroom surroundings. Padlet gives teachers a shared space where they may interact with suppliers, so allowing them to run their courses including their students. Great adaptability offered by online teaching tools and platforms affects not only general school management but also instructional strategies and student learning experiences greatly.

Integration of technology helps to modernise and simplify administrative tasks, boost communication and information exchange, improve teaching and learning results, and provide access to instructional materials. Moreover, Padlet's flexibility in choosing tools and exercises satisfies every student's need, so enhancing the value of training and education. It also streamlines the collecting of homework and feedback delivery, so saving teachers' time to concentrate on especially tailored student assistance and direction. Padlet's real-time comments and

encouragement help students stay on target and overcome challenges, so they improve their academic performance. By providing a centralised platform for communication and cooperation, Padlet can guarantee that everyone agrees and so simplify the data flow between parents, teachers, and children. Padlet delivers announcements, homework, and supplies to parents and children so that teachers may be open and cooperative. By means of study notes, mind maps, and several digital tools, students can interact with learning materials, so promoting self-directed research and group projects.

Comprehensive academic studies on how collaborative digital platforms, such as Padlet, influence classroom management and student interaction provide a strong basis for knowledge of the benefits and possible drawbacks of including these tools into the scene of education. Research repeatedly shows that technologically driven interactive learning environments can allow major student involvement, active participation, and knowledge co-construction on their own. Students' active participation, publication of their work, and peer interactions on Padlet have shown to motivate more ownership and enthusiasm in the learning process. These services support group development in a cooperative environment, inspire students to investigate subjects extensively, share ideas and artistic creations, and help them to actively participate in their education. Better learning outcomes, more retention of course material, and the development of critical thinking, communication, and problem-solving ability to all essential 21st-century skills that have been linked, naturally, to this sense of agency and ownership. Moreover, underlined in the literature are how Padlet and related tools can support well-established theories of engagement—all of which are basic for establishing an interesting learning environment fit for student success: outlining expected performance, setting reasonable goals, providing timely feedback, and tracking development over time. One must first consider how cooperative learning approaches influence students' critical thinking and decision-making processes as well as how technology helps to improve group learning activities to understand the likely advantages of Padlet in the classroom (Ilie, 2023).

The corpus of the current work underlines the need to build a friendly and interesting online learning environment that inspires students to share ideas, engage in active debate, and cooperate to solve problems. A bigger educational effort aiming at inspiring students to participate in learning will involve the construction of active learning classrooms (Wang et al., 2022). The corpus of present research shows even more how Padlet and related collaborative tools can support accepted theories of engagement, including outlining expected performance, establishing reasonable learning objectives, providing instantaneous and useful feedback, and allowing the monitoring of students' development over time. Higher student retention as well as improved skill development in many academic and professional spheres have been repeatedly linked to fundamental 21st-century skills including critical thinking, problem-solving, and good communication. Padlet enables students to actively participate in their education by means of a fascinating and interactive learning environment. This enables them to grow as a team, exchange their artistic works and ideas, and probe closely on subjects. Results of education and the acquisition of highly sought-after critical skills benefiting the modern workforce have come from this sense of agency and ownership. The foundation of problem-based learning is four modern insights: constructive, self-directed, cooperative, and contextual (Dolmans et al., 2005). Although the possible advantages of cooperative digital platforms such as Padlet are well known, the literature emphasizes the need to remove any obstacles to guarantee effective deployment. These include concerns about fair access to technology and internet connectivity, the need of enough teacher preparation and support, and the possibility that, if not properly controlled, technology could overwhelm or divert children. Examining the digital divide and guaranteeing equal access to the required tools and internet connectivity helps one to guarantee that every student can fully participate in online cooperative projects. If teachers are to properly include Padlet and other digital tools into their courses, they must have enough instruction

and support. Clearly specifying the rules and expectations for student involvement in online cooperative projects and behavior will help to reduce distractions and support a targeted learning environment.

Moreover, under research is how well digital environments identify and fix student problems including uncertainty without continuous teacher interaction (Lodge et al., 2018). If students are to properly negotiate and assess the great wealth of knowledge at their hands, they must also create plans for assessing the quality and dependability of online content and encourage critical thinking in them (Srivastava, 2023). Student success shapes access to digital technology if digital tools are used to inspire participation in a more cooperative and exploratory classroom (Sentriyo et al., 2023). Cooperative activities have shown to greatly improve learning outcomes by inspiring active participation and helping students to acquire critical social skills including communication, critical thinking, and decision-making (Nalli et al., 2021). Moreover, creative learning technologies can support group learning by displaying more student participation (Gaad, 2022). By providing access to a great spectrum of tools, knowledge, and resources, digital technology use could help to raise educational standards. The present policies of educational institutions, including schools, have not been quickly enough changed (Shonfeld et al., 2021). Many educators find it difficult to implement new approaches since integrating technology to improve education and learning is a demanding task. Studies, however, reveal that using digital technology might increase student involvement, promote teamwork, and offer customized learning environments (Wallace et al., 2022). The underlined using digital learning tools is the need of supporting obviously active learning strategies in the classroom (Johnson, 2020). These tools provide opportunities for group projects, customized instruction, and access to a wealth of information and resources, so greatly increasing student involvement. Clearly, technology offers chances to advance knowledge and education (Bhattarai & Maharjan, 2020; Terra et al., 2020).

The research also highlights Padlet's creative ability to reinterpret classroom management strategies. Teachers would be able to boost student contact, speed administrative tasks, and customize learning experiences to every student's particular needs and preferences by using this cooperative platform. by better matching materials and activities to the several learning preferences and styles of their students, using padlet's customizing tools helps teachers to increase the general efficacy and impact of both teaching and learning. as such, the classroom becomes more fascinating and customized to support group projects, active student participation, and the development of critical thinking and problem-solving capacity of twenty-first-century abilities. Padlet's interactive components enable educators to create dynamic learning environments supporting real-time feedback, active participation, and student community growth. Technology integration into classroom management strategies eventually has the potential to produce a more efficient, student-centered, orderly learning environment that supports academic achievement and gets students ready for success in the digital age.

Furthermore**,** including computer technology would greatly improve the speed and efficiency of many operations including data management, information retrieval, and the display of instructional resources (Mwanda, 2017). Using digital technologies to save time and effort will enable teachers to concentrate on other critical components of their work, including lesson planning, student support, and professional development. By allowing the learning environment to be more flexible and responsive, this action can help students acquire lifelong learning skills and get ready for the always changing needs of the digital age (Panici, 1998). Digital solutions could also speed letters, automate administrative tasks, and provide students with quick comments—all of which would increase the general efficiency and effectiveness of classroom management plans (Shaffer et al., 2015). Good application of technology can greatly enhance general classroom performance, organisation, and communication (Angers, 2004). Volpe & Gori 2019 also names as means research, communication, manufacturing, and expression.

3 RESEARCH METHOD

3.1 Research Design

The impact of Sandbox Padlet on classroom management, student involvement, and learning outcomes is investigated in this quantitative research project based on a survey-based methodology. The study uses a descriptive and correlational approach to assess relationships between Sandbox Padlet use and several instructional elements. While correlation analysis will look at relationships between digital tool integration and important learning variables, descriptive analysis will offer insights into general trends and perceptions. This method helps the research to record the degree of Sandbox Padlet usage as well as possible impact on instruction and learning. An assessment rubric with reference to the pre-Covid experiential learning assessment principle developed by McGill University (McGill, 2020) was used. The deliverables are content-process mixture, big picture perspective, and reflection on the parameter uncertainties. For instance, the centripetal acceleration lab process in a face-to-face classroom would contain the tacit knowledge in the control of the parameters. A student would need to simultaneously control the spinning of a rubber stopper in terms of the horizontal radius and vertically hanging weight. For online delivery, a simulation of the control of the parameters could be easier because each parameter was programmed to be independent. In other words, the rules in a simulation would transform the tactile experience in face-to-face class to become explicit knowledge in remote delivery class.

3.2 Sampling

With an eye towards rural and semi-rural schools to better grasp technology integration in various educational environments, the study will centre on secondary school teachers and students in North Malaysia Fair representation from several educational environments will be guaranteed using a stratified random sampling technique. The projected sample size comprises 300 to 500 secondary school students who interact with Sandbox Padlet in their learning activities and 100 to 150 teachers who actively employ the tool in their classroom settings. A G*Power study will be done to guarantee statistical relevance and sufficient representation, for guiding the suitable sample size.

3.3 Data analysis

SPSS will be used in analysis of the data gathered. To fulfil the study goals, the analysis will incorporate inferential as well as descriptive statistics. Participant responses will be compiled and an overview of Sandbox Padlet patterns, engagement levels, and classroom management effectiveness using mean, standard deviation, and frequency analysis.

Inferential Statistics:

1. T-tests and ANOVA will be used to evaluate student involvement and classroom management impressions among several groups including gender, type of school—rural vs. semi-rural, and degrees of teaching experience.

2. By means of Pearson's Correlation Analysis, relationships between Sandbox Padlet usage, student engagement, and learning outcomes will be measured, so establishing the strength and direction of associations.

3. Using independent variables including teacher training, digital literacy, and frequency of use, Multiple Regression Analysis will be used to evaluate the predictive power of Sandbox Padlet usage on student engagement and learning outcomes.

These statistical studies will offer empirical data on the efficiency of Sandbox Padlet in classroom environments, so stressing both advantages and difficulties in including digital tools into educational practice

4 FINDING AND DISCUSSION

4.1 Result

Based on the study goals, the data of this part show Using descriptive statistics, correlation analysis, regression analysis, and comparative tests, the data was examined to find how Sandbox Padlet affected classroom management, student involvement, and learning results.

4.2 Respondent Profile

Based on table 1, 520 respondents comprise of 120 teachers and 400 students from secondary schools in North Malaysia including rural and semi-rural areas were participated in the study. This distribution guarantees that the results capture several learning environments. Of the students, 170 came from rural schools and 230 came from semi-rural ones. While 40% of teachers said they needed more training, most of them had some degree of experience with digital tools; 60% reported moderate to high familiarity with Sandbox Padlet. This information emphasizes the need to give enough tools and instruction to maximize the advantages of digital learning systems.

Table 1 Overview of respondent

Category	Total Respondents	Percentage
Teachers	120	23%
Students	400	77%
Total	520	100%

4.3 Examining the Impact of Sandbox Padlet on Classroom Management and Student Engagement

The study looked closely at how Sandbox Padlet affected student involvement as well as classroom environment. By means of thorough data analysis, researchers aimed to expose the subtle ways in which this digital tool affected the general dynamics and learning opportunities in the classroom environment. The study looked at how regularly teachers and students used the Sandbox Padlet platform and the consequent effects on classroom management and student involvement to better grasp these dynamics. According to the descriptive study, Sandbox Padlet has caused a significant majority (82%) of students to report higher degrees of classroom participation and engagement. Furthermore, a good number (74%) of teachers said the platform enabled them to better control classroom dynamics and activities (table 2)

Additional analysis of the usage patterns revealed that, with a range from once every week to daily use, teachers and students interacted with Sandbox Padlet 3.5.5 times average. Although some of the participating

teachers had as little as 2 hours of training on digital tools, the study also underlined the significance of teacher preparation since an average of 10.2 hours of training related to digital tools was reported. These results imply that, especially when teachers are given enough training and support to properly include the platform into their teaching strategies, Sandbox Padlet is quite important in raising student involvement and enhancing classroom management. The thorough study clarifies the subtle ways in which this digital tool might improve the general classroom environment and learning opportunities.

Table 2 Descriptive Statistics

Variable	Mean	SD	Min	Max
Student Engagement (1-5 scale)	4.2	0.6	2.8	5.0
Classroom Management Effectiveness (1-5 scale)	4.0	0.7	2.5	5.0
Sandbox Padlet Usage (Times per Week)	3.5	1.2	1	5
Teacher Training Hours	10.2	4.5	2	20

Table 3 Correlation Analysis

Variables	Engagement	Classroom Management	Learning Outcomes
Sandbox Padlet Usage	0.45*	0.39	0.42
Teacher Training	0.33	0.50*	0.38
Digital Literacy	0.41	0.47	0.44

($p < 0.05$, significant correlation)

Based on table 3, the correlation study strengthens these conclusions even more. Sandbox Padlet use and student engagement showed a modest positive correlation ($r = 0.45$, $p = 0.01$), meaning that students typically become more engaged when the platform is used more regularly. Teacher training and classroom management effectiveness ($r = 0.50$, $p = 0.01$) also showed a more significant relationship whereby teachers who get more training on the platform manage classrooms better. As favorable correlation values show, digital literacy also helps to increase engagement and learning results. These findings underline the need for training courses and digital literacy campaigns to guarantee that technology is properly included into classrooms. Furthermore, notable predictors of student engagement, classroom management effectiveness, and general learning outcomes were found by the correlation analysis to be Sandbox Padlet frequency of use, degree of teacher training, and degree of digital literacy.

This study emphasizes how important Sandbox Padlet is for improving classroom participation and management, especially in cases when teachers get enough tools and instruction to properly integrate the platform. By meeting their needs, digital support can greatly increase student involvement (Chiu, 2021). Advanced digital skill students can deliberately use interactive artificial intelligence tools, tailored feedback, and adaptive learning technologies to create more chances to remain involved and succeed academically (Yaseen et al., 2025). Using technology such as lesson playlists on Schoology has been demonstrated to raise student involvement and motivation, so improving their performance (Bohol & Prudente,2020).

4.4 Exploring the Integration of Sandbox Padlet into Instructional Practices

The study analyzed how teachers integrate Sandbox Padlet into their teaching and the role of teacher training.

Table 4 Regression Analysis (Predicting Student Engagement)

Predictor	B	SE	Beta	t	p
Sandbox Padlet Usage	0.32	0.08	0.40	4.15	0.001*
Teacher Training	0.12	0.05	0.24	2.50	0.014
Digital Literacy	0.19	0.07	0.29	3.12	0.002

The study also looked at how teachers include Sandbox Padlet into their lessons and the part teacher preparation plays in guaranteeing successful application (table 4). Frequent use of Sandbox Padlet greatly increases student engagement ($\beta = 0.40$, $p < 0.001$), according to the regression analysis, indicating that students are more involved when the platform is used routinely. Furthermore, supporting the need of ongoing professional development is the fact that teacher training increases engagement levels ($\beta = 0.24$, $p = 0.014$). Higher digital literate students are more likely to engage actively in classes ($\beta = 0.29$, $p = 0.002$).

The study also explored the important part teacher training plays in guaranteeing efficient use of the Sandbox Padlet and how educators include it into their lessons. The study of the regression analysis showed that regular use of Sandbox Padlet greatly increases student involvement, so proving that students become more actively involved and participatory when the platform is applied in the classroom on demand. Furthermore, underlined by the results are the importance of teacher preparation in raising engagement levels, hence stressing the need of constant professional development chances for teachers. Moreover, the study emphasizes how students who have more degrees of digital literacy are more likely to actively interact with the courses including Sandbox Padlet. These revelations emphasize the need to give teachers the required knowledge and tools to maximize the possibilities of digital learning tools such as Sandbox Padlet, so creating a more interesting and inclusive classroom for every student. Including technology into the classroom will enable interactive communication and group projects meant to increase student involvement (Subandi et al., 2018). Teachers have found generative AI tools useful for raising the quality of student work in project-based learning; training courses can help teachers properly apply these tools (Viruel et al., 2025). Achieving complete academic success depends on both critical thinking skills and practical competencies, which depend on the deliberate integration of technology into educational processes.

These results highlight the critical need of professional development and teacher preparation in allowing Sandbox Padlet to be effectively integrated to create a more interesting classroom. Teachers who underwent at least ten hours of thorough Sandbox Padlet training reported noticeably more confidence and mastery of the tool in their classroom settings. Moreover, those who attended organized seminars concentrated on techniques for easily including Sandbox Padlet to significantly increase student involvement during classes. These training courses also gave teachers insightful knowledge about the several features of the platform, which helped them to design very interactive learning environments that fit the requirements of every student.

These findings strongly support the indispensable nature of continuous, excellent training possibilities for educators. Schools and districts can enable teachers to create vibrant, interactive, and student-centered classrooms by arming them with the knowledge, skills, and practical experience to maximize the potential of digital learning tools like Sandbox Padlet. Empowering teachers to boldly and successfully integrate technology in ways that measurably increase student engagement, cooperation, and academic achievement depends on ongoing professional development investments. Those who feel well informed and competent about technology-/AI-related

subjects often show more openness to using technology/AI-driven learning tools and approaches (Mah & Gross, 2024).

4.5 Identifying Challenges and Opportunities in Using Sandbox Padlet

Table 5 ANOVA Test (Comparison by School Type)

Group	Mean Engagement Score	F	p
Rural Schools (n=200)	4.1	4.32	0.02
Semi-Rural Schools (n=200)	4.3		

Based on table 5, the results of the study exposed several main obstacles to Sandbox Padlet's general acceptance in schools. Forty-three percent of teachers said they had major technical problems and limited access to required tools, which would have hampered their capacity to properly include the platform into their classroom. Furthermore, thirty-five percent of the teachers who responded said they needed more thorough and regimented instruction to improve their mastery of Sandbox Padlet's capabilities. These difficulties imply that even if Sandbox Padlet can enhance student involvement and enhance classroom experiences, its effective application depends on resolving the fundamental infrastructure and training-related issues. By means of deliberate investments in technological resources and focused professional development initiatives for teachers, overcoming these obstacles will enable the complete transforming power of this digital learning tool and create a more interesting and inclusive classroom for every student. Dealing with the digital divide and guaranteeing fair access to technology and internet connectivity for every student is vital since differences in access might aggravate already existing achievement gaps. Furthermore, noted was a notable cultural lag in educational institutions, which became yet another major obstacle to Sandbox Padlet's flawless integration into teaching strategies (Chen, 2007).

Students in semi-rural schools reported noticeably more engagement levels ($M = 4.3$, $p = 0.02$) than those in rural schools according to a comparative analysis done using an ANOVA test. This result implies that schools with better access to digital resources and technological infrastructure are more suited to gain from the integration of tools for educational technology such as Sandbox Padlet. It is imperative to solve the current inequalities in infrastructure and guarantee fair access to digital resources across all institutions, regardless of their geographic location or socioeconomic level, so improving the efficacy of technology-based learning. Schools can build more inclusive and interesting learning environments that maximize the full potential of digital tools to support student involvement, cooperation, and academic performance by bridging these gaps. Furthermore, our research revealed a clear cultural lag in educational institutions, which became a major obstacle to the flawless integration of Sandbox Padlet into pedagogical methods.

4.6 Assessing the Role of Professional Development in Supporting Sandbox Padlet Integration

Table 6 Correlation Analysis for Professional Development and Sandbox Padlet Integration

Variables	1. Teacher Training	2. Digital Literacy	3. Classroom Management Effectiveness	4. Student Engagement
1. Teacher Training	1.00	0.58 ($p < 0.01$)	0.50 ($p < 0.01$)	0.42 ($p < 0.01$)
2. Digital Literacy	0.58 ($p < 0.01$)	1.00	0.46 ($p < 0.01$)	0.49 ($p < 0.01$)
3. Classroom Management Effectiveness	0.50 ($p < 0.01$)	0.46 ($p < 0.01$)	1.00	0.55 ($p < 0.01$)
4. Student Engagement	0.42 ($p < 0.01$)	0.49 ($p < 0.01$)	0.55 ($p < 0.01$)	1.00

The correlation study (table 6) emphasizes how important teacher preparation is to improving digital literacy, classroom control, and student involvement. Teacher training and digital literacy show a strong positive correlation ($r = 0.58$, $p < 0.01$), meaning that those who get more professional development typically have better degrees of digital competency. This implies that continuous education initiatives are crucial in arming teachers with the required skills to properly include digital tools like Sandbox Padlet into their curricula. Teacher training was also found to have a modest to strong correlation ($r = 0.50$, $p < 0.01$) with classroom management effectiveness, so indicating that teachers who engage in professional development are more adept at controlling classroom activity using digital tools. By helping teachers apply Sandbox Padlet in methodical ways, training enables more orderly and interactive learning environments. Moreover, the study revealed a modest correlation ($r = 0.42$, $p < 0.01$) between teacher preparation and student involvement, implying that well-prepared teachers produce more interesting and involved classroom settings. This highlights how crucial professional growth is to provide experience centered on the students.

The results also highlight how much better classroom management and student involvement depend on digital literacy. Digital literacy and classroom management effectiveness have a modest correlation ($r = 0.46$, $p = 0.01$), meaning that teachers with more technical knowledge will be better able to use Sandbox Padlet for teaching needs. In line with this, a modest to strong correlation ($r = 0.49$, $p = 0.01$) was found between digital literacy and student involvement, so supporting the notion that teachers competent in digital tools can create more interactive and dynamic learning activities capturing students' interest. Furthermore, in this study the strongest correlation $r = 0.55$, $p = 0.01$—between student engagement and classroom management effectiveness. This implies that students are more likely to engage actively in lessons when teachers properly run their classrooms with Sandbox Padlet. Higher degrees of motivation and teamwork among students resulting from a well-organized and orderly classroom eventually help to produce better learning results. These results highlight in general the great need of ongoing professional development initiatives emphasizing on raising teachers' digital literacy and classroom management techniques. Structured training courses should be investments made by schools to guarantee that teachers may fully use digital tools to create interesting and efficient learning environments. By giving professional development top priority, educational institutions can maximize the whole success of technology integration and guarantee that tools like Sandbox Padlet are not only embraced but also used properly to enhance teaching and learning environments.

Discussion

The results of this research offer insightful analysis of how Sandbox Padlet affects learning outcomes, student involvement, and classroom management. Still, one should consider the possible negative effects and restrictions of technology. Although the descriptive study showed that teachers and

students generally view Sandbox Padlet as a useful tool for promoting cooperation and improving engagement in the classroom, it is important to investigate the issues and difficulties that might develop from its deployment. Although most educators said Sandbox Padlet helped them better plan courses and keep student organization, some may find the platform too limiting or challenging to smoothly fit into their teaching methods. Likewise, although students said the platform helped to boost motivation and participation in learning activities, over-reliance on digital tools runs the danger of causing distractions and less in-person contact. Technical problems and unequal access also cause questions regarding the fair application of Sandbox Padlet throughout every classroom and institution. Integration of Sandbox Padlet into teaching strategies has long-term consequences that need more research to completely grasp its possibilities and constraints.

Based on the studies, it is hypothesized that using participatory strategies improves teachers' autonomy, so strengthening their commitment and investment in the goals of the university. This empowerment is especially relevant in settings experiencing major transformation since teachers' ability to actively shape the learning environment becomes critical for general success. The first focus of educational institutions should be on creating channels for teacher participation in decision-making procedures so using their knowledge to improve the relevance and efficiency of their projects (Roschelle & Penuel, 2006). Results of the study, derived from semi-structured interviews with 25 middle school teachers, highlight the alignment of PBL with their values and the favorable learning results noted in their students (Liu et al., 2020).

Further boosting these results was the inferential statistical analysis. Sandbox Padlet use and student engagement levels showed a strong positive correlation according to the Pearson correlation analysis, implying that higher behavioral, emotional, and cognitive engagement follows from more tool integration. This suggests that students that actively use and interact with Sandbox Padlet show more concentration, involvement, and investment in their learning activities. Furthermore, a strong relationship between teacher preparation on Sandbox Padlet and the efficacy of classroom management techniques was discovered, so stressing the need of professional development in optimizing technology use in education. This implies that teachers are better able to run their classrooms and create more orderly, interesting learning environments when they receive thorough instruction on using Sandbox Padlet's features and capabilities. Good training gives teachers the tools they need to easily include digital tools like Sandbox Padlet into their teaching strategies, so improving their capacity to keep student attention, promote teamwork, and support general classroom management by means of necessary skills and confidence. As Sandbox Padlet shows, the integration of technology into classroom environments can support active learning experiences whereby students identify and examine real-world challenges to develop decision-making abilities (Silva et al., 2018).

Using Sandbox Padlet greatly predicted better student engagement and learning outcomes, according to regression analysis. Nevertheless, the study also found important elements influencing the general success of Sandbox Padlet application. Two key factors that clearly show the need of enough training and infrastructure to enable the smooth integration of this digital tool are teacher digital literacy and the availability of required tools. The study also revealed important difficulties including technical constraints, limited access to digital tools, and the necessity of more comprehensive professional development to guarantee teachers could make good use of Sandbox Padlet inside their classroom environments. These results highlight the need of a multifarious approach addressing both the pedagogical

and logistical aspects to maximize the advantages for student learning and involvement by means of successful integration of educational technology.

Moreover, addressing the technological and financial constraints can help to create a more fair and efficient learning environment in which digital tools such as Sandbox Padlet can really change teaching and learning encounters (Gayyur, 2021). Digital technology can be a tool for innovation; thus, many nations have made investments in including it into different levels of education (Gayyur, 2021). Still, desired integration may not be achieved with just theoretical knowledge of digital technology in educational settings (Gayyur, 2021). As its popularity rises in adopted teaching and learning environments, the study emphasizes the need to include digital technology into physical education; yet it also notes the continuous discussion about its influence on teaching and learning (Wallace et al., 2022). The growing market for digital learning resources is driving the growing use of technologies in the classroom (Nieto-Márquez et al., 2020). While teachers, students, and teacher education are routinely ignored, businesspeople and the technology sector are using the inclusion of digital technology as a sales tactic to get access to rich markets (N Nguyen & Habók, 2023).

The results of the research presented in this paper confirm earlier studies and support the idea that, when deliberately included into educational environments, technology can act as a transforming tool enhancing learning opportunities. The study also emphasizes, though, that effective implementation calls for constant support, thorough professional development, and careful evaluation of contextual elements including infrastructure limitations and degrees of digital literacy among teachers and students. Early addressing these issues will help teachers and legislators create more strong and sophisticated plans to maximize the advantages of digital tools like Sandbox Padlet, so driving improved student engagement, deeper learning, and more efficient classroom management. This multifarious approach is essential in creating learning environments where the full possibilities of technology-enabled learning can be reached. Giving teachers' digital literacy top priority and providing means for their involvement in decision-making will help them to leverage their knowledge and improve the effectiveness of instructional projects (Hillmayr et al., 2020). Constant improvement of the integration of digital tools like Sandbox Padlet depends on ongoing research and evidence-based practices, which guarantee their efficient support of teaching and learning while minimizing possible negative effects such distractions or unequal access. Through encouraging an innovative and cooperative culture, educational institutions can leverage technology to build dynamic, interesting, inclusive learning environments ready for students for the challenges of the twenty-first century.

5 CONCLUSION

This paper offers a thorough analysis of how Sandbox Padlet affects classroom management, student involvement, and learning outcomes in North Malaysian secondary schools. The results show that Sandbox Padlet is a useful digital tool enhancing classroom interaction, encouraging cooperation, and helping instructional organizations. Positive experiences with the platform were reported by both teachers and students, so underscoring its capacity to support active learning and participation. The study found a strong positive link between student engagement levels and Sandbox Padlet frequency using descriptive and inferential statistical analyses.

Frequent users of the platform showed great degrees of behavioral, emotional, and cognitive engagement, so supporting the part that digital tools play in building interactive and student-centered learning environments. Furthermore, the correlation and regression studies showed that the efficacy of Sandbox Padlet in classroom management and learning outcomes is much influenced by teacher training and digital literacy. This emphasizes

the need for continuous professional development and institutional support to make sure teachers may effectively include digital tools into their instructional practices. The study revealed several challenges related to Sandbox Padlet implementation even if the clear advantages exist. Among these are technical obstacles, inadequate access to digital tools and the necessity of organized training courses. Maintaining seamless technology integration in schools depends on addressing these difficulties. The full possibilities of digital tools may remain underused without enough support, so restricting their efficacy in improving teaching and learning environments.

Finally, by offering empirical data on the function of Sandbox Padlet in secondary education, this study adds to the mounting corpus of studies on educational technology integration. The results emphasize the importance of well-planned digital tool implementation since effective technology adoption goes beyond simple use and calls for strategic planning, professional development, and continuous institutional support. Longitudinal studies to evaluate the long-term effects of digital tools on student performance and teacher pedagogy should be part of future studies. Furthermore, studies including qualitative insights from teachers and students could offer closer views on the actual experiences of using Sandbox Padlet in different learning environments. Schools must ultimately have a holistic approach including strong infrastructure, targeted teacher training, and pedagogically sound implementation strategies if digital technology is to transform education meaningfully. Teachers can maximize the advantages of tools such as Sandbox Padlet by doing this, so producing more interesting, effective, and student-centered learning environments that equip students for success in the digital age.

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Digital Brainstorming: A Comparative Insight into Emerging Collaborative Whiteboard Tools

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ABSTRACT

This paper presents a comparative analysis of three collaborative digital whiteboard platforms, i.e., Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox, with a focus on their integration capabilities and key features relevant to higher learning institution students. A structured desktop review of was conducted from official documentation, educational technology literature, and user feedback to evaluate the integration of each tool with learning management systems (LMS), real-time collaboration capacity, platform compatibility, user interface ease-of-use, educational features, and licensing models. The analysis finds that each platform offers real-time collaborative brainstorming functionality but differs in ecosystem integration and feature richness. Microsoft Whiteboard is tightly integrated into the Microsoft 365 and Teams environment, which supports LMS integration via Learning Tools Interoperability (LTI) and offering robust templates for classroom use. Google Jamboard, which was deprecated in late 2024, provided simple, intuitive whiteboarding within the Google Workspace ecosystem, but was limited in advanced features and eventually phased out. Padlet Sandbox has recently emerged as a powerful Jamboard alternative, combining ease of use with extensive media integration, template libraries, and educator controls, along with LMS integration via LTI and Google Classroom support. Key findings highlight that Padlet Sandbox offers the most feature-rich canvas, particularly for multimedia uploads and breakout boards, while Microsoft Whiteboard excels in institutional integration (e.g., OneNote, Teams, LMS). This work recommends selecting and deploying these tools in higher learning education environments which emphasizes the importance of LMS interoperability and feature alignment with pedagogical needs.

KEYWORDS: Digital whiteboard, collaborative brainstorming, LMS integration, learning tools

1 INTRODUCTION

The need for effective digital collaboration tools has surged in the wake of global disruptions to traditional learning environments. Digital whiteboards offer real-time interactivity, visual expression, and dynamic engagement, which are essential for modern teaching and learning strategies (Reguera et al., 2021). Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox have emerged as prominent platforms, each offering distinctive features supporting brainstorming, ideation, and collaborative knowledge construction (Martín-Blas & Serrano-Fernández, 2018).

Although all three tools are designed to facilitate collaborative learning and ideation, they exhibit notable differences in terms of interface design, accessibility, ecosystem integration, and overall user experience. Analyzing these differences helps to determine which tool aligns best with specific instructional goals or institutional infrastructures. In higher education, collaborative whiteboards support both synchronous and asynchronous activities such as concept mapping, group problem-solving, design thinking, and reflective dialogue, which enhance engagement and active learning in hybrid settings (Vo et al., 2022).

Despite a shared pedagogical purpose, the lineage of each platform shapes its strengths. Microsoft Whiteboard as a part of the Microsoft 365 suite delivers structured templates and deep integration with tools like Teams and OneNote (Microsoft, 2023). Google Jamboard provided a minimalist, intuitive canvas within Google Workspace (Google, 2024), although it has since been phased out. Padlet Sandbox is now positioning itself as a flexible, multimedia-rich alternative, offering template-driven layouts and low-barrier access across multiple platforms (Goel, 2024). Evaluating how these platforms correspond to pedagogical needs is vital for informed technology adoption in university settings.

The proliferation of digital whiteboards aligns with broader shifts toward student-centered learning. Educators increasingly utilize technologies that support co-creation of knowledge, formative feedback, and peer interaction. These are capabilities that collaborative whiteboards facilitate effectively (Nguyen & Chou, 2022). These tools are particularly effective in disciplines requiring visualization and iteration, such as engineering design or language education. As the students have diverse devices and learning environments, flexibility and accessibility are now essential features of educational technology (Vo et al., 2022).

Digital-native students today expect platforms that are not only functional but also intuitive, engaging, and adaptable. Multimedia integration, breakout group facilitation, and asynchronous collaboration are no longer optional and become vital for inclusivity and relevance. Consequently, comparing Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox from an educational perspective helps institutions refine pedagogy and prepare their digital infrastructure for future learning challenges.

This study aims to provide a comprehensive comparison of the three platforms through a structured desktop analysis, focusing on features most relevant to university-level instruction. By examining criteria such as LMS integration, real-time collaboration, accessibility, ease of use, educational feature set, and licensing models, this paper contributes practical insights for educators and institutions seeking effective digital whiteboarding solutions.

2 METHODOLOGY

This study employed a desktop analysis methodology to evaluate the three whiteboard platforms against predetermined criteria relevant to higher education use. Some criteria were identified based on common requirements in university settings, including LMS integration, real-time collaboration capacity, device or platform compatibility, interface design, educational feature set, and licensing. For each platform, data was collected from official documentation, user guides, product support pages, and relevant peer-reviewed articles or ed-tech case studies. For example, we reviewed Microsoft and Google support documentation for feature lists and integration options. We also included insights from academic technology blogs and university IT guidance to capture practical integration information (e.g., LMS plug-ins, authentication). No human subjects were involved; instead, we conducted hands-on trials where possible such as creating sample whiteboards, testing collaboration with multiple users, to qualitatively

assess real-time performance and interface simplicity. The gathered information was organized in a comparison matrix and validated by cross-referencing multiple sources for accuracy. The results are presented as a comparison table accompanied by narrative descriptions for each criterion, which highlights similarities and differences among Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox. This approach ensures a comprehensive and objective comparison grounded in documented capabilities.

3 RESULTS AND DISCUSSION

3.1 Overall Comparison

As an overall comparison, all three tools provide a shared digital canvas for real-time idea generation and brainstorming among students, but they differ in ecosystem alignment and depth of features. Table 1 summarizes the comparison across key criteria, followed by detailed discussions of each aspect.

Table 7 Comparison of Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox on Key Criteria for Higher Education Use.

Criteria	Microsoft Whiteboard	Google Jamboard	Padlet Sandbox
LMS Integration	LTI integration via Microsoft Teams (Assignments); export boards to OneNote Class Notebook	Google Classroom and Drive sharing; no native LTI (share via link/embed)	LTI 1.3 integration for Canvas/others (Padlet Backpack); direct share to Google Classroom
Real-Time Collaboration	Unlimited collaborators (no fixed technical limit); cross-organization collaboration enabled	~50 max collaborators (official) (practical stability ~20); 20 frames (pages) per board	High concurrent user support (class-sized groups); breakout links for group work
Device/Platform Compatibility	Web app, Windows 10 app, iOS app; Android app; integrated in Teams	Web app; Android/iOS mobile apps; 55″ Jamboard physical device (optional); integrates with Google Meet	Web-based on all modern browsers; iOS/Android Padlet apps (Sandbox supported); no install or login needed for student contributors
Ease of Use & Interface	Modern UI with drawing and sticky notes; templates assist with structure; requires Microsoft account sign-in.	Very simple, minimal interface (sticky notes, pens, eraser); easy for newcomers; Google account required for ownership.	Intuitive drag-and-drop “card” interface; rich tools (pens, notes, shapes, media) yet simple to use; no account needed for participants.
Educational Features	Built-in templates for brainstorming, KWL charts, project planning, etc.; ink-to-shape, math assistant, and image export; collaboration via Teams for classes	Limited features: sticky notes, freehand drawing, text boxes; no native locking of background elements (workarounds needed); integration with Google Drive for file import	Extensive features: 20+ content tools (draw, text, sticky, shapes, audio, video, GIFs, etc.); education templates (Venn, timeline, etc.); card-based pages; teacher controls.
Licensing/Cost (Education)	Included with Microsoft 365 Education (no extra	Free as part of Google Workspace (education or personal Google	Free tier: 3 padlets/sandboxes; Paid plans (Padlet Pro,

	cost for most institutions); free for individual Microsoft accounts (personal or EDU)	accounts); physical Jamboard device optional (cost ~$5,000) – now deprecated	Backpack for Schools) offer unlimited boards, LMS integrations, added security (school licenses priced per user, e.g. $99/year per teacher).

3.2 Integration with LMS

Effective integration with Learning Management Systems is crucial for embedding collaborative whiteboard activities into course workflows. Microsoft Whiteboard offers strong LMS integration primarily through Microsoft Teams. Many universities leverage Teams as an LMS or in conjunction with one. Microsoft's LTI 1.3 integration allows Whiteboard-based assignments to be created and linked within popular LMS platforms like Canvas and Blackboard. Using the Teams Assignments LTI, instructors can assign a Whiteboard activity and have grades or feedback pass back to the LMS gradebook automatically. This deep integration means a Whiteboard can be launched directly from an LMS course and students can collaborate without leaving the LMS environment. Additionally, Microsoft Whiteboard content can be exported to OneNote Class Notebooks, which is beneficial for instructors who want to save or distribute the whiteboard output to a class notebook or archive.

Google Jamboard did not provide a dedicated LTI tool for external LMSs but it integrated seamlessly with Google's own educational ecosystem. In Google Classroom, a common LMS alternative in many schools, teachers could attach Jamboard files to class materials or assignments, allowing students to open and edit the Jam within Google Classroom with a single click. Jamboard also stored boards in Google Drive so sharing via Drive or embedding a shareable link in other LMS platforms was the typical integration method. For instance, instructors using Canvas or Moodle could generate a shareable Jamboard link with edit permissions and embed it as an external URL or assignment, a process described by educational guides. While this is not as seamless as a native app integration, it enabled basic interoperability. It should be noted that Google Jamboard's tight integration with Google Meet one-click launch of a Jamboard during a video call was an advantage for live online classes though this was more a video-conferencing integration than an LMS feature. With Jamboard's end of life announced as of December 2024 all Jamboard apps went read-only and full shutdown by January 2025, Google has instead encouraged the use of third-party whiteboard tools that integrate with Google like FigJam, Lucidspark, Miro. This phase-out means future LMS integration for Jamboard specifically is moot but the comparison remains relevant historically and for understanding Jamboard's influence on newer tools.

Padlet Sandbox as part of the Padlet platform offers robust integration options for educational institutions. Padlet provides an LTI 1.3 compliant app often under the Padlet Backpack for Schools subscription that can be installed in LMSs like Canvas. Through these integration teachers can embed Padlet boards or sandboxes directly into LMS assignments or pages and even enable grade pass back if using Padlet as an assignment submission. For example, an instructor can create a Canvas assignment that links to a Padlet Sandbox. When students contribute to it the instructor can assess their work and push a grade to Canvas automatically. This integration also provisions user accounts and groups automatically through LTI simplifying student access with no separate Padlet login needed when launched via LMS. Beyond LTI Padlet has direct integration with Google Classroom. Teachers can share a Padlet including Sandbox boards to a Classroom stream or assignment with one click. Padlet's integration strengths lie in its flexibility. It can be embedded via iframe or link in virtually any LMS and dedicated plugins exist for popular systems. The only caveat is that full LTI integration with roster sync and gradebook requires a paid Padlet Backpack license an institutional plan whereas teachers using the free or individual Pro plan may be limited to manual sharing and embedding. Nevertheless, even without a formal LMS plugin Padlet Sandbox can be used by simply posting the board link in the LMS. Students can access as guests and collaborate instantly since Padlet does not force account creation for contributors. They can post under generic or provided names. This low barrier to entry is a significant advantage in classroom settings where instructors want to quickly spin up an activity.

In summary, Microsoft Whiteboard is ideal for campuses already in the Microsoft 365 ecosystem offering enterprise-grade LMS integration and alignment with tools like Teams and OneNote. Padlet Sandbox stands out for multi-LMS compatibility via LTI and ease of sharing in both LMS and non-LMS contexts like direct links or Google Classroom. Google Jamboard while active was well integrated in Google's environment but required workaround methods to embed in other LMSs. Its phase-out has opened the door for alternatives like Padlet Sandbox which explicitly markets itself as a Jamboard replacement.

3.3 Real Time Collaboration

All three platforms are designed for synchronous collaboration, allowing multiple students to work on a whiteboard simultaneously and see each other's inputs in real time. The capacity and performance of this collaboration, however, differ among the tools.

Microsoft Whiteboard supports real-time co-authoring with virtually no fixed upper limit on participants. Microsoft does not specify a hard cap on the number of collaborators on a Whiteboard. In practice, the platform can handle large groups, constrained mainly by network performance and device capabilities. Microsoft documentation indicates no technical limitation on collaborators in a Whiteboard session. This suggests that classes of 50 plus could theoretically collaborate on the same board. Indeed, as part of Teams meetings, Whiteboard can be accessed by up to 250 meeting participants standard Teams meeting limit or even in view-only mode for webinars with many more attendees, though beyond a certain point the interaction becomes chaotic. For typical class sizes 20 to 100, Microsoft Whiteboard's collaboration is smooth. A 2020 update that shifted Whiteboard storage to OneDrive for Business has also enabled external collaboration. Students or guests from outside the organization other domains can be allowed to edit boards if invited, which was previously a limitation in some school environments. This cross-organization or guest collaboration feature is important in higher education, where participants might include guest speakers or students using personal accounts. The real-time ink and object synchronization in Whiteboard is generally responsive, and it provides visual cues such as coloured cursor initials to indicate where others are working, facilitating live group work.

Google Jamboard also enables live multi-user editing but was known to have more practical limits. Officially, Google stated that up to 50 collaborators could edit a Jamboard file at once. However, many educators reported that performance degraded or users experienced glitches if approaching that upper bound, with a recommended stable limit closer to 20 collaborators for smooth interaction. For most seminar-sized classes or small group activities, 20 was sufficient, but for large lectures such as 100 students, instructors often had to devise workarounds. One such strategy was to create multiple Jamboard copies each identical in setup and split the class into smaller groups, then later compile their input, a cumbersome process documented by practitioners. Another inherent Jamboard limit was the number of frames akin to slides or pages in a board. Each Jamboard file could have at most 20 frames. This meant activities requiring more pages needed multiple Jam files. On the positive side, Jamboard's real-time sync was quick and intuitive. Sticky notes or drawings placed by one student would pop up almost instantly on others' screens. During the pandemic, educators found Jamboard effective for whole-class brainstorming, albeit with the above constraints. Given Jamboard's discontinuation, its collaboration model lightweight and simple is something that users hope to replicate in alternative tools.

Padlet Sandbox is built on Padlet's cloud infrastructure, which historically handles large numbers of users viewing and adding posts to a board. A Sandbox board, which functions like an interactive canvas with possibly multiple cards or pages, can be shared via a link, and any number of students with the link can join and contribute in real time. Padlet has not published a specific max contributor count. Reports indicate it can handle at least class-scale 30 to 60 users without issue. Unlike Jamboard, Padlet Sandbox uses a card-based model separate pages within one sandbox instead of a single infinite canvas. Each card can be thought of as a frame or sub-board. Padlet introduced an innovative feature called breakout links, which greatly benefits group collaboration in large classes. An instructor can generate multiple unique links from a Sandbox. Each link directs to a copy or partition of the sandbox for a specific group. Students working with one breakout link only see their group's work, not others', during the activity. At the end, the teacher can reveal or have everyone look at all the cards to debrief. This simulates breakout rooms in a live

class and is a pedagogical enhancement beyond what Whiteboard or Jamboard natively offered. Real-time syncing in Padlet Sandbox includes not just basic ink and notes, but also more complex objects such as images and audio playback, and the platform handles these with surprisingly low latency. Concurrency management, like avoiding edit conflicts, is partly handled by Padlet's design. For instance, each sticky note or text box is an object that can be individually moved or edited without locking the whole page. Educator experiences so far suggest it remains responsive even with dozens of simultaneous editors, though extremely large crowds over 100 might see some lag. Padlet also has a Safety Net filter for content, which automatically blocks inappropriate images or videos that someone might try to add, useful in open collaboration with students.

In terms of overall real-time experience, all three tools allow instant visual feedback and co-creation. Jamboard was praised for magical simplicity in synchronous use if not pushed beyond its limits. Whiteboard offers enterprise-grade, scalable collaboration especially suited for institutions with existing Microsoft accounts for all users, every participant's identity is known and can be tracked, which can be a plus for moderation. Padlet Sandbox combines ease of access, anonymous or quick link access, with unique group collaboration features, breakouts, that set it apart. From a higher education perspective, if an instructor's class size is very large or includes outside participants, Microsoft Whiteboard's no-hard-limit approach and controlled access might be preferable. For typical class sizes and simpler needs, any of the tools would suffice, but Padlet's approach scales elegantly via breakout boards without losing real-time interactivity.

3.4 Device and Platform Compatibility

In a university setting, students and instructors may access collaborative tools on various devices both in classrooms and remotely. Compatibility across platforms is therefore a key consideration.

Microsoft Whiteboard is available on a broad range of platforms, though with some distinctions between versions. It has a native Windows 10 app that offers full functionality and inking support, optimized for Surface devices and PCs with stylus. This desktop app provides the richest feature set and offline support for inking. Microsoft also provides a Whiteboard app for iOS and as of 2022, a Whiteboard Android app has been released. Initially, Whiteboard functionality on Android was only via the Teams app or web, but now a standalone app is available. Additionally, Whiteboard is accessible via web browser. Users can go to the Office 365 online portal or whiteboard.microsoft.com and use the web version without installing software. The web version is convenient for Mac and Linux users who do not have a native app, since Microsoft has not made a desktop app for Mac. According to university IT guidance, the web version is considered a lite version; some advanced features like certain templates or ink effects might not yet be available there. However, Microsoft has been actively updating the web app to close those gaps.

One of Microsoft Whiteboard's major compatibility advantages is integration into Microsoft Teams meetings and channels. In a Teams meeting, which students can join from any device including mobile, there is a one-click option to open a shared Whiteboard that everyone can draw on. This integration works seamlessly on all Teams-supported devices. For example, a student on an Android phone in a Teams call can ink on the Whiteboard, though on a small screen. Whiteboard is also built into Surface Hub, Microsoft's large interactive whiteboard display, which some universities have in classrooms. Instructors can walk up to a Surface Hub and use the Whiteboard app with pen input on a big screen, then save the board to the cloud. In terms of input, Microsoft Whiteboard supports pen, touch, and keyboard or mouse input equally. The inking experience is especially optimized for tablets and 2-in-1 laptops. It can recognize handwriting and shapes, which is valuable when using a stylus.

Google Jamboard similarly offered multi-platform support. It had a web application accessible through browsers at jamboard.google.com, which was often used on laptops or desktops. For mobile users, Google provided Jamboard apps for Android and iOS that were touch-optimized. These mobile apps enabled drawing with a finger or stylus and adding content on the go. Jamboard's unique hardware component was the Jamboard 55-inch 4K touch display that Google sold to institutions. This device ran the Jamboard app and came with passive styli and an eraser, offering a real whiteboard-like experience in classrooms or meeting rooms. Universities that invested in a Jamboard device could have in-person

participants drawing on the board while remote participants collaborated via the app, all syncing through the cloud. However, the hardware was expensive and not widespread in higher education, often more popular in K-12 and corporate settings. With Jamboard's software now wound down, the device is at end of life as well. Jamboard's integration with Google Meet was a plus. If a Meet call is started, a Jamboard session could be launched in which all participants on any device could join within the call interface. This worked on desktop or mobile, effectively similar to how Teams integrates Whiteboard.

In terms of cross-platform use, Jamboard required an internet connection and modern browser. It worked best in Chrome, being a Google product, but generally functioned in other browsers too. Students using Chromebooks, iPads, or smartphones all had means to participate. One limitation was that Jamboard was tied to Google accounts. On a shared device or computer, one had to log in with a Google account to create or save a Jam. Viewing and editing via shareable link did allow guests without login, if permissions were set to anyone with link can edit, but the experience was optimized for logged-in Google users.

Padlet Sandbox is entirely web-based and device-agnostic. Any device with a web browser can access a Padlet board or sandbox via the link. The responsive design means an iPad or Android tablet sees a touch-friendly interface, and students on phones can scroll and participate, though small screen real estate can be a bit challenging for detailed whiteboard work. Padlet also offers official mobile apps on iOS and Android, which as of 2025 include the Sandbox functionality. These apps provide a slightly more native experience with full screen, notifications, and easier media access from the device, but are essentially wrappers around Padlet's service. In classroom settings, a common scenario is an instructor displays the Sandbox on a classroom projector via a browser while students contribute from their own devices. Because Padlet is cloud-hosted, all users see updates in real time regardless of device. Notably, Padlet does not require any software installation. This is advantageous in institutions where students might not have admin rights to install apps on lab computers or where IT wants to minimize software maintenance. It also does not require a user to create an account just to contribute. They can be a guest. This means compatibility extends to situations like a guest speaker opens the Padlet link on their phone's browser and can add a sticky note or drawing without any setup.

One thing to consider is offline or low-connectivity use. None of these tools are truly offline-capable for collaboration. They all need internet to sync boards. Microsoft Whiteboard's Windows app does allow working on a board offline and it will sync later, but collaborative use demands connectivity. In terms of bandwidth, these whiteboard tools are relatively lightweight, mostly vector drawings and small images, except Padlet which can handle heavy media. For students on cellular networks or older devices, the simpler interfaces of Jamboard or Whiteboard might run a bit more smoothly than a media-rich Padlet board. However, in general all three are optimized for real-time performance with minimal data usage.

In summary, Microsoft Whiteboard covers the most bases with dedicated apps on Windows, iOS, Surface Hub, and web, deeply integrated in Teams. Google Jamboard supported web, mobile apps, and unique hardware, fitting naturally in Google-centric schools. Padlet Sandbox leverages Padlet's universal web availability and mobile apps to be accessible virtually anywhere, with the advantage of not forcing app installs or logins for participants. All are suitable for bring their own device environments common in universities, but the choice may depend on whether an institution is aligned with Microsoft, Google, or prefers a neutral third-party tool.

3.5 Ease of Use and Interface Design

A critical factor for classroom adoption is how easy and intuitive each tool is for both instructors and students. An ideal collaborative whiteboard should have a low learning curve so class time is not wasted from teaching the tool yet provide enough functionality for meaningful activities. The interfaces of Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox reflect different philosophies and evolutions of design.

Google Jamboard was often praised for its simplicity and clean interface. In fact, Jamboard's minimalism was a deliberate choice as it replicates a basic whiteboard with a few essential tools. The toolbar in Jamboard included a pen with a few colours and marker styles, an eraser, a selection tool, a sticky note tool, an image insert, shapes, and a text box. The canvas itself was uncluttered, users could drag items,

resize or rotate them, and that is about it. Educators noted that Jamboard excels in simplicity and ease of use for quick brainstorming or sketching as it does not overwhelm with features, so even less tech-savvy users felt comfortable immediately. The interface was essentially the same on web and mobile, with adjustments for touch. One downside of that simplicity was lack of advanced controls, for example, Jamboard did not allow locking an object in place so students could accidentally move or delete the background image or someone else's notes, and there was no undo redo for individual users, only a global undo if last change was to be made. Additionally, organizing content could get messy since everything was free-floating on an infinite canvas and there were limited formatting options. Despite these limitations, many teachers favoured Jamboard for activities like quick brainstorming, because the barrier to entry was almost zero, sending a Jamboard link will make students immediately see a blank board and a sticky note tool, and they know what to do. This just works ease of use contributed to Jamboard's popularity during the shift to online learning. It felt approachable and non-threatening, even to young students or non-technical faculty.

Padlet Sandbox in contrast packs a lot more functionality, but the designers have tried to keep the interface user-friendly by organizing content into cards and pages. A Sandbox initially looks like a blank canvas, but unlike Jamboard's potentially infinite scroll in all directions, Padlet Sandbox constrains content within individual card windows or frames which can be navigated like slides. Each card has an inner canvas where users can add elements. The interface provides a toolbar with over 20 simple tool icons for different content types. For example, there are buttons for drawing freehand pen, typing text, adding a sticky note, inserting images or GIFs, recording audio, embedding a video, etc. Despite this breadth, each tool is straightforward, clicking the sticky note tool for instance pops up a note for users to type and post similar to Jamboard's note but with more colour choices and formatting. Padlet's design philosophy is reflected in a user review summary, users highlight Padlet's superior ease of use with a score of 9.6 vs Jamboard's 8.9 meaning that even with more features, Padlet remains very accessible. This is likely because Padlet's interface has been honed for years as Padlet walls have been used widely and educators often remark how intuitive it is for students to double-click and post content. Sandbox builds on that by adding whiteboard-like drawing capabilities. The presence of templates for example lined paper backgrounds, graph paper, Venn diagram layouts gives instructors a head start in structuring activities without much fuss. Another aspect aiding ease of use is that participants do not need an account, the teacher can share a link, and students can join instantly and identify themselves by writing their name on their posts or using the guest naming feature. This avoids the common friction of signing up or logging in, which can derail an activity start. On the flip side, Padlet's interface could potentially overwhelm someone expecting a Jamboard level simplicity, however, the tools are optional, one can choose to just use a couple of them. Padlet also provides a help button and tooltips to guide new users. A notable interface feature for educators is the ability to moderate or control contributions, Padlet allows the board owner to remove or edit any post and with Sandbox to set certain cards as read-only or give students write permission without edit rights on others' content. This level of control while adding complexity for the teacher can maintain order in a busy collaborative space, something Jamboard lacked as all editors were equal which sometimes led to accidental content deletion or vandalism if a student misbehaved.

Microsoft Whiteboard has an interface that has evolved to balance simplicity with functionality. It started as a very minimal app but has grown to include features like insertable templates, shapes, and reactions. Upon opening a new Whiteboard, users see a toolbar typically on the left in the Windows app or web with basic tools select, pen, eraser, sticky note, text box, image insert, and a menu for additional content like templates or documents. The overall design is clean with a lot of whitespaces and a focus on ink. Compared to Jamboard, Whiteboard can change pen colour and thickness freely, there is a highlighter, and there is an undo button for each user, but it still keeps the primary canvas fairly uncluttered. One appreciated feature in Microsoft Whiteboard is the template gallery, accessible through a plus or templates icon, it provides ready-made structures like brainstorming grids, KWL charts, project planning Kanban boards that can be dropped onto the board. This is very useful for educators who want a bit of guidance on the board without drawing it out manually. Whiteboard also supports locking images or background via the format background and locking feature recently added meaning an instructor can set up a worksheet or diagram as

the backdrop and students can annotate without moving it, solving a pain point that Jamboard had. In terms of learning curve, if students are familiar with other Microsoft apps like OneNote or PowerPoint's drawing tools, Whiteboard feels familiar. It is considered easy to use, though some faculty noted that requiring a Microsoft login for every participant was a hurdle for initial use in class, once that is done as often institutions handle accounts the UI itself is straightforward. Whiteboard also now includes fun elements like reaction stickers such as thumbs up or smiley stamps which can be used for quick feedback on ideas, this can increase engagement in an intuitive way. According to user feedback aggregated on software review sites, Microsoft Whiteboard gets high marks for collaboration but slightly lower on ease of setup likely due to account authentication complexity. For example, a G2 review noted that Padlet's ease of use was superior to Whiteboard in their experience likely because Padlet is entirely web-based and sign-on optional whereas Whiteboard might involve navigating Office 365. However, once in the app, Whiteboard's tools inking, notes, etc. are quite intuitive.

In summary, Google Jamboard provided the simplest most stripped-down interface great for quick start but limited in control and features. Padlet Sandbox introduces far more capabilities but manages to remain user-friendly by organizing the interface and not requiring logins yielding high ease of use scores from educators. Microsoft Whiteboard strikes a middle ground with more features than Jamboard and thus a slightly higher learning curve but with a logical UI design and templates that help users get started. For higher education where student comfort and time efficiency are important, each tool can work, Jamboard while it existed was ideal for those who value sheer simplicity, Whiteboard fits those in Microsoft ecosystems who want some structure and who have accounts sorted out, and Padlet Sandbox appeals to those who want richer media and facilitation features without sacrificing too much simplicity.

3.6 Educational Feature

Beyond basic whiteboarding, the value of these tools in higher education also lies in features that enrich learning activities, such as templates for specific pedagogical strategies, support for multimedia content, images, videos, and any unique features that cater to educational use, quizzes, voting if applicable.

Microsoft Whiteboard has increasingly tailored its feature set to both business and education contexts. For education, a standout feature is its library of templates, which includes categories like Brainstorming, Problem Solving, Strategy, Project Planning, and Learning. Under Learning, for instance, there are templates for things like KWL charts, lesson reflections, and compare contrast organizers. These can save teachers time and provide a structured activity on the board that students can fill in collaboratively. Microsoft Whiteboard also integrates some of the company's Learning Accelerator tools. For example, in an LMS integration scenario, one could embed a Whiteboard as an assignment for math problem solving or diagram drawing and pair it with other tools. Though Whiteboard itself does not autograde anything, it is more for the student working space. In terms of multimedia, Whiteboard allows insertion of images. There is no direct video embedding or audio recording in Whiteboard as of 2025 as it is mostly visual content. However, one can ink or draw over images, for example annotate a diagram or label a map. Whiteboard's drawing tools include ink to shape and ink to table conversion. If a circle or square was righly drawn, Whiteboard can neaten it into a perfect shape, which is handy for creating diagrams or mind maps on the fly. It also has a virtual ruler tool for drawing straight lines at specific angles, helpful in graphing or geometry lessons. Another feature useful in education is the collaborative text lists and sticky notes. Students can collectively brainstorm on notes and then the instructor can group or colour code them, though it lacks advanced mind mapping features that specialized tools have. Microsoft has also implemented immersive reader support in Whiteboard sticky notes, a plus for accessibility, as it can read aloud text on notes for students who need that support. Given Microsoft Whiteboard is part of 365, it benefits from integration with other apps. For example, a teacher can export a Whiteboard to a OneNote page or PDF to distribute after class so students can review what was done on the board. This archival of boards is useful for educational continuity.

Google Jamboard was relatively sparse in educational specific features. It did not offer built in templates aside from providing a blank canvas. Many educators created their own Jamboard templates, for example by designing a graphic organizer in Google Slides or Drawings then importing that as the

background image on a Jamboard frame. Jamboard's strengths for multimedia were moderate. Users could use the built in Google Image Search to find and insert images quickly with SafeSearch filter, which is good for K12 use. Images can also be inserted from Google Drive, which meant anything from screenshots to PDFs converted to images could be shown. There was no direct audio or video embedding on a Jamboard. One could paste a YouTube link on a sticky note but it would not preview or play. Another feature was the drawing tools. Apart from freehand, Jamboard included a few fun pen modes like a brush pen and a marker as well as a laser pointer mode where the cursor temporarily leaves a red trail to direct attention. The laser pointer is useful for teachers explaining something on the board without actually marking the board. Jamboard supported multimedia background. A custom background can be set for each frame, solid color, dot grid, lined paper or any image. Teachers exploited this by putting instructions or templates as the background so students could not easily move them, though they could erase them by resetting background which was a minor issue if not careful. Being a Google product, Jamboard also emphasized collaboration simplicity over bells and whistles. There was no quiz or polling features unlike some advanced whiteboard tools like Miro or Mentimeter integration. However, teachers sometimes combined Jamboard with Google Forms or other apps for those functions if needed. One impending loss with Jamboard's shutdown is the existing library of Jamboard activities many educators shared. For example, libraries of Jamboard templates for math, music that are now being converted for alternative platforms. Google's own recommended replacements like FigJam or Lucidspark have much richer feature sets but also more complexity, which is why Padlet Sandbox is being touted as a simpler education friendly alternative.

Padlet Sandbox is arguably the most feature rich of the three for educational content. It inherits all the capabilities of Padlet, which itself has been used for years as a bulletin board and multimedia discussion tool, and adds real time drawing and canvas tools akin to Jamboard. In Sandbox, users can insert almost any type of media, images, videos either by uploading or linking from YouTube, Padlet will embed a playable video, audio recordings, there is a built in microphone recorder to post voice notes, screen recordings, drawings, attachments, PDFs or other files, and even use an AI image generator to create pictures from text prompts. This breadth means an instructor could have students doing something like recording short audio explanations and pinning them to the board alongside written notes, enabling multimodal expression which is great for Universal Design for Learning principles. Padlet also supports linking between cards in Sandbox. A shape or text can be hyperlinked to jump to another card or page. This enables nonlinear navigation. For instance, users can choose their own path activities or an interactive syllabus where clicking a topic takes students to a sub board of that topic. Such features are quite advanced and more akin to interactive presentation tools. For educational scaffolding, Padlet Sandbox provides a gallery of education-oriented templates accessible when creating a new sandbox or changing background. Examples include templates for a Column layout good for KWL or categorization tasks, Grid layouts, Venn Diagram backgrounds, Calendars, Mind maps. Teachers can start from these and modify content, saving time in designing an activity from scratch. Another notable feature is teacher controls for moderation. Padlet allows the teacher to require approval for posts, not usually used in live brainstorms but maybe for asynchronous activities to screen content, and as mentioned, has a profanity filter and inappropriate image detection Safety Net to automatically guard against off task or offensive content. Padlet Sandbox also has reaction options like up-vote, like, star ratings on posts which an instructor might use for quick polls or feedback on ideas, turning the board into a lightweight polling tool as well. For example, after a brainstorming, students can like the top ideas posted on the sandbox as a way to prioritize, similar to using the like or upvote feature on a regular Padlet board as a live polling proxy. All these features, while powerful, are integrated in a way that a teacher can choose to enable or ignore them as needed so Sandbox can be used simply or elaborately.

One more educational consideration is assessment and feedback. Microsoft Whiteboard and Google Jamboard themselves do not have grading features but if integrated in LMS, Whiteboard via Teams LTI, Jamboard via Google Classroom assignment, they rely on the teacher reviewing the board and manually grading. Padlet through its LTI integration offered an optional grade entry. A teacher could open a submitted Padlet and enter a score that passes to the LMS though the platform does not automatically grade

anything since it is typically creative work. This is a minor point but it does streamline using a Padlet as an assignment compared to having to grade outside the system.

In summary, Padlet Sandbox provides the richest educational feature set. It can serve as a canvas for virtually any kind of media and interactive activity, effectively combining whiteboard functions with the flexibility of a multimedia discussion board. Microsoft Whiteboard offers a solid range of features focused on inking and structured templates, which align well with classroom use for brainstorming, diagramming, or problem solving sessions especially within the Office 365 toolset. Google Jamboard, while extremely easy to use, had the fewest built in features and relied on the creativity of instructors to adapt it to various pedagogical needs, which many did successfully, for example by manually creating backgrounds for different activities. As educational technology evolves, the trend is toward more versatile tools like Sandbox, which try to address Jamboard's gaps while preserving ease of use.

3.7 Licensing and Cost for Educational Use

Understanding the cost and licensing of these tools is important for universities when deciding on adoption, especially if enterprise integrations or wide student use is expected.

Microsoft Whiteboard is essentially a free tool for those with Microsoft accounts. For education, most universities already have Microsoft 365 Education licensing such as Office 365 A3 A5 or the free A1 licenses that include access to Whiteboard as part of the suite. As the University of Utah's IT guidance notes (University of Utah IT, 2021), Microsoft Whiteboard is included in the campus agreement and integrated with Teams with no cost to current students, staff, and faculty. In other words, if an institution uses Microsoft's services, Whiteboard comes at no additional cost. Even outside institutional licensing, anyone can sign up for a free personal Microsoft account or use an existing one and use Whiteboard on the web or the downloadable app without charge. There are no premium tiers for Whiteboard, all features are available to all users. One subtle aspect is that Whiteboard storage and sharing capabilities can depend on the account type, for example, early on, only enterprise or education accounts could share boards collaboratively, but Microsoft opened this up such that even personal accounts can invite others who also have Microsoft accounts to collaborate. For truly anonymous access, Microsoft Whiteboard is not designed to allow editing without logging in which is a conscious trade-off for security and attribution. From a cost perspective, however, a university can deploy Microsoft Whiteboard broadly at essentially no extra licensing fees beyond their Office 365 subscription and many have those subscriptions in place. The only potential costs might be hardware like Surface Hubs or tablets for inking if they choose to invest in those, but the software itself is free. Microsoft also continuously updates Whiteboard for all users as part of the cloud service, so there is no paid pro version to worry about.

Google Jamboard's software was likewise free for Google Workspace users. Google Workspace for Education, formerly G Suite for Education is free for schools in its fundamental tier, and Jamboard was included in all editions. Even consumers with a free Gmail account had access to Jamboard files via the web or mobile apps. Google never charged for the Jamboard app usage. The cost associated with Jamboard was if one opted to buy the Jamboard physical device, which cost on the order of 4000 to 5000 plus an annual support fee around 600 per year for the device management. This hardware was entirely optional, many users never saw one and just used the app on existing devices. With Jamboard's end of life, Google's recommendation is to use third party whiteboarding tools, some of those like Miro or Lucidspark do have freemium pricing or paid plans, but that is outside Jamboard itself. So, for the time Jamboard was in use, it was a freely accessible resource which made it attractive to schools, no licensing paperwork needed beyond having Google accounts for students. The transition away from Jamboard might incur costs if schools move to paid alternatives. However, a number of alternatives including Microsoft Whiteboard and Padlet's free tier can fill the gap without new expenses.

Padlet Sandbox operates under Padlet's broader freemium pricing model. Padlet offers a Free plan for individual users which allows a limited number of padlets, currently 3 padlet boards or sandboxes active at a time. This means a teacher using a free account can only have up to 3 Sandbox boards unless they delete or archive old ones. Padlet lets users archive and keep content, but only 3 can be live editable boards. The free plan also limits file upload size, for example 25 MB per file, and perhaps the number of

contributors is not explicitly limited, but heavy use might bump into some hidden limits or the need for more moderation tools. For expanded use, Padlet has Padlet Pro for individuals and Padlet Backpack for schools. Padlet Pro is around 99 per year for a teacher, and provides unlimited padlets, larger uploads 250 MB per file, and priority support. Padlet Backpack for Schools is an enterprise license that covers a certain number of teacher and student accounts, for example a minimum package might be 30 teacher accounts and however many student accounts needed, priced maybe at a few hundred to a couple thousand dollars per year depending on size. Padlet typically quotes 1500 per year for 100 teachers as an example, though exact pricing is by arrangement. Backpack also includes added features like LMS integrations, enhanced security private domain, and admin controls. As an example, from Padlet's pricing info, the smallest Padlet for Schools subscription starts at 10 teacher accounts, and includes student accounts, LMS integrations, increased security. Many universities, if they want campus wide usage, might opt for a Backpack license so that each class can use Padlet without the 3-board limit and with the comfort of a walled garden, all boards under the school domain and student data kept private. Padlet Sandbox is included in all paid plans at no extra cost, even free users can use Sandbox, each sandbox just counts as one of their 3 boards. But for sustained heavy use in multiple classes, a paid plan is likely needed.

From a budget perspective, Microsoft Whiteboard and formerly Google Jamboard have the advantage of zero direct cost for software, which is significant for public institutions or any resource strapped educators. Padlet, being a commercial product, may introduce cost if an instructor's needs exceed the free tier. That said, Padlet's value in terms of features and ease might justify the cost for many. Some universities have already purchased Padlet Backpack licenses to make Padlet available institution wide, for example an article from Washington University in St. Louis noted they acquired an institutional Padlet license, motivated by increased usage. Such licenses generally allow unlimited student use without each student needing to pay, the school bears the cost. If an individual instructor is considering Padlet without institutional support, they might weigh using the free tier with limited boards versus paying out of pocket for Pro.

Another subtle aspect is data governance and privacy, often tied to licensing. With Microsoft and Google, institutions usually have agreements in place covering FERPA compliance and data security under their educational offerings, so using Whiteboard or Jamboard falls under those umbrellas. With Padlet, some institutions might be cautious unless using the Backpack plan which can offer more control, like hosting in region data, dedicated subdomains. From an integration standpoint, to use LMS LTI integration, one must have the Padlet Backpack school account, which is a paid service. So, while Padlet can be used in a limited free capacity, to get the full seamless experience in a higher education environment with LMS integration and unlimited use, an investment is needed.

In conclusion, cost should not be a barrier for Microsoft Whiteboard or historically Google Jamboard, they come essentially free with the dominant academic productivity suites. Padlet Sandbox offers a generous free trial for basic use, but scaling it in a university likely involves budgeting for a subscription. Institutions evaluating these tools will consider not only feature fit but also the long-term cost of providing them to all students. For many, leveraging the already paid Microsoft or Google tools is attractive. However, Padlet's unique features may justify its cost for enhanced collaboration experiences. It is worth noting that compared to some other enterprise whiteboard collaboration tools, which can be quite expensive, Padlet is relatively affordable, especially given its educational discount packages.

4 CONCLUSION

Collaborative digital whiteboards have become indispensable in higher education. These platforms aid in enhancing active learning, brainstorming, and group collaboration across both in-person and online settings. In this paper, Microsoft Whiteboard, Google Jamboard, and Padlet Sandbox were portrayed as having a similar core purpose but their distinct features and integrations make them uniquely suited to different institutional needs. Microsoft Whiteboard stands out in Microsoft-centric environments, offering seamless integration with Teams, OneNote, and LMS platforms, along with robust security and structured collaboration tools. Although now discontinued, Google Jamboard played a pivotal role in popularizing digital whiteboarding mainly due to its simplicity and seamless integration within Google's ecosystem. Its

phase-out has driven educators to explore alternatives, with Padlet Sandbox emerging as a leading successor. Padlet combines intuitive design with advanced multimedia and breakout features that foster dynamic, creative learning experiences. When selecting a whiteboard tool, institutions must consider factors such as ecosystem compatibility, LMS integration, scalability for different class sizes, accessibility features, and cost-effectiveness. Microsoft Whiteboard provides a strong, no-cost solution for institutions already using Microsoft 365, while Padlet Sandbox offers greater flexibility and richer functionality, thereby justifying potential licensing investments. The shift away from Jamboard highlights the need for educational technology to evolve alongside pedagogical demands. This is to ensure that digital collaboration remains engaging and effective. Ultimately, no single tool fits all scenarios; instead, universities may benefit from supporting multiple platforms by allowing educators to choose the best option based on specific learning objectives. By thoughtfully integrating these tools into curricula, higher education can foster more interactive, inclusive, and collaborative learning environments, equipping students with essential digital communication and teamwork skills for the future.

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Tailoring MOOCs to Modern Learners: A Study of Preferred Digital Learning Objects

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ABSTRACT

Learning objects in Massive Open Online Courses (MOOCs) play a vital role in enhancing the digital learning experience. This study was conducted to analyse the usage patterns of learning objects such as videos, PDF documents, PowerPoint slides, as well as assessment activities including quizzes and essays among students enrolled in MOOCs, to meet the needs of today's learners. This research employed a survey design using questionnaires administered to 59 student respondents based on gender and academic qualification backgrounds. The reliability of the questionnaire was recorded at Cronbach's alpha of 0.78. Findings reveal that PDF files, PowerPoint slides, and videos were the most preferred learning objects, with an ideal interaction time ranging from 10 to 20 minutes. Additionally, quizzes were identified as the most preferred form of assessment. This study underscores the necessity for instructional designers to tailor digital content according to students' attention spans and to offer a variety of learning objects to ensure inclusivity. The implications from this study can serve as a guideline in developing a more flexible and effective instructional framework for MOOC-based teaching.

KEYWORDS: MOOC, Learning Objects, Usage Analysis, Instructional Design, Online Assessment

1. INTRODUCTION

Massive Open Online Courses (MOOCs) have emerged as a prominent platform in contemporary education, offering open-access learning opportunities to a global audience. Within these courses, a wide array of digital learning objects—such as instructional videos, PDF readings, slide presentations, interactive quizzes, and discussion forums—are used to convey knowledge. One critical issue that remains under scrutiny is the effectiveness and suitability of these learning objects in meeting the needs of modern learners. Unlike traditional learners, contemporary students tend to have shorter attention spans, diverse technological habits, and distinct expectations for flexibility and interactivity in online learning environments (Guo et al., 2014; Hu & Xiao, 2025). As such, understanding which types of learning objects are most effective and preferred is central to the instructional design of MOOCs.

This study aims to investigate learners' preferences for various types of digital content in a MOOC environment, with a specific focus on students from technical education backgrounds. The research seeks to (1) identify patterns of learning object usage and (2) examine previous findings regarding the effectiveness of different types of learning objects within MOOCs. By doing so, the study intends to offer insights into how digital learning content can be better aligned with learner needs, ultimately informing more effective MOOC design strategies.

2. LITERATURE REVIEW

MOOCs provide instructional content through multiple types of digital learning objects, including video lectures, PDF documents, presentation slides, and interactive assessments. Understanding how each type of learning object influences engagement and learning outcomes—and how learners from different backgrounds perceive and interact with them—is vital for optimizing instructional effectiveness in MOOCs (Guàrdia et al., 2013; Ozan & Ozarslan, 2016).

2.1 Learning Object Types and Their Impact on Engagement and Outcomes

Videos are often considered one of the most engaging forms of content in MOOCs due to their ability to combine visual, auditory, and narrative elements (Guo et al., 2014). Research suggests that learners benefit from short, well-structured videos that emphasize core concepts and avoid unnecessary distractions. Similarly, PDF documents and slides are valued for their textual clarity and ability to convey information in a concise format. However, while PDFs are useful for deep reading and reference, slides often serve as visual guides that complement other materials. Quizzes play a dual role in both engaging learners and providing formative assessment, which enhances retention through repeated retrieval practice (Roediger & Butler, 2011).

2.1 Learner Preferences for Digital Learning Objects

While videos dominate in terms of learner preference, studies show that a balanced approach that includes textual resources and interactive activities is more effective overall (Celaya et al., 2019). Learners often appreciate having access to a variety of content types that match their learning styles—visual learners benefit from infographics and slides, while reflective learners prefer reading materials and written assessments. The integration of these formats ensures that no single learning style is excluded from the learning experience (Monib et al., 2024).

2.3 The Role of Duration, Interactivity, and Modality in Effectiveness

Content duration has a significant effect on learner engagement. Studies reveal that videos under 10 minutes achieve higher engagement rates, supporting the adoption of microlearning strategies (Guo et al., 2014; Monib et al., 2024). Interactivity also plays a crucial role in maintaining attention and improving learning outcomes. Embedding quizzes within video lectures or readings can significantly enhance cognitive processing and learner satisfaction (Anderson et al., 2014). The use of multimodal content—combining text, audio, and visuals—caters to diverse cognitive preferences and enhances knowledge retention (Hu & Xiao, 2025).

2.4 Best Practices in MOOC Instructional Design

Effective MOOC design incorporates insights from empirical research and user feedback to ensure inclusivity and learner engagement. Best practices include modular content delivery, scaffolded assessment tasks, adaptive learning paths, and mobile-friendly design features (Guàrdia et al., 2013; Celaya et al., 2019). Instructional designers are encouraged to adopt a learner-centered approach that emphasizes accessibility, engagement, and flexibility, particularly in a globalized learning context.

3 METHODOLOGY

This study employed a quantitative descriptive survey design using a questionnaire to collect data from students enrolled in a MOOC. The survey instrument was developed based on current literature and was validated with a Cronbach's alpha of 0.78, indicating an acceptable level of internal consistency. The questionnaire was designed to identify learner preferences for different types of digital learning objects – including video lectures, PowerPoint slides, PDF documents – as well as preferred forms of assessment such as quizzes and essay assignments. A purposive sampling technique was used to recruit 59 respondents from a technical education background, with variation in gender and academic qualifications. Data were collected online over a two-week period with assurances of confidentiality and adherence to research ethics. The data were analysed descriptively, using percentage distributions and graphical visualizations to identify patterns of usage and preferences among learners.

3. FINDING

This section presents a descriptive visual analysis based on a study conducted among learners from technical education backgrounds. The purpose is to identify trends in learning preferences, interaction durations with various learning materials, and preferred types of assessment. The following charts and summaries provide an overview of participants' responses.

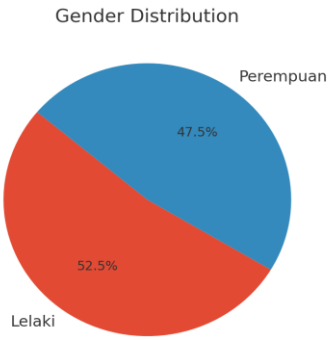


Figure1: Gender Distribution

The gender ratio among respondents is relatively balanced, with males (52.5%) slightly outnumbering females (47.5%). This distribution offers a diverse perspective in interpreting learning behaviors across genders.

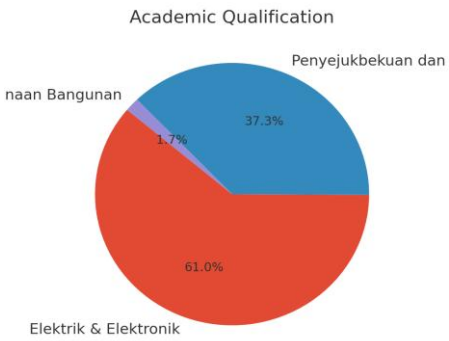


Figure 2: Academic Qualification

A majority of respondents come from the Electrical and Electronics background (61%), followed by Refrigeration and Air Conditioning (37.3%), and a minor representation from Building Construction (1.7%). This suggests that the dataset primarily reflects learners from technical and engineering-based disciplines.

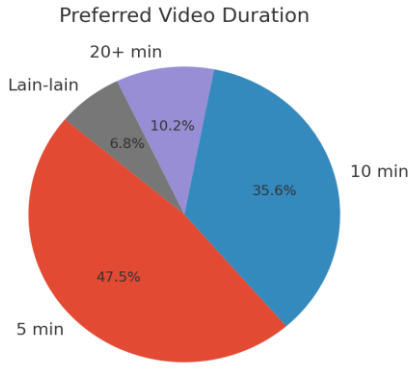


Figure 3: Preferred Video Duration

Videos with durations of 5 minutes (47.5%) and 10 minutes (35.6%) are most preferred, indicating that microlearning is effective in sustaining learner attention.

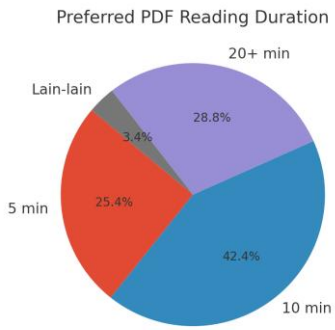


Figure 4: Preferred PDF Reading Duration

Reading durations of 10 minutes (42.4%) and over 20 minutes (28.8%) were favored for PDF materials, suggesting the ability of learners to engage with moderately long texts.

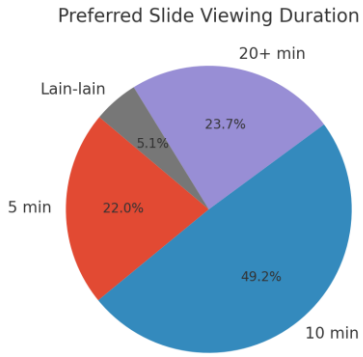


Figure 5: Preferred Slide Viewing Duration

Slides with a viewing time of 10 minutes (49.2%) are most preferred, emphasizing the importance of brevity and clarity in presentation design.

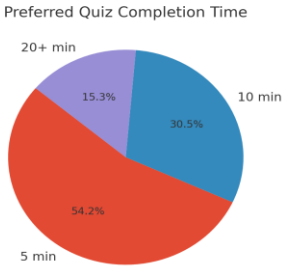


Figure 6: Preferred Quiz Completion Time

Quizzes completed in approximately 5 minutes (54.2%) were the most preferred, highlighting the value of brief formative assessments.

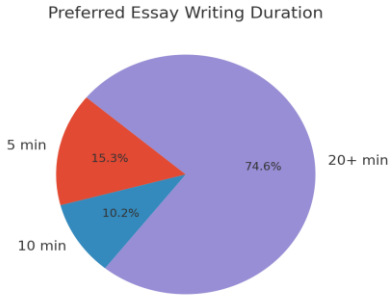


Figure 7 : Preferred Essay Writing Duration

Unlike quizzes, essay assignments were preferred with durations exceeding 20 minutes (74.6%), reflecting learners' willingness to engage in deeper critical thinking.

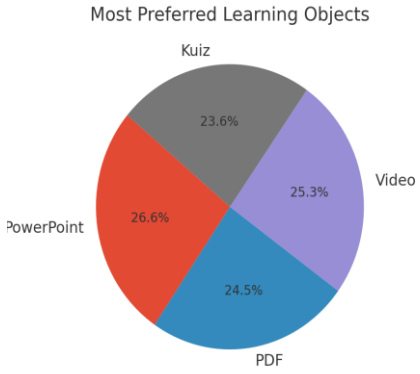


Figure 8: Most Preferred Learning Objects

PowerPoint (26.6%), Video (25.3%), and PDFs (24.5%) are almost equally preferred, indicating the effectiveness of a balanced instructional approach. Quizzes (23.6%) also contribute to active engagement in learning.

4 DISCUSSION

The findings indicate that the most favoured learning objects among participants were PDF files, PowerPoint slides, and video lectures. This preference suggests that learners gravitate towards materials that are easily accessible, information-dense, and supported by visual elements to aid understanding. The popularity of video content likely stems from its ability to dynamically illustrate complex concepts, making learning more engaging. Notably, the study also found that shorter videos – ideally around 5 to 10 minutes in length – are most preferred by students. This aligns with the principle of *microlearning*, wherein brief,

focused learning modules better accommodate the limited attention spans of modern learners. Prior research has similarly shown that video lectures under roughly 10 minutes tend to achieve the highest viewer engagement and completion rates, whereas longer videos often see significant drop-off in attention. In terms of assessments, quizzes emerged as the most favoured mode of evaluation, in contrast to essays which require more time and deep reflection. This preference for quizzes reflects a desire for immediate, formative assessment opportunities that provide quick feedback. Such an inclination is consistent with the well-documented "testing effect," where frequent retrieval practice through quizzes enhances long-term retention of knowledge. In the MOOC context, offering low-stakes quizzes can keep learners engaged, especially given that many participants tend to focus on short interactive activities and may be less inclined to complete lengthy assignments or exams. The emphasis on quizzes as a primary assessment form thus underscores the need for timely feedback and reinforcement in online learning environments.

These results reinforce the importance of a flexible MOOC design in both content delivery and assessment methods. The findings are in line with previous studies that emphasize delivering content in a modular, concise, and focused manner to sustain student engagement. Breaking information into manageable chunks is known to reduce cognitive overload and improve learning efficiency, which helps explain why learners in this study responded positively to shorter videos and succinct learning objects. Furthermore, providing a variety of learning object formats is crucial for accommodating the diverse preferences and learning modalities of students. This supports the notion that no single medium suits all learners – a mix of visual, auditory, and text-based materials can cater to different learning styles and needs. Indeed, incorporating diverse content types (e.g. videos, readings, interactive quizzes, podcasts) in MOOCs has been shown to increase learner engagement and enhance learners' perception of the course. Therefore, MOOC instructional designers should consider not only the subject matter of the content but also the format, length, and accessibility of learning materials on the digital platform. Attention to these factors will help ensure that the course design is learner-cantered and inclusive. In particular, tailoring the instructional design to learners' needs – such as using bite-sized content, interactive elements, and multiple content modalities – can better engage today's online learners and accommodate a range of learning preferences (Guàrdia et al., 2013; Celaya et al., 2019). This learner-cantered approach is especially vital in the rapidly evolving era of open education, where maintaining learner engagement is a constant challenge. By aligning content delivery and assessment strategies with how learners best engage, MOOCs can become more effective and inclusive.

5 CONCLUSION

Overall, this study highlights that in the MOOC context, learning materials that are visual, concise, and easily accessible tend to be the most well-received by learners. The prominence of PDF documents, short video lectures, and quick quizzes in learner preferences reflects the need for content that is information-rich yet not overwhelming. The key implication for MOOC developers is to design learning objects that meet the needs of modern learners by considering factors such as attention span, preferred assessment methods, and the accessibility of content for students from various backgrounds. Specifically, course designers should strive to create modular content segments (e.g. brief videos or readings) and incorporate interactive assessments that provide immediate feedback, thereby keeping learners actively involved.

This study, however, is not without limitations. The sample size was relatively small (N=59) and drawn from learners in technical disciplines, which may limit the generalizability of the findings. Future research could broaden the sample to include a larger and more diverse population of MOOC learners. Additionally, employing a mixed-methods approach (combining quantitative and qualitative data) would allow for a deeper understanding of learners' experiences and the reasons behind their content preferences. Further studies might also analyse system log data from MOOCs to observe actual learning object usage

patterns and their impact on learning outcomes. Such data-driven investigations could validate and extend the insights from this survey-based study.

In conclusion, designing effective MOOCs requires a data-informed and learner-centric approach. The insights from this study point towards the value of adapting instructional strategies to learners' preferences – for example, by integrating shorter, engaging content pieces and formative assessments that align with learners' habits. By doing so, MOOC designers can better align with the principles of inclusive and adaptive digital education, ensuring that the courses remain responsive to the needs of learners and conducive to meaningful learning at scale.

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Exploring Educator's Insight on Education 4.0: Transforming Secondary Education

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ABSTRACT

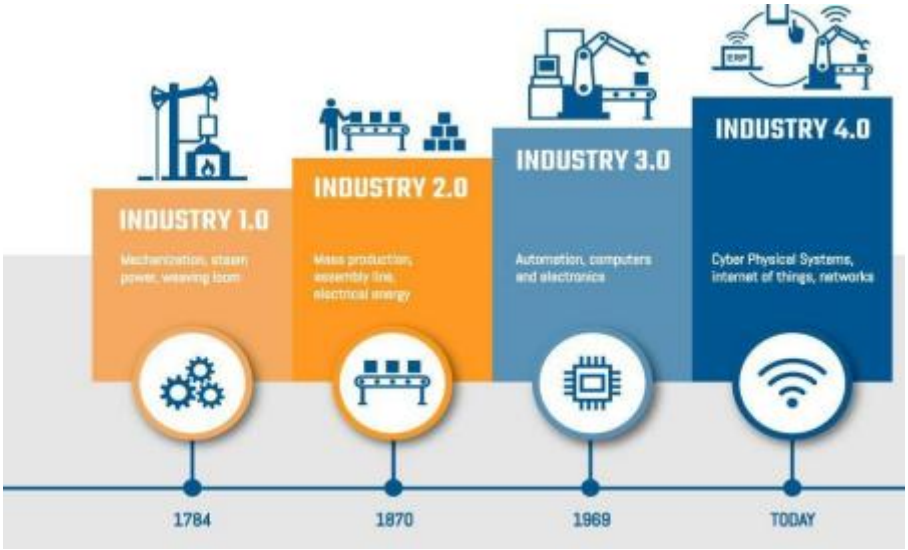
The Fourth Industrial Revolution accentuatesthe profound significance of swift technological and industrial transformations occurring in the 21st century, propelled by advancements in smart automation. Concurrently, Education 4.0 embodies a comprehensive educational framework meticulously crafted to align with the Fourth Industrial Revolution, necessitating proficient technological and pedagogical competencies for effective implementation. Furthermore, it also functions as a preparatory mechanism for students to cultivate the requisite skills essential in a digitally oriented Industry 4. Nevertheless, in spite of these transformative changes, Malaysia is still regarded as an emerging nation concerning technological advancement, particularly in terms of dissemination and exposure, especially for educators. Consequently, this study delves into the perspectives of educators regarding Education 4.0 and its potential to transform secondary education. Employing purposive sampling, the research included 12 educators from four institutions within the Larut zone, chosen based on their experience, age, and levels of instruction, encompassing both mainstream and pre-university educators. This paper adopted a qualitative research design, incorporating semi-structured interviews featuring open-ended questions. The results obtained from the interview sessions reveal that the readiness of the majority of educators to implement Education 4.0 varies markedly between seasoned and novice educators. Additionally, the findings indicate that educators encountered a plethora of challenges within educational institutions, hindering the comprehensive implementation of Education 4.0 within the educational framework.

KEYWORDS: *Fourth Industrial Revolution, Educators' Insights, Education 4.0, Technological Advancement, Secondary Education*

1 INTRODUCTION

The Fourth Industrial Revolution (Industry 4.0), which underscores the importance of interconnectivity, automation, real-time data analytics, and sophisticated technologies such as the Internet of Things (IoT), has profoundly impacted diverse sectors, including the realm of education (Daniel & Posey,

2021 and Norshima Humaidi et al., 2020). In Malaysia, this paradigm shift has engendered the advent of Education 4.0. Education 4.0 is an educational framework that incorporates digital technologies into pedagogical practices to prepare learners with the competencies essential for a future characterized by technological advancement. While the transition to Education 4.0 aligns with national initiatives such as the Malaysia Digital Economy Blueprint and the National Higher Education Action Plan, numerous educators persistently encounter obstacles in its actualization. Prior to this, the educational framework has experienced four distinct phases of transformation (Widia Kemala Sari, 2020). The initial phase, Education 1.0, was formulated to address societal demands, wherein knowledge was transmitted unidirectionally from instructors to learners through the lecture method. The subsequent phase, Education 2.0, emphasizes the incorporation of technology within the educational environment. Progression led to Education 3.0, which prioritizes the utilization of technology to enhance interactive pedagogical practices, whereas Education 4.0 advocates for the employment of technology to encourage continuous learning. Consequently, Education 4.0 is anticipated to address the challenges associated with energy dependence, which is likely to exert a profound influence on the labor market.



Source: German Research Centre for Artificial Intelligence (DFKI)

Figure 1 : Industry Evolution from 1.0 to 4.0

However, challenges such as limited digital literacy, inadequate training opportunities, time limitations, insufficient infrastructure, and unreliable internet connectivity impede the seamless integration of technology within educational environments n (Johnson et al., 2016). Despite a considerable number of educators advocating for the incorporation of technology in the educational landscape, their preparedness remains an area of concern, with research indicating that a substantial proportion encounters difficulties with online instructional competencies (Picton's ,2019). Notwithstanding the significance of these challenges, there exists a deficiency of comprehensive research that specifically addresses educators' preparedness to execute Education 4.0 (Hameed, 2022). Therefore, this study aims to explore secondary school educators' awareness of Education 4.0 by assessing their overall readiness towards educational transformation.

2 Educators' Awareness on Paradigm Education 4.0

Hidayati et al. (2022) showed that many educators regardless of age, gender or teaching level are less familiar with the concept of Education 4.0. They are also unsure of how to effectively implement it in the education system. Sani (2013) also noted a general lack of awareness among educators about the implications of the Fourth Industrial Revolution. One of the main challenges is the limited understanding

among educators of the systemic changes brought about by Education 4.0. This leaves many unsure about their role in adapting to this shift (Lai et al., 2020). Furthermore, Syarifuddin et al. (2013) noted that some educators are still unaware of recent educational reforms due to a preference for conventional teaching practices and a reluctance to move beyond their comfort zones. Therefore, it is important for educators to be informed about curriculum updates and provided with clear and in-depth guidance on integrating Education 4.0 into their teaching approaches.

3 Factors Influence Educators' Readiness

The preparedness of educators remains at a moderate level, as a significant proportion of them are inadequately equipped to utilize technology effectively. It has been concurred by Yong Man Ling et al. (2020) that the readiness of educators continues to be moderate owing to various technological limitations. C.S. Lai et al. (2020) asserted that the degree of educator readiness is at a satisfactory level, primarily attributable to the educators' own attitudes. For example, an extended duration is required for educators to acclimate to new technologies. Nevertheless, numerous other factors contribute to the suboptimal readiness observed among educators.

3.1 Internet Access

According to the research conducted by Mohd Rustam Mohd Rameli et al. (2018), the preparedness of educators reveals unfavourable responses towards Education 4.0, particularly concerning the accessibility of Internet connectivity. Moreover, this assertion is corroborated by the findings of Hamed Al-Awidi and Fayiz Aldhafeeri (2017), indicating that a significant number of educators encounter challenges in securing adequate facilities and Internet access due to the lack of provision by educational institutions. Furthermore, Abdul Halim Abdullah et al. (2016) contended in their investigation that suboptimal Internet connectivity could hinder the professional progress of educators, as reduced Internet speed can impede the operational systems utilized by them. Consequently, the efficacy of Internet connectivity is paramount for the readiness of educators to advance within the framework of Education 4.0.

3.2 Insufficient Training

As posited by Charles Buabeng-Andoh (2012), a pivotal factor contributing to the deficiency in technological competencies among educators is the inadequate training provided. This notion is reinforced by Taban Habibu et al. (2012), who identified numerous impediments in the execution of training initiatives for educators, primarily due to the complexity involved in ensuring the effectiveness of such training programs. For example, challenges include the allocation of time for training, as well as the need for pedagogical and skills-focused training. The DigitalLEARNING Network (2020) has indicated a notable scarcity of dynamic educators proficient in ICT. Additionally, the training-related issues encompass the absence of consistent, high-quality professional development for educators in the realm of ICT Education.

3.3 Time Constraint

Majority of educators concur that time limitations constitute a principal factor adversely affecting their readiness to implement Education 4.0 within the classroom environment. The integration of technology in educational settings necessitates that educator acquire proficiency in software pertinent to their teaching disciplines and instructional resources. This knowledge acquisition is a time-intensive endeavor for educators striving to attain expertise in these areas. Furthermore, within educational institutions, each subject encompasses an extensive array of syllabi that must be addressed annually within a specified timeframe, while educators simultaneously prepare for additional curricular activities. As a result of the substantial workload, the incorporation of technology in the classroom has diminished educators' preparedness to embrace the Education 4.0 paradigm within the educational framework (Abdul

Halim Abdullah et al., 2016; C. Vrasidas et al., 2014; S. Unal et al., 2012). This perspective is further supported by the observations of Samira Nikian et al. (2013), who noted that the predominant challenge faced by many educators is the difficulty associated with utilizing technology in the classroom, primarily due to insufficient time. Educators are required to develop instructional materials that integrate technology, which necessitates a considerable investment of time. Therefore, time constraints have emerged as a significant barrier to the effective implementation of Education 4.0.

In contrast to the assertions made by W K Sari, Wilujeng (2020) contended that the preparedness of educators yields affirmative responses towards Education 4.0. Educators exhibit a significant level of preparedness for Education 4.0, as it has been effectively integrated into the contemporary educational framework. Additionally, a majority of educators demonstrate commendable proficiency in navigating the advancements associated with the technological evolution. This assertion is corroborated by Muhammad Sukri Saud et al. (2018), who indicate that a substantial number of educators possess a high degree of readiness for the development of pedagogical methodologies and the establishment of 21st-century learning paradigms, given its integration within the existing educational structure.

In light of the aforementioned points, it can be inferred that Education 4.0 has elicited both positive and negative responses regarding the preparedness of educators. Moreover, the Education 4.0 framework is perceived as multifaceted, as the incorporation of technology in education presents both efficacious outcomes and obstacles in its implementation within the educational system. Nevertheless, considering that Education 4.0 remains a nascent concept, there exists a scarcity of research addressing the concerns related to educators' awareness and their comprehension of Education 4.0.

4 RESEARCH METHODOLOGY

A qualitative methodology has been meticulously chosen for the execution of the present study. The application of the qualitative approach is intended to facilitate an in-depth comprehension and interpretation of the respondents' perspectives. Given that the central emphasis of this study pertains to the viewpoints of educators, the qualitative approach represents the most fitting methodology for eliciting nuanced information regarding individual beliefs and experiences. Moreover, qualitative methodologies furnish a degree of insight that is challenging to achieve through the administration of surveys comprising closed-ended questions (Tiley, 2017). Throughout this study, a semi-structured interview format will be employed.

This study seeks to examine educators within secondary educational institutions located in the Larut, Matang, and Larut Selama district, with particular attention directed towards the Selama zone. This specific demographic was chosen due to the suburban characteristics of the district, which have culminated in a scarcity of resources and limited exposure to technological advancements in the majority of schools. Additionally, certain educational establishments within the region lack access to the Internet. The researcher employed purposive sampling for this investigation, as it facilitates the acquisition of qualitative data, thereby enhancing the understanding of the research objectives. This particular sampling technique necessitates that the researcher delineates eligibility criteria for participants based on their expertise, which is essential for garnering insights within their respective disciplines.

To ensure the integrity and dependability of the research, it is customary for scholars to establish guidelines for estimating the requisite number of interviews. As posited by Baker & Edwards (2012), experts concur that achieving data saturation is optimal, recommending a sample size that varies from 12 to 60, with 30 as the average. Furthermore, Guest et al. (2006) established that in homogeneous studies employing purposive sampling, akin to many qualitative investigations, a total of 12 interviews should suffice to attain data saturation. Consequently, this study will select 12 educators from four secondary schools within the Selama zone for interviews, with four educators being chosen from each institution.

The criteria for selecting respondents in this particular investigation are predicated upon their age demographics and their degree of professional experience within the educational domain. The researcher, in the execution of this inquiry, has chosen to collaborate with educators whose ages span from 24 to 60 years, aiming to elucidate the diverse viewpoints regarding the integration of Education 4.0 within the educational framework, as perceived by various generational cohorts of educators. Additionally, the evaluation of work experience is paramount, as it functions as an indicator of the practical applicability of Education 4.0 in the pedagogical responsibilities of educators, specifically within the ambit of their obligations in the academic setting.

Table 1: Criteria in Selecting Respondents

Experience in Teaching (years)	Ages (years old)	**Level of Teaching**
0-5	24-29	Form 6
6-10	30-35	
11-15	36-40	
16-20	41-45	
21-25	46-50	Main Stream (Form 1 – Form 5)
26-30	51-55	
31-35	56-60	

5 RESULT AND DISCUSSION

The findings were obtained through the input of three essential informants with the readiness of the educators towards the implementation of Education 4.0. The informants unanimously acknowledged the presents of fourth industrial revolution into education field known as education 4.0. Nevertheless, the involvement of educators is necessary, given that most of them come from diverse backgrounds. Therefore, the first element in this study was indicate the knowledge of informants towards industrial revolution 4.0. However, the results show that not all the informants are familiar with the Industrial Revolution 4.0.

"Hmmmm, Industrial Revolution 4.0? I never heard about it before this."

(Respondent 4, respondent 6, respondent 7)

"I heard about it from other teachers talking about those terms in the teachers' room, but I do not know what it is." (Respondent 10) "I have heard people talk about the terms of the industrial revolution, but I don't know much about it. I think it is about the use of IT."

(Respondent 2)

"Yes, I have heard about the Industrial Revolution 4.0. It began when we utilised or started the industry of the internet."

(Respondent 1)

"Yes, I know. It is like the use of technology in terms of robotics and automation starts playing its role."

(Respondent 3, Respondent 5, Respondent 8, Respondent 12)

"I've heard people talking about this. What I understand is that the government wants to develop the economy, so they need to find industries that can have a positive impact on it. Before this, our country was known as an agriculture country, and then today our government said we needed to find and master other industries as well to increase our economy".

(Respondent 9)

"I have heard about Industrial Revolution but the one with 4.0 I have no idea what it is. But, for the industrial revolution, I think it is about we improve the economic sector with the use of technologies nowadays."

(Respondent 11)

In addition to this, the researcher also evaluated the informants' comprehension of Education 4.0. This assessment aims to ascertain the informants' awareness of the integration of Education 4.0 within the educational domain. Nevertheless, a mere fraction of the informants possesses a substantial understanding and knowledge of Education 4.0.

"In terms of the application of ICT in education, Education 4.0 begins when we start using computers. It's the way it started, and it's how it's evolved over time. Lesson plans, for example, have been converted from a manual to an online system. So, when educators began to use online systems, that's how Education 4.0 was set up. Then, students' data systems were switched from manual to online system registration."

(Respondent 1)

"I'm not sure about Education 4.0, but what I know about the 4.0 thingy is about teaching and learning using technology."

(Respondent 2)

"Ohh, Education 4.0…I never heard about that before."

(Respondent 3, Respondent 5, Respondent 6, Respondent 7, Respondent 8, Respondent 10, Respondent 12)

"I think I have heard about it before but I don't know detail"

(Respondent 4)

"Hmmmmm… That 4.0, I'm not sure, but I think it is about the development of Education from century to century".

(Respondent 9)

"The world of Education in the digital era and the challenge to shape future generations to be creative, innovative, and competitive."

(Respondent 11)

In addition, to ensure the implementation of Education 4.0 during instructional sessions, the researcher has also developed several validated questions to ascertain the incorporation of Education 4.0 among educators in their pedagogical practices. Nevertheless, not all participants have employed the Education 4.0 methodology in their teaching, with a majority expressing a preference for traditional instructional methods, particularly among educators teaching at mainstream educational levels.

"Most of the time I teach using an LCD projector and ask my students to use their phones to find additional information in the class. Then I will ask my students to present. By the way, Form 6 students are allowed to bring gadgets to school."

(Respondent 1)

"I usually apply 21st century learning like gallery walks, and sometimes I do outdoor activity classes to avoid students getting sleepy. The purpose of the gallery walk is to test students' understanding of certain topics. But I do not really use technology in classroom settings."

(Respondent 2)

"For science subjects, most of its students will do it instead of teachers." For most of the class, I will ask the students to make a slide for their presentation. Other than that, I will do a gallery walk, but before that, I will already tell them that students will do the activity so that they are prepared. Moreover, in science, we have experiments. What I did was assign one group to 27 demonstrate how to do the experiment. But before that, I will call the in-charge group to meet with me, and I will show them the procedure of the experiment. So, in the class, they will explain, demonstrate, and guide their classmates."

(Respondent 3)

"I do a lot of group activities in class, such as group presentations, so they can learn how to pitch their ideas, and usually I ask the students to create instead of telling them what to do. In terms of the use of technology, I've never tried it yet."

(Respondent 5)

"I will do activities based on topics. An example of an activity that I did was using materials around the classroom. Besides, sometimes I play a YouTube video using an LCD projector. For the geography subject, I will do an activity outside the classroom to show the structure of the earth."

(Respondent 6)

"Activity for 1 period I'll just give exercises, and students will refer to the textbook. But for two periods, I will use an LCD projector. Besides, I also implement group activities. After I explain to the students the concept, I will put them into groups to have a discussion on the exercises I assign them. Usually at the end of the discussion, the teacher will explain instead of the students because students will take some time to present, so it will drag."

(Respondent 7)

"I teach Islamic subject so usually I will do activity like gallery walk, i-think map and sometimes I asked my students to write a poem on divine theme so that students enjoy learning in the class. besides, I will assign my students some homework for them to present for the next class. so, they need to find and search for the information at home through Google or any resources they can access. Next, I also use google classroom for students submit all their homework and at my school has provide a smart TV at library. So, sometimes I will use it in my class."

(Respondent 9)

"For speaking, I did a pen pal activity. Back in time, we connected via letters and email. But nowadays, we have a lot of platforms to make connections. So, in my class, I used the Zoom platform to connect my students with students in Sarawak. This is because a lot of my students never go to Sarawak, so I connect them with Sarawak's people so that they have experience interacting in English."

(Respondent 10)

"For Form 6 students, teaching and learning can be done anytime and anywhere, meaning they are not limited to just in class. Sometimes, I will do a Google Meet with my students. Besides, students also submit their homework softcopy via telegram. For their assignments, the use of technology is very helpful in order for the students to search for information, and they will present their findings through Google Meet. Furthermore, for Form 6 students, they are allowed to bring smartphones or any gadget to school to find the materials and for the purpose of presentation. So I used that opportunity to ask students to do presentations using the digital materials in the class."

(Respondent 12)

Furthermore, to assess the influence of Education 4.0 on educators, researchers have formulated inquiries aimed at gauging educator responses. A significant number of educators have provided affirmative feedback regarding the beneficial impact of Education 4.0 on the educational sector. However, the willingness to implement this approach remains limited, primarily due to inadequate technological resources within the educational context and constraints related to time.

"Of course, in terms of creativity, it is increasing because, like it or not, we as teachers need to follow the trend because we are put in a situation where we need to use platforms like Google Meet, Zoom, etc. Even now, after the pandemic, I sometimes do class online via Meet. So, from time to time, with a lot of practises, I manage to handle and follow it."

(Respondent 1)

"As for me, I'm becoming a more creative person because I need to always think about what activity I should do in the classroom so that students are not bored. Besides, the bad impact for teachers is time constraints. This is because teachers need to take some time to get ready with the gadget.

(Respondent 2, respondent 6, respondent 7, respondent 12)

"Of course, teachers become more creative than before, but at the same time, they become busier because of that. Even though the concept of Education 4.0 sees the teacher as a facilitator in the class, teachers need to think more about what activities they need to do. Besides, let's say I want to do a gallery walk activity; students will text me and ask more about the activity."

(Respondent 3)

"Teachers don't have to explain too much detail to students like in the traditional method because students have access to the information first before getting into the topic. So, I just give an explanation and comment on the students' findings. In order for me to test students' understanding, I will use the questioning method. So, I feel happy because I don't have to talk for a long time in the class. The process becomes calmer and more relaxed".

(Respondent 9)

"It helps to complete the syllabus quickly because students already find the information and make notes on some topics. So, teacher just need to explain and add on the information students got".

(Respondent 12)

"The use of technology in education is good for teachers like me because back then teachers just used books and whiteboards to teach. Besides, sometimes preparations for school that are not fully facilitated, like mine, will take a few times to prepare."

(Respondent 4)

Therefore, in line with the results obtained from primary sources, the following is a brief version of the previous discourse from the primary sources. The researcher explained that there are four main components that are very important to assess the readiness of education 4.0 among educators.

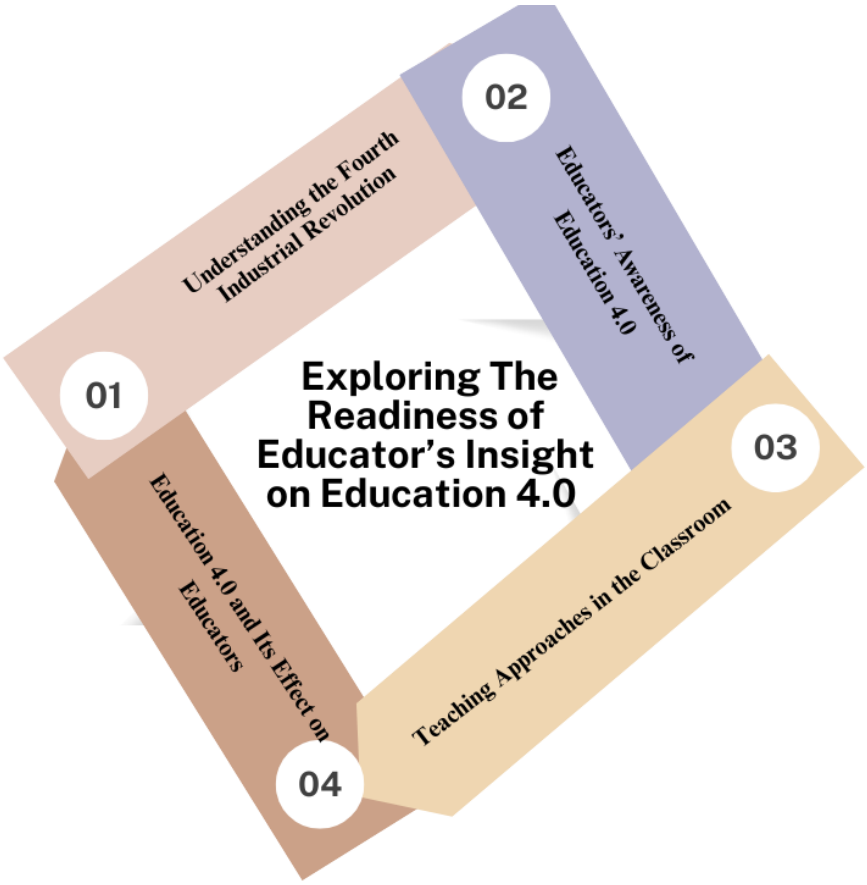


Figure 2 : Summary of Discussion Among Key Informants

6 CONCLUSIONS

In conclusion, many educators, particularly those with more experience, are unfamiliar with the concepts of IR 4.0 and Education 4.0. While some younger educators have a basic understanding of IR 4.0 due to their exposure to technology in university, they lack knowledge of how Education 4.0 specifically applies to teaching. Even though some educators incorporate aspects of Education 4.0 in their teaching, they do so without a clear understanding of its theoretical framework or the advanced technologies it involves. Most educators rely on basic tools like PowerPoint and projectors, but do not use more advanced technologies such as IoT, robotics, or artificial intelligence. While 21st-century learning focuses on critical thinking and collaboration, Education 4.0 emphasizes integrating digital skills and advanced technologies into the learning process. Access to technology varies among educators, with some schools, like those with Form 6 students, having easier access. However, budget constraints and limited technology in many schools remain significant challenges, preventing full implementation of Education 4.0.

7 PAPER CONTRIBUTIONS TO RELATED STUDY

The findings of this research have the potential to enhance the understanding of policy makers and educators regarding the mobilization of industrial revolution 4.0 into education known as education 4.0. Accordingly, this inquiry will furnish future scholars interested in education field with valuable insights gleaned from experts in the education sector particularly on educators' insights. The involvement of policymakers, parents and students in this research endeavor has the potential to broaden the scope of knowledge to improve education system particularly with regards on

Thus, this research can act as a beacon, especially for the Ministry of Education, to elevate and refine the educational landscape, focusing particularly on the well-being of educators, the dynamics of school management, and the calibre of students. Moreover, this research holds the promise to heighten the consciousness of school administration regarding the expertise of each educator in navigating and embracing the forefront of technological innovations. As a result, the study could assist the school administration in launching a training initiative for educators, empowering seasoned educators to synchronize with the rapidly advancing technology and avert any risk of obsolescence.

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Immersive Technology in Chemical Engineering and Chemistry Education: Promise, Practice, and Challenges

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ABSTRACT

This literature review examines 19 studies published between 2020 and 2025 that explore the use of immersive technologies, including virtual reality (VR), augmented reality (AR), and mixed reality (MR), in chemical engineering and chemistry education. These studies consistently report the effectiveness of immersive tools in simulating chemical processes, enhancing safety training, and providing virtual access to industrial environments and laboratory procedures. Quantifiable learning gains are noted in several cases, such as a 30% improvement in task accuracy, a 22% post-test increase among novice learners, and a doubling of assessment scores in complex simulations. Applications with an industrial focus are particularly common in virtual plant walk-throughs and hazard simulations. However, several implementation challenges remain. Common barriers include the lack of high-fidelity, industry-aligned content; high costs of development and hardware; limited instructor training; and difficulties integrating immersive modules into existing curricula. Compatibility issues with institutional infrastructure were also frequently reported. To address cost-related challenges, some studies identify open-source platforms as viable alternatives that reduce expenses while maintaining educational value. While such approaches can improve affordability, broader adoption remains constrained by limited collaboration with industry partners and the lack of longitudinal assessments that evaluate long-term learning outcomes. Overall, the papers reviewed highlight the potential of immersive technologies to bridge the gap between theory and practice in chemical engineering education. However, realizing this potential at scale will require targeted development, institutional support, stakeholder-specific customization, and deeper academic-industry partnerships.

KEYWORDS: Immersive technologies, Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Chemical engineering education, Simulation-based learning, Open-source platforms, Academic-industry collaboration.

1 INTRODUCTION

Immersive technologies, including virtual reality (VR), augmented reality (AR), and mixed reality (MR), are increasingly being integrated into STEM education. Their application is particularly relevant in high-risk disciplines such as chemical engineering and chemistry, where complexity, safety hazards, and the high cost of hands-on experimentation pose significant barriers to traditional teaching methods. While conventional approaches remain foundational, they often struggle in conveying the dynamic, spatial, and hazardous nature of industrial chemical processes. Immersive tools offer a compelling alternative, allowing students to engage safely with environments that are otherwise too dangerous, abstract, or resource-intensive to experience firsthand. Moreover, these technologies support diverse learning preferences (visual, kinesthetic, and experiential) reflecting the multifaceted demands of real-world industry (Zhou et al., 2024; Su et al., 2025).

Motivated by the need to bridge theoretical instruction with practical application, this review synthesizes findings from 19 recent studies. It aims to (1) map application areas of immersive technologies, (2) summarize observed educational outcomes, and (3) identify common barriers to adoption. Given the interdisciplinary nature of chemical education, encompassing topics from thermodynamics and kinetics to ethics and safety, immersive tools can foster integrated learning experiences that meet both academic and industry expectations.

2 METHODOLOGY

A systematic literature search was conducted using databases such as Scopus, ScienceDirect, and Google Scholar. To qualify for inclusion, studies had to meet the following criteria:

i. Published between 2020 and 2025
ii. Focused on immersive technologies (VR, AR, MR)
iii. Targeted chemical engineering or chemistry education

Each selected study was analysed for the type of technology used, educational level, focus area, pedagogical outcomes, and implementation challenges.

3 RESULTS

3.1 Study Overview

Table 1 summarizes the distribution of the 19 included studies by year, country or region, technology type, education level, and study design. The studies span undergraduate, professional, and cross-level training environments.

Table 1: Overview of included studies

Authors	Year	Country/ Region	Technology type	Education level	Study design
Pirola et al.	2020	Italy	VR	Undergraduate	Quasi-experimental
Stransky et al.	2021	USA	VR	Undergraduate	Comparative
Fracaro et al.	2021	Europe	VR	Professional	Prototype and framework
Toyoda et al.	2021	Japan	VR	Professional	Multi-group SEM (Structural Equation Modeling)
de las Heras et al.	2021	New Zealand	VL (Web-based)	Undergraduate	Mixed methods (survey + focus groups)
del Alamo et al.	2022	Spain	VR	Undergraduate	Simulated lab study

De Micheli et al.	2022	USA	MR	Undergraduate	Intervention study (scaffolded protocols)
Zhao et al.	2022	China	VR	Undergraduate	Usability evaluation
Wedelstedt et al.	2022	Germany	VR	Undergraduate	Platform trial
Udeozor et al.	2023	UK	VR	Undergrad/ Professional	Survey
Laricheva & Ilikchyan	2023	USA	VR	Undergraduate	Controlled study
Gao et al.	2023	Singapore	AR	Undergraduate	Quasi-experimental (pre/post-test, no control group)
Zhou et al.	2024	China	AR	Undergraduate	Experimental
Hassan et al.	2024	UK	VR	Professional	Digital twin case study
Hassim et al.	2024	Malaysia	VR	Undergraduate	Curriculum review
Tene et al.	2024	Europe	VR	Educator/ Institutional	Thematic analysis (educator/institutional focus)
Su et al.	2025	USA	Mixed	Undergraduate	Policy discussion
Protogeros et al.	2025	Greece	XR	Cross-level	Conceptual / framework development
Sohail et al.	2025	Malaysia	VR	Undergraduate	Gamified design

**Note: "Europe" refers to multi-country or EU-funded studies with contributors from multiple European nations (e.g., CHARMING consortium).*

3.2 Application Areas

Table 2 summarizes the primary application areas of immersive technologies identified across the reviewed studies, highlighting their pedagogical focus, typical use cases, and representative implementations.

Table 2: Overview of primary application areas

Application area	**No. of studies**	**Example tools / Outcomes**	**Representative studies**
Safety & emergency training	8	Ethical reasoning, hazard awareness (e.g., Contents Under Pressure (CUP) and CHARMING projects)	(Stransky et al., 2021; Fracaro et al., 2021)
Process simulation	8	Operations like distillation and bioreactor control (e.g., EYE4EDU, AR distillation column)	(Pirola et al., 2020; Hassan et al., 2024; Gao et al., 2023; de las Heras et al., 2021)
Molecular visualization	5	Spatial concepts in 3D (e.g., Manta, MOF-VR)	(Zhao et al., 2022; von Wedelstedt et al., 2022)
Equipment operation	5	Real-time feedback for lab workflows	(Zhou et al., 2024; Udeozor et al., 2024)
Industry readiness	7	Workplace scenario training and skill transfer	(Fracaro et al., 2021; Toyoda et al., 2023; Protogeros et al., 2025)

3.3 Educational Outcomes

Immersive technologies demonstrated several educational benefits across the reviewed studies, which are summarized in Table 3. These included increased engagement, improved conceptual understanding, heightened safety awareness, enhanced procedural accuracy, better ethical reasoning, and improved learner confidence. In multiple cases, these gains were supported by measurable improvements. For instance, Fracaro et al. (2021) reported a 25% increase in learner retention; Pirola et al. (2020) observed a rise in post-assessment scores from 10.5/30 to 20.8/30 in CDU simulations; Stransky et al. (2021) found statistically significant changes in students' moral schema development through the use of immersive ethical games; Udeozor et al. (2023) found that students trained with VR achieved 30% higher task accuracy than peers using traditional methods; and De Micheli et al. (2022) noted a 22% improvement in post-test scores among novice learners using mixed reality tools.

Table 3: Common educational outcomes reported

Educational outcome	Description	Representative studies
Increased engagement	Higher motivation and participation	(Zhao et al., 2022; Fracaro et al., 2021; Stransky et al., 2021; Gao et al., 2023)
Improved conceptual understanding	Better grasp of abstract/spatial chemical concepts	(von Wedelstedt et al., 2022; Laricheva and Ilikchyan, 2023; Gao et al., 2023)
Heightened safety awareness	Enhanced hazard perception and safety protocol understanding	(Stransky et al., 2021; Hassan et al., 2024)
Greater procedural accuracy	Improved technical execution in simulations	(Udeozor et al., 2024; Zhou et al., 2024)
Enhanced ethical reasoning	Strengthened moral reasoning in safety scenarios	(Fracaro et al., 2021)
Increased confidence	Boosted self-efficacy in lab/industry tasks	(Fracaro et al., 2021; Hassan et al., 2024; Zhou et al., 2024; del Alamo et al., 2022)

3.4 Implementation Challenges

Despite the benefits, the studies reported several barriers to widespread adoption. Table 4 outlines common challenges, including high costs, lack of training, and infrastructure issues.

Table 4: Common barriers to implementation

Challenge	Frequency	Representative studies
High development and hardware costs	12	(Fracaro et al., 2021; Pirola et al., 2020; Laricheva and Ilikchyan, 2023; Gao et al., 2023)
Limited instructor training	9	(Su et al., 2025), (Hassim et al., 2024)
Integration difficulties	8	(Sohail et al., 2025; Tene et al., 2024; Zhou et al., 2024; Gao et al., 2023)
Infrastructure compatibility issues	7	(Zhou et al., 2024; Su et al., 2025; Fracaro et al., 2021)
Lack of longitudinal data	10	(Stransky et al., 2021; Udeozor et al., 2021; Toyoda et al., 2023)

3.5 Industry Collaboration

Only six studies explicitly involved active collaboration with industry stakeholders: Fracaro et al. (2021), Stransky et al. (2021), Udeozor et al. (2021), Hassan et al. (2024), Pirola et al. (2020), and Toyoda et al. (2023). These partnerships contributed to the realism, applicability, and technical relevance of the immersive tools. For example, the CHARMING project (Fracaro et al., 2021) focused on simulating real-world chemical reactor operations and emergency scenarios of operator training, while CUP (Stransky et al., 2021) emphasized ethical decision-making and moral reasoning under process safety pressure. Pirola et al.'s EYE4EDU leveraged AVEVA's industrial simulation software to recreate crude distillation operations with high technical fidelity. However, the majority of studies were developed in purely academic contexts, suggesting an opportunity to strengthen partnerships with industry. Doing so could enhance both the authenticity of training simulations and the employability outcomes for students, while also facilitating wider deployment of VR tools in professional environments.

4 DISCUSSION

The reviewed literature reveals a pedagogical shift toward experiential and integrative learning, increasingly enabled by immersive technologies in chemical engineering and chemistry education. From simulating bioreactor operations (Hassan et al., 2024) to visualizing reaction dynamics in 3D (Zhao et al., 2022), these tools support both conceptual understanding and procedural competence. Notably, tools like MOF-VR and Manta have proven particularly impactful among students with low spatial reasoning skills, improving access to abstract and spatially complex content (Laricheva & Ilikchyan, 2023). Mixed reality platforms like ALETHA (De Micheli et al., 2022) further reinforced this benefit by layering multimodal instructional scaffolding.

Beyond student learning, immersive tools offer clear advantages in professional training. For instance, digital twins improved reaction times by 30% in safety-critical environments (Hassan et al., 2024). Previously discussed tools like CUP and CHARMING exemplify the potential for immersive crisis training and ethical decision-making.

However, implementation challenges persist. Barriers include institutional inertia, inadequate digital infrastructure, and limited instructor training (Su et al., 2025; Toyoda et al., 2023). Many projects remain pilot-based and disconnected from formal curricula. Moreover, the lack of longitudinal studies limits understanding of long-term learning outcomes and real-world skill transfer.

Despite these limitations, the diversity of immersive tools from virtual reality laboratories to augmented reality-based maintenance applications reflects a common goal of bridging theory with practice. Whether designed for cognitive development, procedural fluency, or ethical reasoning, these tools collectively form a supportive ecosystem that addresses the evolving needs of chemical science education.

5 CONCLUSION

Immersive technologies are emerging as transformative tools in chemical engineering and chemistry education. By enabling the simulation of hazardous environments, complex systems, and abstract concepts, platforms such as virtual reality, augmented reality, and mixed reality enhance both conceptual understanding and practical proficiency. However, despite their potential, widespread integration is still constrained by several challenges, including high development costs, limited infrastructure, and insufficient educator training.

To support broader adoption, a phased implementation approach is advisable. Initial pilot projects using open-source platforms, as demonstrated by Protogeros et al. (2025) in agro-food training, provide an accessible entry point for institutions to develop technical capabilities and instructional strategies. As experience and capacity grow, these efforts can be scaled through the establishment of immersive learning centres, cross-disciplinary collaboration, and sustained professional development initiatives.

Institutional strategies should also address several key areas of focus:

1. Developing platform-independent solutions to ensure long-term flexibility and reduce vendor dependence.
2. Promoting equitable access to immersive learning across institutions and student populations.
3. Implementing longitudinal evaluation frameworks to measure impact, skill retention, and return on investment over time.

Finally, strengthening academic–industry partnerships, as highlighted earlier in this review, is essential for aligning educational simulations with real-world expectations and enhancing graduate employability. With thoughtful planning and ongoing institutional commitment, immersive technologies can become a core component of a modern, future-ready chemical engineering curriculum.

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Bridging Theory and Understanding: Development and Evaluation of a Virtual Reality-Based Circuit Theory Module

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ABSTRACT

Circuit theory is a foundational course in electrical and computer engineering programmes. However, students often find the course challenging, especially in visualizing current flow and potential differences in complex circuits. This paper presents the development and evaluation of a Virtual Reality (VR) learning module designed to address these challenges. Based on constructivist learning theory, the VR module was developed using a five-phase methodology, which are the requirement analysis, design, development, implementation, and evaluation. This ensures that the VR module is developed in alignment with the course learning outcomes. The design is focused on interactivity, allowing students to actively explore and build upon prior knowledge through an immersive VR experience. The evaluation consisted of a pre-survey, quiz and post-survey. Students reported that VR enhanced their ability to visualize circuit behavior, making abstract concepts more intuitive. The results showed significant improvement in student motivation, engagement, and understanding. Furthermore, feedback also highlighted the value of traditional teaching methods, especially for theory and its application in circuit analysis. Therefore, utilization of VR as a complementary approach to conventional teaching offers the most effective strategy for circuit theory education. Finally, this work highlights the potential of VR to transform engineering education by bridging the gap between theoretical abstraction and intuitive understanding.

KEYWORDS: Virtual reality, circuit theory, engineering education, constructivist learning theory.

1 INTRODUCTION

Electrical and Electronics Engineering and Computer Engineering study programmes are critical to modern technological advancement. Graduate engineers in these disciplines are driving innovations in areas such as artificial intelligence, and automations in telecommunications, power systems, embedded systems, robotics, and computing. Circuit theory is a fundamental course that provides a strong foundation for many other advanced subjects.

Despite its importance, students often find it challenging to fully grasp concepts such as nodal and mesh analysis, as well as Thevenin's and Norton's theorems, which are essential for analyzing complex

circuits. These circuits typically contain multiple voltage and current sources, along with interconnected resistors, capacitors, and inductors. In analysing these circuits, students must calculate parameters such as voltage drops, current flows, and power dissipation. Making it more challenging, these quantities are abstract in nature and not directly observable, even in a laboratory setting.

2 LITERATURE REVIEW

The emergence of virtual reality (VR) technology and its application in education has attracted growing interest. Numerous studies have examined the effectiveness of VR-based learning environments across a range of disciplines (Rojas-Sánchez, 2023). Research has shown that immersive VR experiences provide enhanced engagement, improved concentration and better knowledge retention (Liu, 2025). Additionally, VR simulations have been recognized for fostering increased understanding, especially in grasping complex concepts (Fitrianto, 2024). By creating immersive and interactive learning experiences, VR has been demonstrated to enhance engagement, focus, and knowledge retention, thereby facilitating a deeper understanding of complex and abstract concepts that are often challenging to master through traditional teaching methods (Asham, 2023).

This scoping review investigates recent studies on the effects of VR on students' motivations (Jiang, 2024). The findings reveal that VR was effective in increasing student's self-motivation. A systematic review was conducted to identify the impact of VR on students' engagement (Lin, 2024). The results show that VR is expected to increase engagement among students in the classroom, especially if adequate training and technical support are provided to the instructors to effectively implement them. Furthermore, another review studied the effectiveness of VR in enhancing student's understanding in achieving the learning outcomes (Conrad, 2024). The study showed that VR is an effective technology with good potential to increase student understanding, especially in learning environments that incorporate active learning and practical application. These studies highlight the immense potential of VR in education to facilitate better motivation, engagement and understanding among learners at all stages of education.

Nevertheless, to the best of our knowledge, the impact of VR on circuit theory education in general and circuit analysis involving Kirchoff Laws in particular, is still not well established. Therefore, this study reports on the development of VR module for circuit theory education, and results on improved students' understanding.

3 METHODOLOGY

The methodology for the development of the VR module for circuit theory comprises five main phases: 1) Requirement analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation (Li, 2024). In the requirement analysis, it was decided that the module will address the Course Learning Outcomes (CLO) that is related to Kirchoff Laws in analyzing complex circuits using nodal and mesh analyses. The targeted students are first year undergraduate students from both Electrical and Electronics Engineering and Computer Engineering programmes.

In the design phase, the VR learning environment is formulated based on the constructivist learning theory, which emphasizes the active construction of knowledge through prior experience and engagement (Marougkas, 2023). In this project, the VR module is not just a visual aid but more of an experiential medium that allows students to interact with circuit elements, experiment with configurations, and develop conceptual understanding through guided exploration.

A storyboard was developed to clearly describe the flow of content and user interaction within the VR environment. It provides a structured guide for organizing learning activities, interactive tasks, and system feedback. The storyboard consisted of three main sections. The 1st section provides an introduction to UTP's VR Electronics Lab, familiarization with the lab equipment and interactive circuit setup, as shown in Figure 1.

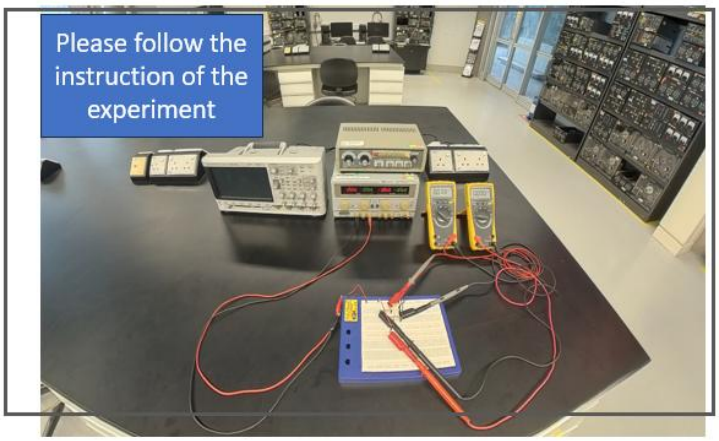


Figure 1: Familiarization with lab equipment and interactive circuit setup

The 2nd section of the storyboard is the main section and focuses on the virtualization of the simple and complex circuits. The simple circuit was given first to provide some scaffolding, allowing students to build foundational understanding through guided exploration. Once the basic concepts were reinforced, a complex circuit involving series-parallel resistor combinations and multiple voltage sources were presented. This progressive structure supports deeper conceptual learning by encouraging students to apply earlier knowledge in progressively challenging circuit scenarios. In these circuit scenes, students can experience interactive elements and gain deeper understanding of the behaviour of voltage potential differences and current flows.

The final and 3rd section of the storyboard involves the assessment component, which features a 10-question interactive quiz designed to consolidate learning and evaluate students' understanding. Immediate feedback is provided at the end of the quiz, allowing learners to reflect on their performance. An opportunity is also provided to revisit the questions, to reinforce key concepts through active recall and correction.

Once the design phase is completed, the development phase is undertaken to translate the storyboard into a fully functional VR learning module. This phase involves the creation and integration of 3D assets, user interface elements, and interactive features. Development is carried out using VR development tools to simulate realistic circuit behavior and ensure smooth user interaction. It is important to note the repeated closed loop iterative testing and refinements to the storyboard design that will be required to ensure an effective VR module development.

The implementation phase involves deploying the completed VR module in a controlled learning setting. The VR module is set up at UTP's Metaverse Lab, which is equipped with the required hardware such as VR headsets. A selected group of 19 students experiences the VR module under close supervision and technical support. This phase allows for observation of user interaction, collection of feedback to identify areas for improvement and ensure the effective function of the VR module.

Finally, the evaluation phase includes assessing student performance and feedback. This will be conducted through a pre-survey, an interactive quiz at the end of VR module (shown in Figure 2) and a post survey. The instrument that measures the CLO attainment is the quiz, which evaluates the student's understanding. On the other hand, the surveys gather data on students' attitudes and perceptions before and after using the VR module. Additionally, student reflections and observations will provide qualitative insights into the learning experience and the effectiveness of the VR modules.

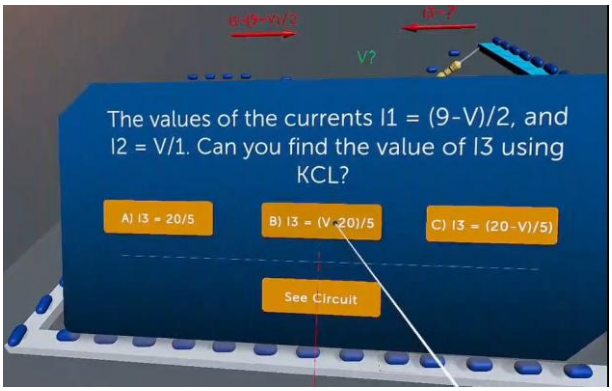
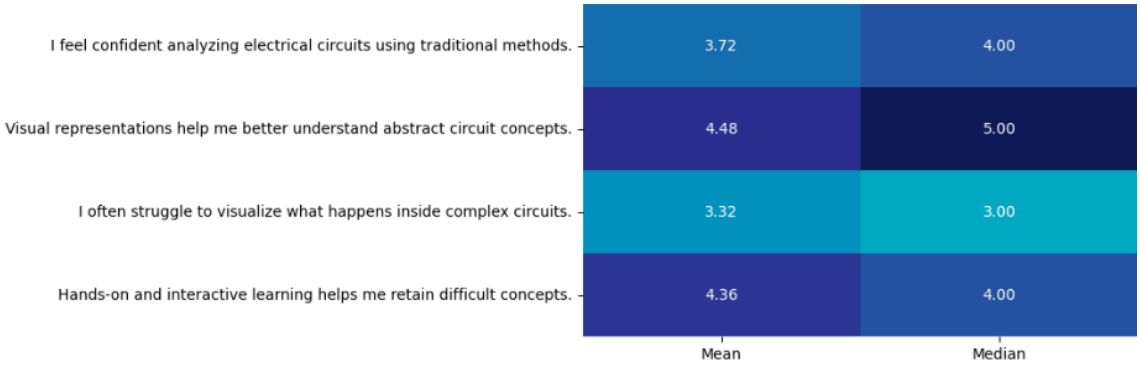


Figure 2: Interactive quiz assessment

4 RESULTS AND DISCUSSION

In this section, the results from the pre-survey, interactive quiz post survey, will be analyzed and presented. In the surveys, a five points Likert scale is used: (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree and (5) Strongly agree. The pre-survey consisted of two groups of questions: 1) Background information and 2) Learning preferences & confidence. In the background information, it is interesting to see that up to 88% of students had no prior experience with VR in a learning environment. This underscores the vast potential of VR in engineering education. On the other hand, most students generally rated their understanding of the Kirchoff laws as good (4/5) although it was marginally lower for nodal and mesh analysis, as can be expected since the analysis is more complex. As for the learning preferences & confidence, the mean and median values for the corresponding statements are shown in Table 1. A highlight is that these responses confirm that students faced challenges in visualizing and understanding the inner workings of the complex circuits.

Table 1: Statistics for learning preferences & confidence survey questions



A 10-question interactive quiz was conducted at the end of the VR session to evaluate the student's understanding. The distribution of the quiz marks is shown in Figure 3. It can be noted that the majority of the students (>93%) did very well in the quiz by scoring more than 7 marks. Almost 20% of students had perfect scores of 10 marks. These scores indicate excellent and improved understanding of the concepts after the VR session.

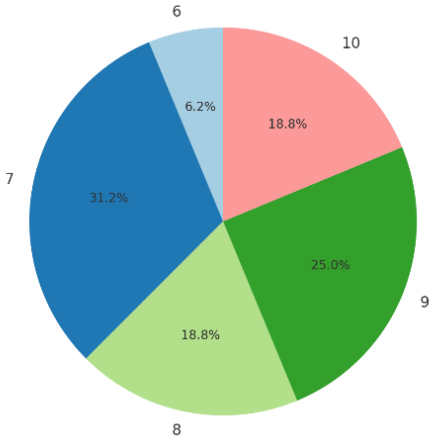


Figure 3: Distribution of quiz marks

The post survey consisted of three groups of questions: 1) Learning experience, 2) Comparison to traditional learning, and 3) Constructivist elements. In terms of learning experience, most students reported a very positive experience, especially with a significantly high level of engagement (mean = 4.74) and improved visualization of abstract concepts (mean = 4.68). These responses show that the immersive nature of VR is very effective in engaging the students and also has the capability to provide improved visualization of abstract concepts in an interactive manner.

When compared to traditional learning, while most students acknowledge the advantages of VR, they also recognize the value of the former and suggest that the most effective approach is to combine both. Nevertheless, 95% of students agreed that the VR module made learning more enjoyable and less intimidating. As for the constructivist elements, all questions were met with positive responses. Students valued self-directed exploration (mean = 4.68) and felt actively constructing knowledge (mean = 4.53), as shown in Figure 4.

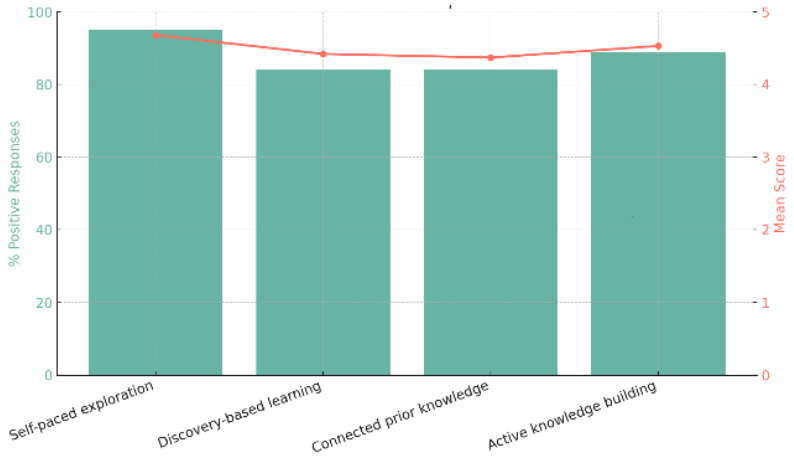


Figure 4: Constructivist elements: Positive response rates and mean scores

Student feedback and reflections were also gathered, with selected highlights presented below:
“Finally understood current flow by seeing it in 3D.”
“Seeing circuits in 3D made everything looks much clearer and way more interactive than just looking at diagrams in the book.”
“It makes it easier to understand abstract concepts.”

“It really brought out the visualization to life. I think it helps seeing where all those currents go and how fast they go through certain node.”
“I learned more by trial-and-error than lectures.”

The results from this study highlight the students’ average confidence and their difficulties in visualizing circuits before the VR session. After the session, the students demonstrated significant improvements in conceptual understanding and confidence. They also enjoyed the interactivity of the VR module and higher level of engagement experienced. These observations were confirmed by their very high scores in the quiz. In overall, these results have shown that the integration of VR into the circuit theory course is highly effective.

5 CONCLUSION

The abstract nature of circuit theory presents significant challenges for students, particularly in understanding and visualizing complex circuits. This study explores how the implementation of VR can enhance students' understanding and engagement in the course. VR offers immersive and interactive experiences that make complex concepts more understandable and intuitive. The VR was developed using a five-phase methodology, ensuring alignment with the learning outcome and based on constructivist theory. Its interactive and iterative design ensures an immersive, captivating and effective VR experience. The results showed improved motivation, engagement, and learning outcomes. Nevertheless, traditional teaching methods such as lectures remain relevant to provide a strong theoretical foundation. Therefore, a blended approach that integrates VR with conventional teaching is the most effective. Finally, the ability of VR in bridging the gap between theory and student’s understanding presents an invaluable tool and promising opportunity for educators globally.

6 ACKNOWLEDGEMENTS

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Kesedaran Penggunaan Aplikasi Berasaskan Kecerdasan Buatan (AI) Dalam Kalangan Pelajar Diploma Pengurusan Sumber Manusia Semester 4 Di Kolej Poly-Tech MARA, Batu Pahat

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ABSTRAK

Penggunaan aplikasi berasaskan kecerdasan buatan (AI) dalam pelajaran semakin berkembang pesat yang mungkin memberikan kesan terhadap potensi dalam merevolusikan sistem pendidikan. Secara amnya, penggunaan aplikasi berasaskan AI menawarkan pelbagai faedah terhadap pendidikan terutama dalam pembelajaran yang memberikan akses kepada pelajar untuk mendapat pelbagai ilmu pengetahuan dari pelbagai sumber, bantuan pembelajaran automatik, dan pemantauan kemajuan pelajar secara terperinci dan berkesan. Oleh itu, kajian ini dijalankan untuk menilai tahap pengetahuan dan kesedaran pelajar Diploma Pengurusan Sumber Manusia Semester 4 di Kolej Poly-Tech MARA, Batu Pahat seramai 77 orang pelajar. Soal selidik ini direka khusus untuk mendapatkan pandangan pelajar tentang manfaat teknologi AI, cabaran yang mungkin dihadapi, serta keperluan untuk melaksanakan langkah strategik bagi memaksimumkan penggunaannya dalam konteks pendidikan. Hasil kajian diharapkan dapat memberikan gambaran yang mendalam tentang bagaimana teknologi AI dapat dimanfaatkan untuk meningkatkan keberkesanan proses pembelajaran. Selain itu, kajian ini juga menekankan pentingnya sokongan berterusan dari institusi pendidikan, pendidik, dan pembuat dasar untuk memanfaatkan potensi AI secara optimum. Kesimpulannya, artikel ini menggariskan kepentingan penggunaan AI dalam meningkatkan keberkesanan proses pembelajaran, mengatasi pelbagai cabaran, dan memperkukuhkan peranan teknologi dalam mempercepat transformasi sistem pendidikan masa depan. Kajian ini diharapkan dapat menjadi panduan berguna untuk institusi pendidikan, pendidik, dan pembuat dasar dalam memanfaatkan potensi teknologi AI secara optimum.

KATA KUNCI
Kecerdasan Buatan, Cabaran Kecerdasan Buatan, Langkah Promosi Kecerdasan Buatan, Manfaat Kecerdasan Buatan, Risiko Kebergantungan

1 PENGENALAN

Dalam era digital yang berkembang pesat, kecerdasan buatan (Artificial Intelligence, AI) telah menjadi salah satu teknologi yang paling berpengaruh dalam pelbagai aspek kehidupan, termasuk dalam bidang pendidikan. Aplikasi berasaskan AI seperti chatbot, sistem penilaian automatik, dan platform pembelajaran adaptif semakin banyak digunakan oleh pelajar sebagai alat sokongan pembelajaran harian. Namun begitu, tahap kesedaran terhadap penggunaan teknologi ini, termasuk kefahaman tentang manfaat, batasan dan isu etika yang berkaitan dengannya, masih menjadi persoalan utama.

Menurut Mohd Yusof dan rakan-rakan (2023), "kesedaran pengguna terhadap aplikasi AI bukan sahaja mempengaruhi keberkesanan penggunaannya, malah turut menentukan sejauh mana teknologi ini dapat dimanfaatkan secara optimum dalam proses pembelajaran." Oleh itu, kajian ini bertujuan untuk meneliti tahap kesedaran pelajar terhadap penggunaan aplikasi AI dan faktor-faktor yang mempengaruhi penerimaan serta penggunaan teknologi ini dalam konteks pendidikan. (Mohd Yusof et al., 2023)

Kajian oleh Lim dan Chia (2022) menunjukkan bahawa walaupun pelajar hari ini tergolong dalam generasi digital, ramai yang masih kurang memahami bagaimana AI berfungsi dan implikasinya terhadap pembelajaran serta etika akademik. Kajian tersebut juga menyatakan bahawa "kebanyakan pelajar hanya menggunakan aplikasi AI sebagai alat menjawab soalan atau menyiapkan tugasan, tanpa menyedari potensi sebenarnya dalam membantu proses pembelajaran kendiri dan pemikiran kritis" (Lim & Chia, 2022). Hal ini menunjukkan bahawa kesedaran bukan sahaja berkait dengan pengetahuan teknikal, tetapi juga melibatkan pemikiran reflektif dan literasi digital yang lebih mendalam. (Lim & Chia, 2022)

Kajian oleh Ismail et al. (2024) mendapati bahawa kesedaran pelajar universiti di Malaysia terhadap Pelan Hala Tuju Kecerdasan Buatan Kebangsaan (AI-Rmap) adalah rendah, dengan hanya 15.1% yang benar-benar memahami objektif dan strategi pelan tersebut. Situasi ini menunjukkan keperluan mendesak untuk meningkatkan kesedaran dan pemahaman pelajar mengenai AI, agar mereka dapat memanfaatkan teknologi ini secara optimum dalam pembelajaran mereka. (Ismail et al., 2024)

Perkembangan pesat teknologi AI memerlukan pelajar bukan sahaja celik teknologi, tetapi juga mempunyai kefahaman yang jelas tentang fungsi, batasan serta impak jangka panjang penggunaan AI terhadap pembelajaran kendiri dan masa depan kerjaya mereka. Oleh itu, pemahaman mendalam mengenai tahap kesedaran ini adalah penting untuk memastikan pelaksanaan teknologi AI dalam pendidikan dapat berlaku secara bertanggungjawab dan beretika.Kecerdasan Buatan (Artificial Intelligence, AI) kini menjadi pemangkin utama dalam transformasi pendidikan global, termasuk di Malaysia. Aplikasi AI seperti sistem pembelajaran adaptif, chatbot pendidikan, dan alat bantu penulisan pintar telah memperkaya pengalaman pembelajaran pelajar dengan menyediakan pendekatan yang lebih peribadi dan interaktif. Namun, tahap kesedaran dan pemahaman pelajar terhadap teknologi ini masih berbeza-beza.

2 KAJIAN LITERATUR

Kecerdasan Buatan (AI) semakin mendapat tempat dalam bidang pendidikan, terutamanya melalui aplikasi seperti ChatGPT, QuillBot, dan alat bantu pembelajaran lain. Namun, tahap kesedaran dan penerimaan pelajar terhadap teknologi ini berbeza-beza bergantung kepada latar belakang, bidang pengajian, dan pendedahan mereka terhadap teknologi terkini.

Satu kajian mengenai tahap pengetahuan dan kekerapan penggunaan Artificial Intelligence (AI) dalam kalangan pelajar oleh Khairul Anuar Mohd Radzali et al. (2024) di Politeknik Ungku Omar mendapati bahawa lebih 80% pelajar dalam program Diploma Teknologi Maklumat (DIT) dan Diploma Teknologi Digital (DDT) mengetahui serta kerap menggunakan aplikasi berasaskan AI dalam pembelajaran

mereka. Ini menunjukkan tahap kesedaran yang tinggi dalam kalangan pelajar teknikal terhadap penggunaan AI. (Mohd Razali & Mohd Safian, 2024)

Dalam kajian oleh Salbihana Samsudin et al. (2024), bakal guru menyatakan persepsi pelajar dalam penggunaan Artificial Intelligence (AI) dalam pembelajaran bahawa aplikasi AI memudahkan pencarian bahan pengajaran (100%), meningkatkan minat murid (95.3%), dan membantu dalam menentukan kaedah pengajaran yang sesuai (86.3%). Walau bagaimanapun, 98.1% tidak bersetuju bahawa AI dapat membentuk akhlak dan adab murid, menunjukkan kebimbangan terhadap aspek nilai dan etika dalam penggunaan AI. (Samsudin et al., 2024)

Terdapat cabaran dan etika dalam penggunaan Kecerdasan Buatan (AI) yang sering diperkatakan dalam pendidikan di Malaysia. Kajian oleh Intan Idura Mohamad Isa dan Hishamuddin Ahmad (2024) menekankan cabaran dalam penggunaan AI untuk pentaksiran prestasi akademik pelajar. Antara isu yang dibangkitkan termasuk kebimbangan terhadap integriti akademik, privasi data, dan kekurangan faktor manusia dalam teknologi AI. Ini menunjukkan perlunya garis panduan etika yang jelas dalam penggunaan AI dalam pendidikan. (Mohamad Isa & Ahmad, 2024)

Dalam satu kajian oleh Noorasmahwati Md. Diah dan Sufian Mastor (2024) di Kolej Komuniti Paya Besar mendapati bahawa pelajar Sijil Teknologi Maklumat menunjukkan kesediaan yang tinggi dalam menggunakan aplikasi ChatGPT untuk pembelajaran pengaturcaraan. Ini menunjukkan potensi AI dalam meningkatkan minat dan kefahaman pelajar dalam subjek teknikal. (Md. Diah & Mastor, 2024). Kajian menunjukkan bahawa kesedaran dan penggunaan aplikasi berasaskan AI dalam kalangan pelajar semakin meningkat, khususnya dalam bidang teknikal.

Namun, untuk memastikan penggunaan yang berkesan dan beretika, adalah penting untuk menyediakan pendidikan berkaitan etika AI, menawarkan latihan serta sokongan kepada pelajar dan pendidik, dan menjalankan penyelidikan lanjutan tentang kesan jangka panjang teknologi ini terhadap pencapaian akademik serta pembangunan nilai pelajar. Dengan pemahaman yang lebih mendalam terhadap tahap kesedaran ini, institusi pendidikan dapat merangka strategi yang sesuai untuk mengintegrasikan AI secara menyeluruh dan bertanggungjawab dalam sistem pembelajaran. (Abas, 2025)

3 PERNYATAAN MASALAH

Penggunaan aplikasi berasaskan kecerdasan buatan (AI) dalam bidang pendidikan kini berkembang dengan pesat dan berpotensi merevolusikan sistem pembelajaran. AI menawarkan pelbagai kemudahan kepada pelajar seperti akses maklumat yang lebih cepat, pembelajaran tersuai, pembantu pembelajaran automatik, dan keupayaan membuat keputusan berdasarkan data. Namun begitu, tahap pengetahuan dan kesedaran dalam kalangan pelajar terhadap potensi AI dalam pendidikan masih berada pada tahap yang membimbangkan (Almalki & Aziz, 2021). Kajian mendapati ramai pelajar tidak memahami sepenuhnya bagaimana AI dapat dimanfaatkan dalam konteks pembelajaran mereka, sekali gus menimbulkan jurang antara keupayaan teknologi yang tersedia dengan penggunaannya dalam pendidikan (Holmes et al., 2019). Justeru, satu kajian diperlukan untuk menilai tahap kefahaman dan kesedaran pelajar terhadap ideologi dan penggunaan teknologi AI dalam konteks pendidikan. Kajian ini penting bagi membantu pelajar, pendidik dan pembuat dasar memahami bagaimana AI boleh digunakan secara berkesan, etikal dan strategik dalam proses pembelajaran dan pembangunan pendidikan.

4 PERSOALAN KAJIAN

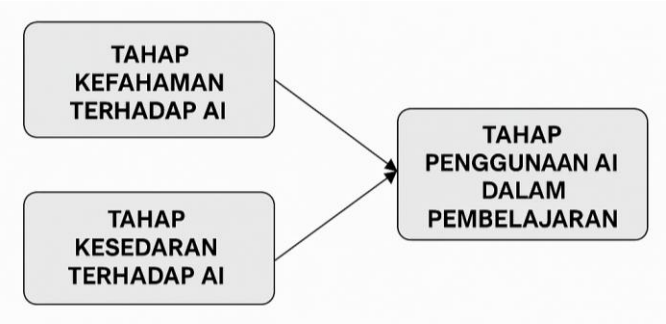
Persoalan kajian ini adalah seperti berikut:

4.1 Apakah tahap kefahaman pelajar terhadap penggunaan aplikasi berasaskan kecerdasan buatan (AI)?

4.2 Apakah tahap kesedaran pelajar terhadap penggunaan aplikasi berasaskan kecerdasan buatan (AI)?

4.3 Apakah terdapat hubungan yang signifikan di antara tahap kefahaman dan kesedaran pelajar terhadap penggunaan aplikasi berasaskan kecerdasan buatan (AI)?

Kajian ini berdasarkan kepada kerangka kajian seperti Rajah 1 di bawah:



Rajah 1: Kerangka Asas Konseptual Kajian

5 METODOLOGI

Kajian kuantitatif digunakan untuk kajian ini dengan pemilihan responden secara rawak dari pelajar semester 4 Diploma Pengurusan Sumber Manusia dari Kolej Poly-Tech MARA, Batu Pahat. Instrumen kajian yang dipilih untuk mengumpul data daripada responden ialah soal selidik. Soal selidik dibahagikan kepada dua bahagian yang membincangkan maklumat yang diperlukan untuk dicapai objektif kajian.

Bahagian A merangkumi data demografi responden, manakala Bahagian B mengandungi item-item yang menilai tahap kesedaran dan kefahaman pelajar terhadap penggunaan aplikasi kecerdasan buatan (AI). Soalan 1 hingga 5 memberi tumpuan kepada kefahaman pelajar terhadap aplikasi AI, manakala soalan 6 hingga 10 menilai tahap kesedaran mereka terhadap penggunaan aplikasi tersebut. Kesemua soalan dalam Bahagian B menggunakan skala Likert lima mata, iaitu daripada "sangat tidak setuju" hingga "sangat setuju". Senarai item soalan bagi Bahagian B dipaparkan dalam Jadual 1.

Jadual 1: Item Soal Selidik

No	Item
1	Saya tahu tentang Kecerdasan Buatan (AI)
2	Saya faham teknologi AI seperti ChatGPT mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit
3	Saya faham teknologi AI mempunyai kecerdasan emosi dan empati yang terhad, yang boleh membawa kepada output yang tidak sensitif atau tidak sesuai
4	Saya faham teknologi AI mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit
5	Saya faham teknologi AI boleh mempamerkan berat sebelah dan ketidakadilan dalam pengeluarannya

6	Saya percaya AI akan memberi impak yang ketara kepada pelbagai aspek kehidupan harian kita pada masa hadapan.
7	Teknologi AI mempunyai potensi untuk meningkatkan kebolehcapaian dan keterangkuman dalam pendidikan.
8	Menggunakan teknologi AI untuk menyelesaikan tugasan menjejaskan nilai pendidikan.
9	Saya percaya teknologi AI boleh meningkatkan kecekapan digital saya dan menjimatkan masa
10	Secara keseluruhannya, saya percaya teknologi AI akan memberi kesan positif kepada masyarakat dalam jangka masa panjang.

Soal selidik dilakukan menggunakan *Google Form* dan pautan kepada soal selidik diedarkan kepada responden melalui mesej WhatsApp. Pengedaran soal selidik telah dijalankan dalam tempoh 1 minggu pada bulan Mac 2025 untuk mengumpulkan bilangan respons yang mencukupi untuk analisis kajian awal. Data yang dikumpul telah diperiksa menggunakan analisis deskriptif untuk menggambarkan profil demografi, dan maklumat dianalisa menggunakan *The Jamovi Project* bagi mendapatkan min dan sisihan piawai.

6 DAPATAN KAJIAN

Kajian ini meneliti persepsi pelajar terhadap teknologi Kecerdasan Buatan (AI) dari segi pengetahuan, potensi impak, dan isu etika. Hasil menunjukkan pelajar mempunyai tahap kesedaran dan kefahaman yang tinggi.

Jadual 2: Kekerapan Mengikut Semester / Seksyen

Semester / Seksyen	Bilangan	Bil. Jumlah %	Kumulatif %
4 SECTION 1	22	28.6%	28.6%
4 SECTION 2	19	24.7%	53.2%
4 SECTION 3	23	29.9%	83.1%
4 SECTION 4	13	16.9%	100.0%

Responden kajian terdiri daripada 77 orang pelajar Semester 4 yang dibahagikan kepada empat seksyen. Agihan tertinggi adalah dari Seksyen 3 sebanyak 29.9%, diikuti oleh Seksyen 1 (28.6%), Seksyen 2 (24.7%), dan Seksyen 4 (16.9%).

Jadual 3: Soalan 1 - Saya tahu tentang Kecerdasan Buatan (AI)

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
3	15	19.5%	19.5%
4	38	49.4%	68.8%

5	24	31.2%	100.0%

Berdasarkan Jadual , majoriti pelajar menyatakan mereka tahu tentang Kecerdasan Buatan (AI), dengan 49.4% memberikan skor 4 dan 31.2% memberikan skor 5. Hanya 19.5% yang memberi skor 3, menunjukkan tahap pengetahuan yang tinggi secara keseluruhan dalam kalangan responden.

Jadual 4: Soalan 2 - Saya faham teknologi AI seperti ChatGPT mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
2	1	1.3%	1.3%
3	8	10.4%	11.7%
4	41	53.2%	64.9%
5	27	35.1%	100.0%

Sebanyak 88.3% responden memberikan skor 4 dan 5, menunjukkan kefahaman tinggi terhadap keterbatasan AI seperti ChatGPT dalam melaksanakan tugas rumit. Hanya 1.3% memberikan skor rendah (2), menandakan kesedaran umum yang tinggi.

Jadual 5: Soalan 3 - Saya faham teknologi AI mempunyai kecerdasan emosi dan empati yang terhad, yang boleh membawa kepada output yang tidak sensitif atau tidak sesuai

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
3	17	22.1%	22.1%
4	40	51.9%	74.0%
5	20	26.0%	100.0%

77.9% pelajar memberikan skor 4 dan 5, mencerminkan kefahaman bahawa AI mempunyai keterbatasan dari segi emosi dan empati. Selebihnya (22.1%) memberikan skor 3, menunjukkan sebahagian masih kurang pasti.

Jadual 6: Soalan 4 - Saya faham teknologi AI mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
2	1	1.3%	1.3%
3	8	10.4%	11.7%
4	43	55.8%	67.5%
5	25	32.5%	100.0%

Majoriti pelajar (88.3%) memberikan skor 4 dan 5, selari dengan dapatan Soalan 2. Ini mengukuhkan kefahaman pelajar terhadap kekangan AI dalam menyelesaikan tugasan kompleks

Jadual 7: Soalan 5 Saya faham teknologi AI boleh mempamerkan berat sebelah dan ketidakadilan dalam pengeluarannya

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
2	2	2.6%	2.6%
3	21	27.3%	29.9%
4	35	45.5%	75.3%
5	19	24.7%	100.0%

Sebanyak 70.2% memberikan skor 4 dan 5, menunjukkan kesedaran terhadap isu etika dan potensi bias dalam AI. Walau bagaimanapun, 27.3% memberi skor 3, menandakan keperluan kepada pendedahan lanjut.

Jadual 8: Soalan 6 Saya percaya AI akan memberi impak yang ketara kepada pelbagai aspek kehidupan harian kita pada masa hadapan.

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
2	1	1.3%	1.3%
3	9	11.7%	13.0%
4	41	53.2%	66.2%
5	26	33.8%	100.0%

Sebanyak 87% responden memberikan skor 4 dan 5, menunjukkan keyakinan tinggi bahawa AI akan memberi impak besar dalam kehidupan harian pada masa hadapan.

Jadual 9: Soalan 7 Teknologi AI mempunyai potensi untuk meningkatkan kebolehcapaian dan keterangkuman dalam pendidikan.

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
1	1	1.3%	1.3%
2	1	1.3%	2.6%
3	13	16.9%	19.5%
4	40	51.9%	71.4%
5	22	28.6%	100.0%

80.5% pelajar memberikan skor 4 dan 5, menandakan keyakinan terhadap potensi AI dalam memperluas keterangkuman pendidikan. Hanya 2.6% memberi skor rendah (1 dan 2).

Jadual 10: Soalan 8 Menggunakan teknologi AI untuk menyelesaikan tugasan menjejaskan nilai pendidikan.

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
1	1	1.3%	1.3%
2	6	7.8%	9.1%
3	22	28.6%	37.7%
4	29	37.7%	75.3%
5	19	24.7%	100.0%

Sebanyak 62.4% responden memberikan skor 4 dan 5, menunjukkan kebimbangan bahawa penggunaan AI untuk tugasan boleh menjejaskan nilai pendidikan. 28.6% memberi skor 3, mencerminkan pandangan bercampur.

Jadual 11: Soalan 9 Saya percaya teknologi AI boleh meningkatkan kecekapan digital saya dan menjimatkan masa

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
1	1	1.3%	1.3%
3	12	15.6%	16.9%
4	43	55.8%	72.7%
5	21	27.3%	100.0%

Sebanyak 83.1% pelajar memberikan skor 4 dan 5, menunjukkan kepercayaan bahawa AI membantu meningkatkan kecekapan digital dan menjimatkan masa.

Jadual 12: Soalan 10 Secara keseluruhannya, saya percaya teknologi AI akan memberi kesan positif kepada masyarakat dalam jangka masa panjang.

Skor	Bilangan	Bil. Jumlah %	Kumulatif %
2	1	1.3%	1.3%
3	22	28.6%	29.9%
4	34	44.2%	74.0%
5	20	26.0%	100.0%

Sebanyak 70.2% responden memberi skor 4 dan 5, menunjukkan pandangan positif terhadap kesan jangka panjang AI kepada masyarakat. Namun, 28.6% memberikan skor 3, menunjukkan sebahagian pelajar masih berhati-hati.

Jadual 13: Dapatan Deskriptif

No. Soalan	Soalan	Mean	Median	Mod	Jumlah	Sisihan piawai	Min
1	Saya tahu tentang Kecerdasan Buatan (AI).	4.12	4	4.00	317	0.707	3
2	Saya faham teknologi AI seperti ChatGPT mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit.	4.22	4	4.00	325	0.681	2
3	Saya faham teknologi AI mempunyai kecerdasan emosi dan empati yang terhad, yang boleh membawa kepada output yang tidak sensitif atau tidak sesuai.	4.04	4	4.00	311	0.697	3
4	Saya faham teknologi AI mempunyai had dalam keupayaan mereka untuk mengendalikan tugas yang rumit.	4.19	4	4.00	323	0.670	2
5	Saya faham teknologi AI boleh mempamerkan berat sebelah dan ketidakadilan dalam pengeluarannya.	3.92	4	4.00	302	0.791	2
6	Saya percaya AI akan memberi impak yang ketara kepada pelbagai aspek kehidupan harian kita pada masa hadapan.	4.19	4	4.00	323	0.689	2
7	Teknologi AI mempunyai potensi untuk meningkatkan kebolehcapaian dan keterangkuman dalam pendidikan.	4.05	4	4.00	312	0.793	1
8	Menggunakan teknologi AI untuk menyelesaikan tugasan menjejaskan nilai pendidikan.	3.77	4	4.00	290	0.958	1
9	Saya percaya teknologi AI boleh meningkatkan kecekapan digital saya dan menjimatkan masa.	4.08	4	4.00	314	0.739	1
10	Secara keseluruhannya, saya percaya teknologi AI akan memberi kesan positif kepada masyarakat dalam jangka masa panjang.	3.95	4	4.00	304	0.776	2

7 PERBINCANGAN

7.1 Tahap Pengetahuan dan Kefahaman Terhadap AI

Dapatan soal selidik menunjukkan pelajar mempunyai tahap pengetahuan dan kefahaman yang tinggi terhadap teknologi Kecerdasan Buatan (AI). Soalan 1, dengan min 4.12, menunjukkan bahawa majoriti pelajar menyedari kewujudan AI. Selain itu, soalan 2 dan 4, yang masing-masing mencatatkan min 4.22 dan 4.19, menunjukkan kefahaman yang jelas terhadap had keupayaan AI dalam melaksanakan tugas rumit. Pelajar juga sedar bahawa AI mempunyai kecerdasan emosi dan empati yang terhad, seperti yang tercatat pada soalan 3 dengan min 4.04. Dapatan ini sejajar dengan kajian oleh Kaur et al. (2023) yang menyatakan bahawa golongan muda lebih cepat memahami kelemahan AI, terutamanya dalam interaksi sosial dan moral.

7.2 Kesedaran Etika dan Risiko Bias

Kesedaran pelajar terhadap isu etika dalam teknologi AI juga jelas. Soalan 5, dengan min 3.92, menunjukkan bahawa pelajar sedar akan risiko bias dan ketidakadilan yang mungkin timbul dalam penggunaan AI. Walaupun begitu, sisihan piawai yang lebih tinggi (0.791) mencerminkan variasi pendapat yang wujud di kalangan responden mengenai sejauh mana isu ini penting. Hal ini konsisten dengan kajian etika AI yang mengingatkan bahawa AI boleh mewarisi bias dari data yang digunakan (Floridi et al., 2018). Oleh itu, kesedaran mengenai ketelusan algoritma dan etika penggunaannya amat penting dalam kalangan pelajar.

7.3 Keyakinan Terhadap Impak Positif AI

Pelajar secara umum mempunyai keyakinan yang tinggi terhadap impak positif teknologi AI. Soalan 6 dan 10 menunjukkan min 4.19 dan 3.95, yang mencerminkan kepercayaan bahawa AI akan memberikan impak besar terhadap kehidupan harian dan manfaat kepada masyarakat dalam jangka panjang. Di samping itu, soalan 7 dan 9 menunjukkan min 4.05 dan 4.08, menunjukkan keyakinan bahawa AI dapat meningkatkan kebolehcapaian dan kecekapan digital dalam pendidikan. Keputusan ini sejajar dengan kajian Luckin et al. (2016), yang mendapati AI dapat memperluas akses pendidikan dan mempercepatkan penyampaian kandungan pembelajaran yang lebih diperibadikan.

7.4 Kebimbangan terhadap Nilai Pendidikan

Walaupun pelajar menunjukkan keyakinan terhadap kelebihan AI, terdapat kebimbangan terhadap kesan penggunaannya terhadap nilai pendidikan. Soalan 8 mencatatkan min 3.77, dengan sisihan piawai tertinggi (0.958), mencerminkan pandangan bercampur-campur mengenai penggunaan AI untuk menyelesaikan tugasan. Sebahagian pelajar berpendapat bahawa penggunaan AI boleh merosakkan integriti akademik dan mengurangkan nilai pembelajaran sebenar. Isu ini juga dibincangkan dalam kajian Cotton et al. (2023), yang menekankan bahawa aplikasi AI seperti ChatGPT berpotensi disalah guna dalam penulisan tugasan atau ujian, memperlihatkan perlunya garis panduan etika yang jelas dalam penggunaan teknologi AI.

8 KESIMPULAN DAN IMPLIKASI

Secara keseluruhannya, kajian ini menunjukkan bahawa pelajar Diploma Pengurusan Sumber Manusia Semester 4 di Kolej Poly-Tech MARA Batu Pahat memiliki tahap pengetahuan dan kesedaran yang tinggi terhadap penggunaan aplikasi berasaskan kecerdasan buatan (AI) dalam pembelajaran. Majoriti pelajar memahami fungsi serta batasan teknologi AI, termasuk keupayaannya dalam meningkatkan kecekapan digital, mempercepat akses maklumat dan menyokong pembelajaran kendiri. Pada masa yang sama, mereka turut menyedari risiko etika seperti kecenderungan bias algoritma serta kebimbangan terhadap kemungkinan penyalahgunaan AI yang boleh menjejaskan nilai pendidikan dan integriti akademik. Walaupun pelajar secara umumnya bersikap positif terhadap peranan AI dalam memperkasa sistem pendidikan, kewujudan kebimbangan ini menunjukkan bahawa penggunaan teknologi ini masih

memerlukan panduan yang jelas dan pendekatan yang lebih seimbang. Justeru, kajian ini menegaskan keperluan kepada usaha yang lebih sistematik dalam memastikan penggunaan AI dalam pendidikan berlaku secara bijak, beretika dan bertanggungjawab. Kajian ini turut memberi implikasi bahawa institusi pendidikan perlu memperkukuh literasi AI dalam kalangan pelajar melalui kurikulum yang merangkumi aspek teknikal dan etika. Pendidik juga harus diberi latihan untuk mengaplikasikan AI secara berkesan dalam pengajaran. Selain itu, garis panduan penggunaan AI yang jelas perlu dibangunkan bagi mengelakkan penyalahgunaan dan menjaga integriti akademik. Pelajar turut memerlukan pendedahan terhadap dasar nasional seperti Pelan Hala Tuju AI bagi meningkatkan kesedaran sivik dan persediaan kerjaya masa depan. Secara keseluruhan, penggunaan AI dalam pendidikan perlu disokong oleh penerapan nilai dan etika agar manfaatnya dapat dioptimumkan secara berhemah dan bertanggungjawab.

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Perception of Interactive Basic Computer Concept using Smart AR among Diploma in Digital Marketing Students at KPTM Ipoh

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ABSTRACT

The integration of technology in the field of education has shown that the use of technology has been able to increase motivation in the learning process. Augmented Reality (AR) technology is one of the technologies that has the potential to develop virtual objects into the real world that are interactive in reality. This will help to attract the interest in understanding the contents. Introduction to Information Technology is one of the courses in the Diploma in Digital Marketing program at Kolej Poly-Tech MARA Ipoh. A chapter has been selected from the content to build interactive content using augmented reality technology. Students only refer to notes that have been uploaded in any Learning Management System (LMS) platform. It is possible that students are less interested in reading notes and find it difficult to understand the content. There are no interactive activities that occurred during the learning process. Apart from that, the development of this innovative application was developed due to the lack of reference materials that use augmented reality-based learning in the market. The objectives of this project are to create interactive learning using Smart AR as well as to enhance students' understanding on the selected topic. Research about Smart AR will be conducted to find the Smart AR usage in other lessons. Based on the research, the idea to create interactive learning using Smart AR has been identified for selected topics. Augmented reality apps will be used to scan the code that has been matched. Once the code is matched, an object will be displayed in the real environment. The use of this application is expected to have a better effect on lecturers and students to formal learning methods due to the increased use of smartphones and mobile devices among students. As a result of this innovative idea, students are expected to use this application as an effective reference material for learning activities. The result of this innovative idea is to encourage the students to access teaching materials easily at any time.

KEYWORDS: Smart AR; Augmented Reality; Interactive Learning; Learning Management System

1 INTRODUCTION

The integration of information and communication technologies (ICT) in education and training is steadily growing day by day. The education system has placed significant emphasis on utilizing ICT in

classrooms, with substantial efforts directed towards equipping schools with advanced tools and interactive teaching technologies (Sural, I. 2018). Recently, one of the biggest opportunities is augmented reality. New possibilities for teaching and learning provided by augmented reality have been increasingly recognized by educational researchers. Augmented reality is such a technology that offers a new educational approach in helping learners develop critical capacity and deeper understanding of the concepts underlying scientific investigation.

Augmented reality is an emerging technology that blends physical objects with virtual reality. "Augmented Reality" has become an emergent technology with great possibilities for its use in education (Akcayir and Akcayir, 2017). It allows for the combination of digital and physical information in real time through different technological formats such as tablets or smartphones to create this new reality, which has had repercussions in the number of applications created for augmented reality (Fombona et. al, 2017). Augmented reality is an emerging form of experience in which the real world is enhanced by computer-generated content which is tied to specific locations and/or activities (Yuen et. al, 2011). In simple terms, augmented reality allows digital content to be seamlessly overlaid and mixed into our perceptions of the real world. In addition to the 2D and 3D objects which many may expect, digital assets such as audio and video files, textual information, and even olfactory or tactile information can be incorporated into users' perceptions of the real world. Augmented reality refers to a wide spectrum of technologies that project computer generated materials, such as text, images, and video, onto users' perceptions of the real world.

Introduction to Information Technology is one of the courses in the Digital Marketing Diploma program. As usual, this theory course is taught using traditional methods only. Students will be taught in a lecture room and students will refer to the notes that have been given in a particular medium. It is likely that students are less interested in reading the notes and find it difficult to understand the content. No interactive activities take place during the learning process. Therefore, a Smart AR application development was developed to create interactive learning using Smart AR as well as improve students' understanding of the chosen topic. In addition, the development of this innovative application was developed due to the lack of reference materials that use augmented reality-based learning in the market.

One of the chapters was selected from the content to build interactive content that uses augmented reality technology. The use of this application is expected to give lecturers and students a better effect on formal learning methods following the increase in the use of smartphones and mobile devices among students. This study also aims to know the perception using Smart AR among Digital Marketing students at KPTM Ipoh in interactive basic computer concepts.

The following research questions will guide this study:

i. What is the function of Smart AR in learning the basic computer concept subject?

ii. What is the perception among students regarding this Smart AR Application?

iii. How can this application increase interest among students for learning the basic computer concept subject?

The findings of the current study will contribute to the current literature on perception using Smart AR among Digital Marketing students at KPTM Ipoh in interactive basic computer concepts. More importantly, the current study may know this application might increase interest among students for learning the basic computer concept subject. The study was made by obtaining a random sampling of 50 students from Digital Marketing KPTM Ipoh students. Questionnaire instruments were developed to obtain the information in the form of structured questions and open-ended questions.

Interactive basic computer learning using Smart AR is an innovative educational application designed to teach fundamental computer skills through the power of augmented reality. This cutting-edge tool transforms traditional computer lessons into engaging, interactive experiences, making learning more effective and enjoyable.

The application covers a wide range of basic computer skills, from operating system navigation and file management to using essential software applications. The use of this application is expected to have a better effect on lecturers and students to formal learning methods due to the increased use of smartphones and mobile devices among students.

As a result, students are expected to be able to use this application as an effective reference material for learning activities. The result is to encourage students to access teaching materials easily at any time.

2 RESEARCH METHODS

This study employed a quantitative research design aimed at exploring students' perceptions in using the Smart AR application for learning interactive basic computer concepts. A survey method was used, with a questionnaire as the primary instrument for data collection as well as open ended questions to study the interest of using the Smart AR.

The population of the study consisted of students enrolled in the Diploma in Digital Marketing program at Kolej Poly-Tech MARA (KPTM) Ipoh who were taking the Introduction to Information Technology course. A total of 74 students were selected as the study sample using the simple random sampling method. This method ensured that each student in the target population had an equal chance of being selected as a respondent. This sampling method was chosen to minimize selection bias and ensure the reliability and validity of the study data. As stated by Creswell (2014), simple random sampling is appropriate when researchers want to ensure that every individual in the population has an equal chance of being selected, without the need for grouping into specific strata.

Data were collected using a structured questionnaire based on a five-point likert scale to measure levels of perception and interest among students. The questionnaire consisted of several sections, including: (i) student demographic information, (ii) perceptions of using AR applications in learning and (iii) level of interest in using interactive technology.

The data were analyzed descriptively using statistical software such as SPSS. Descriptive statistics such as mean, percentage, and frequency distribution were used to describe the levels of perception and interest among students regarding the use of augmented reality applications. Open ended question was used to identify the advantages and disadvantages of using augmented reality applications to learn basic computer concepts.

In the implementation of this study, several ethical considerations have been taken into account to ensure the integrity and rights of the participants are preserved. Each participant will be given a clear briefing on the objectives of the study, and informed consent will be obtained before the data collection process is carried out. To maintain confidentiality, all collected data will be anonymized, and any personal identifying information will be removed to ensure participants' privacy. In addition, participation in this study is entirely voluntary, and participants have the right to withdraw from the study at any time without any academic implications or penalties.

However, this study has several limitations that need to be taken into account. First, the scope of the study is limited to Digital Marketing Diploma students at Kolej Poly-Tech MARA (KPTM) Ipoh, which may restrict the applicability of the findings to other institutions or fields. Additionally, there is a possibility of technical issues involving the devices or augmented reality applications used, which could affect students' perceptions and learning experiences. Furthermore, this study relies entirely on self-reported data from participants, which may be susceptible to perception bias or information inaccuracies due to individual factors.

3 RESULTS AND DISCUSSIONS

Table 1 shows both the frequency and percentage of responses for augmented reality (AR)experience.

Table 1 Augmented reality (AR) experience

Augmented Reality (AR) Experience	**Frequency**	**Percentage**
Yes	50	67.57%
No	24	32.43%

The respondents' initial exposure to augmented reality technology is used to understand the context of user interaction with the Smart AR application, as well as the perceptions of augmented reality based educational tools. Based on the findings, 67.57% of respondents have previously used augmented reality apps. This suggests that they are generally aware of this technology and they may be more willing to adapt to instructional tools that combine augmented reality. One-third or 32.43% of respondents had never used an AR application before discovering the Smart AR system.

Table 2 presents the perceptions of users regarding the effectiveness and usability of the Smart AR application in learning basic computer concepts. Each item reflects a specific aspect of user experience, including helpfulness, effectiveness, usability, engagement and increased interest in learning.

Table 2 Perceptions of Users

Item	Perception	Mean
1	The Smart AR application is helpful in understanding basic computer concepts.	4.36
2	The Smart AR application is effective compared to traditional learning methods for understanding basic computer concepts.	4.30
3	The usability of the Smart AR application.	4.18
4	The Smart AR application makes learning more engaging.	4.28
5	The Smart AR increased interest in learning basic computer concepts.	4.49

The findings show positive use of Smart AR applications among students to learn basic computer concepts. The highest average score is from Item 5, which is 4.49, indicating that the Smart AR application not only supports learning but also enhances students' motivation and interest. The Smart AR application is also found to be effective as a tool for understanding basic computer concepts. This is shown in an average of 4.36 for Item 1 where the tool can help improve learning outcomes. Meanwhile, the comparison between the use of the Smart AR application and traditional methods shows an average value of 4.30. This means that students find the approach of using this tool to be more effective compared to traditional methods. For the usability of this Smart AR application, the average score shows 4.18, which refers to a high level of usability satisfaction among students. Generally, this application is user friendly and accessible. A score of 4.28 for the item on using the Smart AR application to make learning more engaging indicates that students find the tool interactive and capable of stimulating learning to better understand basic computer concepts. In conclusion, the Smart AR application is an effective tool to help students understand, motivate, increase interest, and assist as a better alternative to using traditional methods for learning basic computer concepts.

Based on the results from the survey among students regarding the strengths and weaknesses of the Smart AR application, it shows that the application provides many benefits to enhance students' learning experience in understanding basic computer concepts. Respondents have repeatedly stated that this application makes learning more enjoyable, more engaging, less boring and entertaining. The elements of fun were highlighted in the immersive nature of augmented reality respondents, making this application provide a more interactive learning experience compared to traditional methods. Additionally, comments such as interactive and fun, interesting to learn, a great tool for learning and good for lessons, highlight a high level of satisfaction among participants. Moreover, the respondents commented as follows to express the 3D and multimedia features, show things in 3D, show internal parts, show real-time steps and enhance visual explanation. These visual components allow students to see how a part functions and simulate steps that are impossible to perform, thereby creating a realistic and immersive learning experience.

Respondents also stated that there was an improvement in understanding basic computer concepts while using the Smart AR application, such as helps understand things better, enhances my understanding, helps with memory recall and enhances memory retention. The respondents felt that the content was easier to understand, with clear and interactive explanations that supported better knowledge retention. Furthermore, respondents provided the following feedback to indicate that this application can be used anytime and anywhere. Watch the video anywhere, easily access the notes, practice anywhere and repeat learning items most of the time. This supports self-directed learning and meets the needs of various learning styles and environments. Besides, respondents stated easy to use the application, easy to learn the subject and makes navigation easier to indicate that the Smart AR application is user friendly. It shows that this application supports active participation and self-directed learning among students.

As a result of the findings, the data collected has shown the strengths of Smart AR. These findings do not provide direct negative feedback regarding the use of the application in learning. This finding highlights that the Smart AR application is a highly effective and engaging educational tool for teaching basic computer concepts. It helps in transforming basic computer concepts into a visual, interactive, and user-friendly experience. Although most feedback is positive, future improvements could focus on the development of more in-depth content, the addition of collaborative features, and ensuring accessibility for all students in various learning contexts.

4 CONCLUSION

This study highlights the significant impact of the Smart AR application on enhancing students' engagement, understanding, and interest in learning basic computer concepts. With 67.57% of respondents already having prior experience with AR, it is evident that a majority of students are interested in augmented reality based instructional methods. Even among those without prior exposure, the Smart AR application proved to be user-friendly and accessible, encouraging wide adoption and positive learning experiences. Students reported high levels of satisfaction with the application's usability, interactivity, and effectiveness, as reflected by consistently high mean scores across all evaluation items. Notably, the application not only enhanced their understanding of basic computer concepts but also increased motivation, engagement, and interest in learning. These results are similar to those reported by Pellas et. al (2019), student motivation can be enhanced in the learning process by providing a better learning experience and that subsequently has a positive impact on students.

The immersive and interactive nature of the augmented reality experience such as 3D visuals, real-time simulations and multimedia content was repeatedly praised by users for making lessons more enjoyable, memorable and easier to comprehend. The integration of augmented reality technology allowed for better visualization of abstract concepts, increased motivation, and facilitated memory retention. This aligns with previous research by Gopalan et. al (2023), which found that the understanding of learning contents in a 3D format can be enhanced using augmented reality because it enables visualization from different perspectives. The students' thinking process can be stimulated, and thus the learning process will provide a better perception. Moreover, the ease of access and user-friendly interface supported autonomous learning, enabling students to revisit content at their convenience. These results affirm that the Smart AR

application offers a compelling alternative to conventional teaching methods, particularly in subjects that benefit from interactive and visual representation. As such, Smart AR serves as a promising innovation in educational technology, particularly within higher education settings that aim to foster technology-enhanced learning environments. A broadly similar point has also recently been made by Wang, Lin, and Lu (2023), that a comfortable and enjoyable environment is an advantage that students receive through the interactive learning process using augmented reality. In addition, students can use augmented reality for the learning process anytime and anywhere because it is more flexible and does not require a formal classroom. Therefore, the repetition of the learning process is easy to do for the purpose of learning knowledge in depth.

Based on the positive responses and feedback obtained from the study, several key suggestions can be made to further improve the implementation and effectiveness of the Smart AR application in the teaching and learning of basic computer concepts. Firstly, it is recommended that the content of the application be expanded to cover more topics from the basic computer concepts syllabus. By broadening the range of topics, students will have the opportunity to experience interactive learning across the entire course, thereby deepening their understanding and engagement. Secondly, future development of the application should consider incorporating collaborative features that promote peer interaction and group-based learning. Such enhancements could include options for students to work on shared activities, provide peer feedback or engage in real-time discussions within the augmented reality environment, which would further support social learning and critical thinking.

Another important consideration is the optimization of the application across various devices to ensure that all students, regardless of the type of smartphone or mobile device they own, are able to access and use the tool effectively. In addition, accessibility features such as support for screen readers, customizable text sizes, and alternative navigation methods should be included to accommodate students with diverse needs, particularly those with disabilities. Furthermore, it is essential that educators receive adequate training and support in using augmented reality technology within their teaching practices. Institutions are encouraged to organize professional development workshops and provide teaching resources that help lecturers effectively integrate Smart AR into their instructional methods. Such initiatives would ensure that the pedagogical potential of the technology is fully realized.

Further research could usefully explore a longitudinal approach to evaluate the long-term impact of Smart AR on student learning outcomes and knowledge retention. By tracking students' progress over a longer period and comparing it with traditional teaching approaches, a more comprehensive understanding of the application's educational effectiveness can be achieved.

In conclusion, the Smart AR application has successfully transformed traditional learning of basic computer concepts into a more dynamic, interactive, and student-centred experience. It demonstrates significant potential to serve as a model for future educational tools that incorporate augmented reality technology, aligning with the needs of 21st-century learners and supporting improved educational outcomes through innovation in teaching and learning strategies.

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Bibliometrics Analysis of Economics Teaching and Learning: Year 2000-2024

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ABSTRACT

Economics teaching and learning is vital to the education field because it equips students with analytical frameworks to understand complex societal problems, provides essential tools for making informed personal and policy decisions, and fosters critical thinking skills that enable individuals to navigate an increasingly interconnected global economy where resource allocation, market dynamics, and policy impacts affect virtually all aspects of modern life. Due to this, the bibliometrics analysis is implemented to examine the trends of research in economics teaching and learning published between year 2000-2024 using Scopus database. Two types of analysis which are performance analysis and science mapping is performed via Scopus database analysis, VOSViewer and Harzing's Publish or Perish software. The results found that there are 2,609 documents retrieved after search refinement has been made. From this documents, United States of America is leading the publication and trends of economics teaching and learning.

KEYWORDS: bibliometrics analysis, economics teaching and learning, economics, VOSViewer, Harzings.

1 INTRODUCTION

Bibliometrics analysis represents a powerful quantitative approach to evaluate and map the structural and dynamic aspects of scholarly literature within a specific field. As defined by Pritchard (1969), bibliometrics is "the application of mathematical and statistical methods to books and other media of communication." This methodological framework employs statistical techniques to analyze patterns in published literature, including citation counts, authorship networks, institutional collaborations, and thematic trends (Van Eck & Waltman, 2014). By systematically examining these bibliographic data, researchers can identify influential works, trace the intellectual evolution of a discipline, and uncover emerging research fronts that shape scholarly discourse.

The importance of bibliometrics in contemporary academic research cannot be overstated. According to Aria and Cuccurullo (2017), bibliometric analysis provides an objective basis for evaluating research performance and impact across institutions, countries, and individual scholars. In the context of economics

teaching and learning, bibliometric approaches offer valuable insights into how pedagogical methods, curricular frameworks, and educational technologies have evolved over time. Mingers and Leydesdorff (2015) emphasize that bibliometrics transcends simple counting metrics to reveal the social structures and knowledge networks that underpin scientific communities, thereby illuminating both the intellectual and social dimensions of academic fields.

Furthermore, bibliometric analysis serves as an essential tool for identifying research gaps and future directions. Hallinger and Kovačević (2019) demonstrate how mapping the intellectual landscape of a field can guide scholars toward unexplored territories and promising research avenues. For policymakers and educational administrators, bibliometric insights can inform strategic decision-making regarding resource allocation, curriculum development, and pedagogical innovation (Zupic & Čater, 2015). As economics education continues to evolve in response to changing economic realities and educational paradigms, bibliometric approaches provide an evidence-based framework for understanding where the field has been and where it might be headed.

1.1 Research Gap

The bibliometrics analysis in education is relatively new (Karantali & Panagiotidis, 2023). The trends of scholarly literature and research in economics teaching and learning has been by several researchers but the string or Boolean operators in the search strategy only involve economics education. Though economic education enables the researchers to see the trends in wider perspective and larger database, it is imperative to see the economics teaching and learning to expand and extend the bibliometrics studies. This is because economics teaching and learning gives more focused and pedagogy-and-andragogy-oriented perspective. Thus, this study tries to close the gaps by assessing the patterns and trends in scholarly literature for economics teaching and learning.

1.2 Research Question

RQ 1: What are the research trends in economics teaching and learning for year 2000 until 2024?
RQ 2: Who and how much has been published in the area with regard to the authors, their affiliated organisations and countries?
RQ 3: What is the co-occurrence, co-citation, and countries' collaboration in economics teaching and learning for year 2000-2024?
RQ 4: What are the most cited articles for economics teaching and learning for year 2000-2024?

1.3 Research Objectives

RO 1: To assess the research trends in economics teaching and learning for year 2000 until 2024.
RO 2: To examine the most influential authors, the affiliations, and countries that produced most in economics teaching and learning for year 2000-2024.
RO 3: To assess the co-occurrence, co-citation and countries' collaboration in economics teaching and learning for year 2000-2024.
RO 4: To identify and analyse the most influential scholarly works in economics teaching and learning measured by citation counts during the 2000-2024 period.

2 LITERATURE REVIEW

Karantali & Panagiotidis (2023) in economics education using Scopus database from 1985 until 2022, also by Yiğittekin et. al., (2025) which using Web of Science (WOS) database from 1970 until 2024. Other researchers such as Romi Kurniadi (2023) identifying the economics education in Fourth Industrial

Revolution using Google Scholar database for year 2017 until 2022. Another study by Kusworo Kusworo et al., (2024) performed bibliometrics analysis on microlearning and economics learning in higher education using data published from 2014-2022. Other notable mention here is the study by Kazak et al., (2024) on the bibliometrics analysis in STEM education in the field of finance, economics and management using WOS database up to January 2024.

The landscape of economics teaching and learning has undergone significant transformation since the early 2000s, with particular acceleration following the 2008 global financial crisis. This period saw increasing critiques of conventional economics pedagogy, which traditionally emphasized abstract theoretical models with limited real-world application. Becker (2004) documented the persistence of lecture-based instruction and mathematical formalism in undergraduate economics education, while Colander and McGoldrick (2009) argued for more pluralistic approaches that incorporate diverse theoretical perspectives and emphasize contextual understanding.

The technological evolution in economics education represents another significant trend during this period. Goffe and Kauper (2014) found that while lecture remained the dominant teaching method, instructors increasingly incorporated digital tools and active learning strategies. The COVID-19 pandemic accelerated digital transformation in economics teaching, with Becker and Watts (2020) cataloguing rapid adoption of virtual learning environments, asynchronous instruction techniques, and digital assessment tools. Hansen et al., (2002) found that this forced experimentation with online and hybrid formats led to lasting pedagogical innovations, particularly in assessment practices and the integration of real-time economic data analysis in coursework.

Recent research has increasingly focused on developing students' economic literacy through teaching approaches that emphasize critical thinking and real-world applications. Simultaneously, there has been growing interest in diversifying economics education to address persistent gaps in representation. Aernie et al., (1999) examined how inclusive pedagogical practices can address the underrepresentation of women and minorities in economics, while Bayer et al., (2020) demonstrated how curriculum diversification and alternative teaching methods can broaden participation in the discipline. These developments reflect a broader shift toward what Bowles and Carlin (2020) term "*new paradigm economics teaching*," which emphasizes real-world problems, empirical evidence, and the social embeddedness of economic systems rather than abstract optimization exercises divorced from institutional context.

3 METHODOLOGY

Bibliometrics means the combination, managing and investigation of bibliographic information obtained from publications which are scientific in nature (Verbeek et al., 2002). Along with general descriptive statistics, such as, publishing journals, publication year and main author classification (Wu and Wu, 2017); it also comprises complex techniques, such as, document co-citation analysis. An iterative sequence of suitable keywords, literature search and analysis are required for an effective review of literature, bibliography building and achieving reliable results, respectively (Fahimnia et al., 2015).

The bibliometrics analysis procedure will follow the Donthu et al., (2021) as in the following diagram. It starts with the aim and scope of bibliometrics analysis. In this study, the aims and scope of bibliometrics is economics teaching and learning. Step 2 is the determination of techniques for bibliometrics analysis. In this study, the technique is examining the past and present thus the co-word and co-citation will be reported. Step 3 is the determination of database. In this study, Scopus database is chosen due to high-quality publications is indexed here and the accessibility and availability of the database. For this step, the researcher include only publication in English language and exclude all publication in other languages. Step 4 is the bibliometrics analysis which include performance analysis and science mapping, which will answer

the research questions determined upfront. For performance analysis, the Scopus analysis data will be used and for science mapping, the VOS Viewer will be used to analyse the co-occurrence and co-citation.

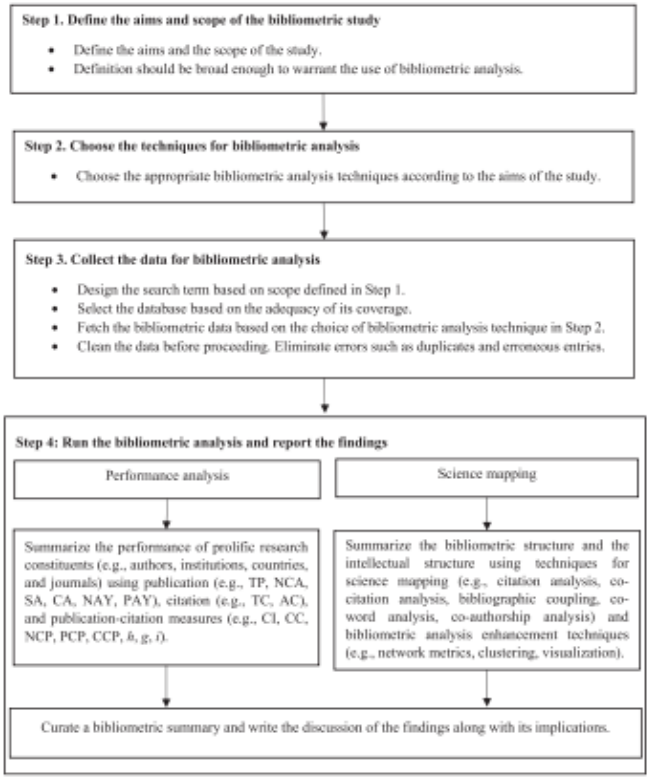


Figure 1: Bibliometrics analysis procedure
Source: Donthu et al., (2021), pg. 294

3.1 Data Search Strategy

Study employed a screening sequence to determine the search terms for article retrieval. Study was initiated by querying Scopus database with online TITLE-ABS-KEY (economics AND teaching AND learning) AND (EXCLUDE (LANGUAGE , "Afrikaans") OR EXCLUDE (LANGUAGE , "Dutch") OR EXCLUDE (LANGUAGE , "Hungarian") OR EXCLUDE (LANGUAGE , "Korean") OR EXCLUDE (LANGUAGE , "Lithuanian") OR EXCLUDE (LANGUAGE , "Norwegian") OR EXCLUDE (LANGUAGE , "Persian") OR EXCLUDE (LANGUAGE , "Thai") OR EXCLUDE (LANGUAGE , "Turkish") OR EXCLUDE (LANGUAGE , "Arabic") OR EXCLUDE (LANGUAGE , "Polish") OR EXCLUDE (LANGUAGE , "Undefined") OR EXCLUDE (LANGUAGE , "Croatian") OR EXCLUDE (LANGUAGE , "Slovenian") OR EXCLUDE (LANGUAGE , "Ukrainian") OR EXCLUDE (LANGUAGE , "Japanese") OR EXCLUDE (LANGUAGE , "Italian") OR EXCLUDE (LANGUAGE , "Portuguese") OR EXCLUDE (LANGUAGE , "Chinese") OR EXCLUDE (LANGUAGE , "French") OR EXCLUDE (LANGUAGE , "Russian") OR EXCLUDE (LANGUAGE , "German") OR EXCLUDE (LANGUAGE , "Spanish") The final search string refinement included 2609 articles which is used for bibliometric analysis. articles from Scopus database from year 2000 until 2024 relating to economics teaching and learning.

3.2 Data Analysis

Data sets containing the study publication year, publication title, author name, journal, citation and keyword in Plaintext format were acquired from Scopus database covering the period 2000 to 2024 and was analysed in VOS viewer software version 1.6.15. This software was utilized for analysis and formation of maps by employing the VOS clustering and mapping methods. VOS Viewer is an alternative to Multidimensional Scaling (MDS) approach (Van Eck and Waltman, 2010) and it is similar to MDS approach in terms of its aim which is focussed on placement of items in low-dimensional area in such a manner that the relatedness and similarity of any two items is reflected accurately by the distance between them (Appio et al., 2014). Unlike MDS, which is focussed on the computation of similarity measures such as Jaccard indexes and cosine, VOS implements a more suitable technique for normalising co-occurrence frequencies (Van Eck and Waltman, 2007), such as, the association strength (ASij) and it is calculated as:

$$ASij ¼ Cij Wiwj$$

which is "proportional to the ratio between on the one hand the observed number of cooccurrences of i and j and on the other hand the expected number of co-occurrences of i and j under the assumption that co-occurrences of i and j are statistically independent" (Van Eck and Waltman, 2010, p. 531).

Hence, with help of this index, VOS viewer places items in the form of a map after reducing the weighted sum of the squared distances between all item pairs. According to Appio et al. (2016), the LinLog/modularity normalization was implemented. Furthermore, by applying visualisation techniques through VOSviewer to the data set, patterns built on mathematical relationships were uncovered and analyses such as keyword co-occurrence, citation analysis and co-citation analysis were performed. Development of research area during a period can be explored by keyword co-occurrence analysis (Zhao, 2017) and is successful in identifying popular topics in different fields (Li et al., 2016). Whereas, citation analysis is useful in identifying key research issues, trends and techniques, along with exploring the historical relevance of a discipline's main area of focus (Allahverdiyev and Yucesoy, 2017). Document co-citation analysis is one of the frequently applied bibliometric methods (Appio et al., 2016; Fahimnia et al., 2015) and its result is map dependent on the network theory to identify relevant structure of data.

4 FINDINGS

RQ 1: What are the research trends in economics teaching and learning for year 2000 until 2024?

The publication rate started quite low in 2000, with approximately 25 documents per year, and remained relatively stable until around 2003. From 2003 to 2006, there was a modest increase to about 55 documents annually, followed by a slight dip around 2007. Beginning in 2008, the field experienced consistent growth, with publications steadily increasing year over year through 2016, reaching approximately 135 documents annually.

Between 2016 and 2018, publication numbers plateaued briefly before resuming growth from 2019 to 2022, reaching a peak of about 215 documents in 2022. The data shows some volatility in the most recent years, with a noticeable dip in 2023 followed by a recovery in 2024, ending at approximately 210 documents.

This overall pattern suggests growing academic interest in Economics education over the past two decades, with the most significant acceleration occurring after 2018, potentially indicating increased focus on teaching methods, learning outcomes, and pedagogical research in the field of Economics.

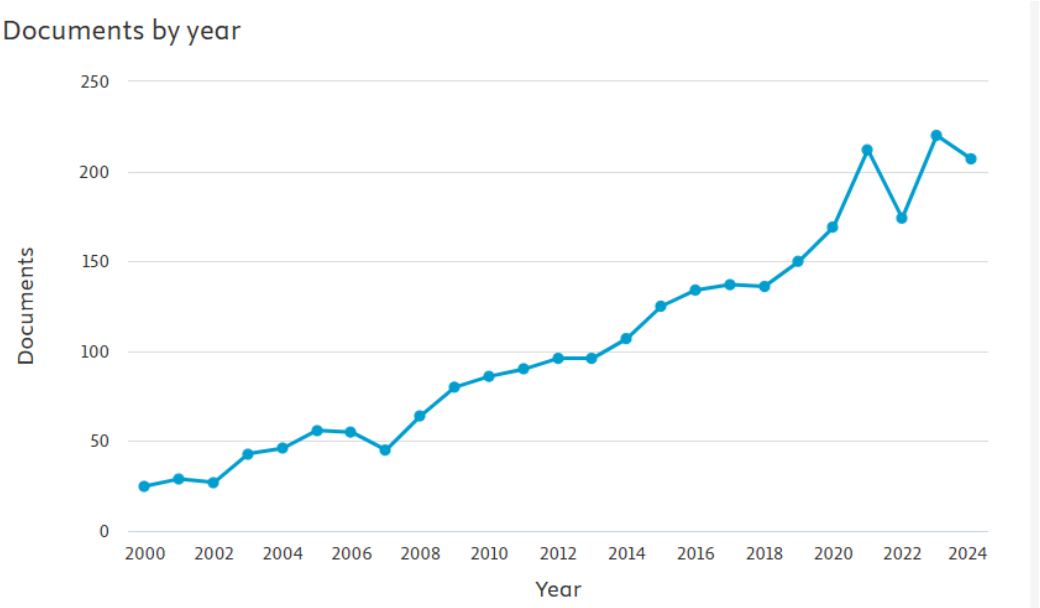


Figure 2: Documents by Year

The publication rate in Economics teaching and learning started at just 25 documents in 2000, showing minimal growth initially with only 29 documents in 2001 and 27 in 2002. A more noticeable increase began in 2003 (43) and continued through 2006 (55), followed by a slight decline in 2007 (45). From 2008 (64), there was consistent annual growth through 2016 (134), with the pace of increase becoming more substantial after 2013. The years 2016-2018 showed a plateau period (134, 137, and 136 documents respectively), before another significant growth phase began.

The most dramatic increases occurred in recent years, with notable jumps from 2019 (150) to 2020 (169) and then to 2021 (212). After a slight dip in 2022 (174), publications reached their highest point in 2023 (220) before slightly decreasing to 207 in 2024. Overall, this represents an approximately 728% increase in the number of publications from 2000 to the peak in 2023, indicating substantially growing academic interest in Economics education research over this quarter-century period.

Table 1: Documents by year

Year	**Documents published**
2024	207
2023	220
2022	174
2021	212
2020	169
2019	150
2018	136
2017	137
2016	134
2015	125
2014	107
2013	96
2012	96
2011	90
2010	86
2009	80
2008	64

2007	45
2006	55
2005	56
2004	46
2003	43
2002	27
2001	29
2000	25

RQ 2: Who and how much has been published in the area with regard to the authors, their affiliated organisations and countries?

Figure 3 displays the publication output of the most prolific authors in economics teaching and learning research. Van Wyk, M.M. clearly stands as the dominant contributor with approximately 12 documents, significantly outpacing all other researchers. The next three most productive authors—Al-Bahrani, A., Zlatkin-Troitschanskaia, O., and Aleksic-Maslac, K.—form a secondary tier with between 7-8 publications each.

A middle group of authors including Asarta, C.J., Harter, C., Sierra, J., and Van Wyk, M.M. (possibly the same author as the top contributor but with different capitalization) have each published around 6 documents. Completing the list are Maier, M.H. and Simkins, S.P., who have contributed approximately 5 documents each.

Interestingly, there appears to be potential duplication with Van Wyk, M.M. listed twice with different capitalizations, which may indicate either database inconsistency or the presence of two different researchers with similar names. The overall distribution reveals a field where a small number of dedicated scholars are disproportionately influencing the research landscape, with Van Wyk, M.M. establishing a particularly strong presence in economics education literature.

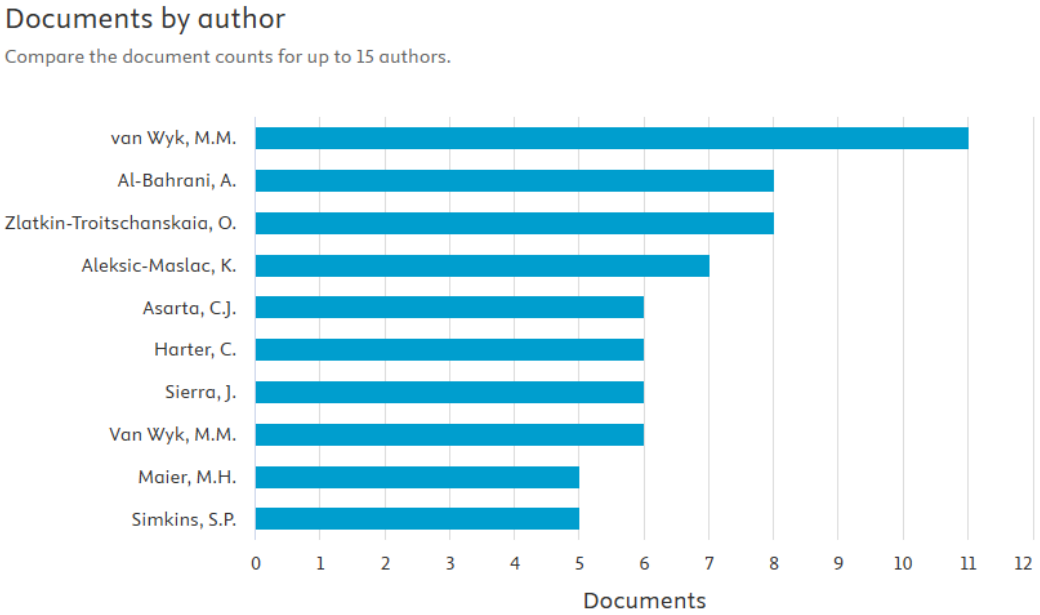


Figure 3: Documents by Author

Figure 4 reveals a striking disparity in publication output in economics teaching and learning research across nations. The United States dominates the field with approximately 750 documents, nearly

four times more than its closest competitors. China and the United Kingdom form a second tier, each producing around 200 documents, while Australia follows with approximately 150 publications.

There's a clear step-down to the next group of nations—Spain, Russian Federation, and Germany—each contributing between 75-125 documents. South Africa, India, and Canada form a middle tier with roughly 75 documents each, while Malaysia, Indonesia, Czech Republic, Italy, and Sweden round out the list with modest contributions of fewer than 50 documents each.

This distribution highlights the overwhelming influence of Western, particularly American, academic institutions in economics education research. It also shows emerging contributions from developing economies like China, Russia, South Africa, and Southeast Asian nations, suggesting growing global interest in economics pedagogy. The significant gap between the United States and other countries indicates potential opportunities for greater international collaboration and development of research capacity in economics education across more diverse geographic contexts.

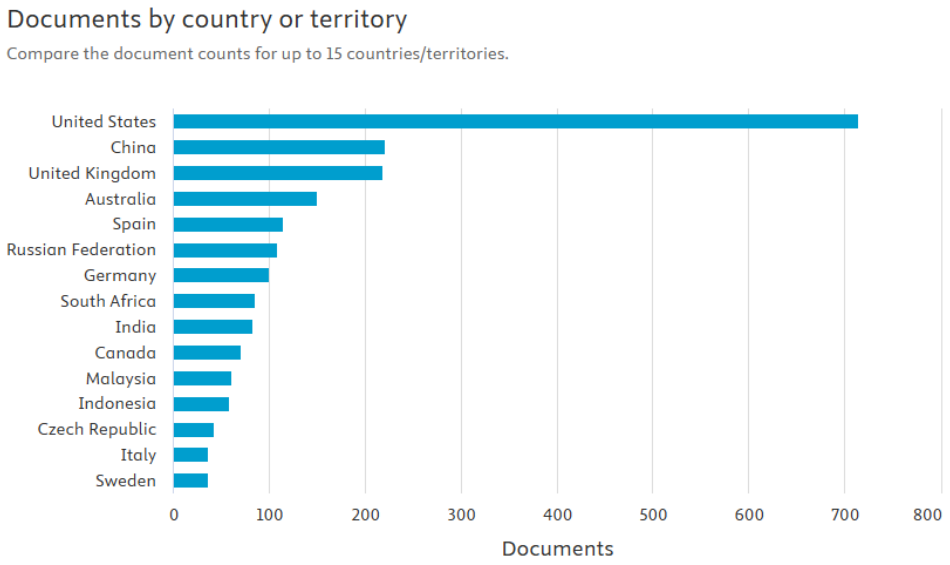


Figure 4: Documents by Country or Territory

The United States stands as the overwhelming leader with 713 publications, accounting for approximately 34% of the output among the top 15 countries. This dominance likely reflects the country's extensive higher education system, substantial research funding, and historical prominence in economics as a discipline. China and the United Kingdom form a clear second tier with nearly identical contributions (220 and 217 documents respectively), demonstrating strong but significantly smaller research communities compared to the US. Australia follows with 149 publications, creating a distinct gap between the top four nations and others.

A middle group of European and Eurasian countries—Spain (114), Russian Federation (107), and Germany (99)—contribute substantially but at less than half the rate of US-based institutions. The meaningful presence of South Africa (84) and India (82) in the top ten highlights growing contributions from countries outside the traditional Western research power houses. Remaining countries—Canada (70), Malaysia (60), Indonesia (57), Czech Republic (41), and Italy and Sweden (tied at 35)—show more modest but still significant participation. The presence of Southeast Asian nations like Malaysia and Indonesia among the top contributors signals the expanding geographic diversity of scholarship in economics education.

This distribution suggests both established patterns of Western academic dominance and an evolving landscape where developing economies are increasingly participating in and contributing to global discourse on economics teaching and learning methodologies.

Table 2: Documents by country

Country	Documents Published
United States	713
China	220
United Kingdom	217
Australia	149
Spain	114
Russian Federation	107
Germany	99
South Africa	84
India	82
Canada	70
Malaysia	60
Indonesia	57
Czech Republic	41
Italy	35
Sweden	35

Documents by affiliation

Figure 5 shows interesting patterns in institutional contributions to economics teaching and learning research. The University of South Africa stands out as the most prolific institution with approximately 23-24 publications, significantly outpacing all other affiliations. This dominance is particularly notable given that South Africa ranks eighth in country-level output, suggesting concentrated research activity within this specific institution. Monash University in Australia follows with about 18 documents, establishing itself as the second most productive center for economics education research. The remaining institutions form a relatively homogeneous group with similar output levels ranging between 12-15 documents each.

The geographic diversity among top-contributing institutions is striking, with representation from South Africa (University of South Africa, University of Pretoria), Australia (Monash University, The University of Sydney), the United States (University of Kentucky, Purdue University), the United Kingdom (University College London), Hungary (Budapest University of Technology), Germany (Johannes Gutenberg-Universität Mainz), and Russia (Kazan Federal University).

This institutional distribution presents a more balanced international picture than the country-level data, which showed strong US dominance. While American universities appear in the top ten, they don't dominate the institutional rankings, suggesting that economics education research excellence is distributed across multiple countries with centers of expertise emerging in various regions globally. The strong showing of institutions from countries like South Africa and Hungary highlights how specific universities can establish significant research presence in this field regardless of their country's overall output.

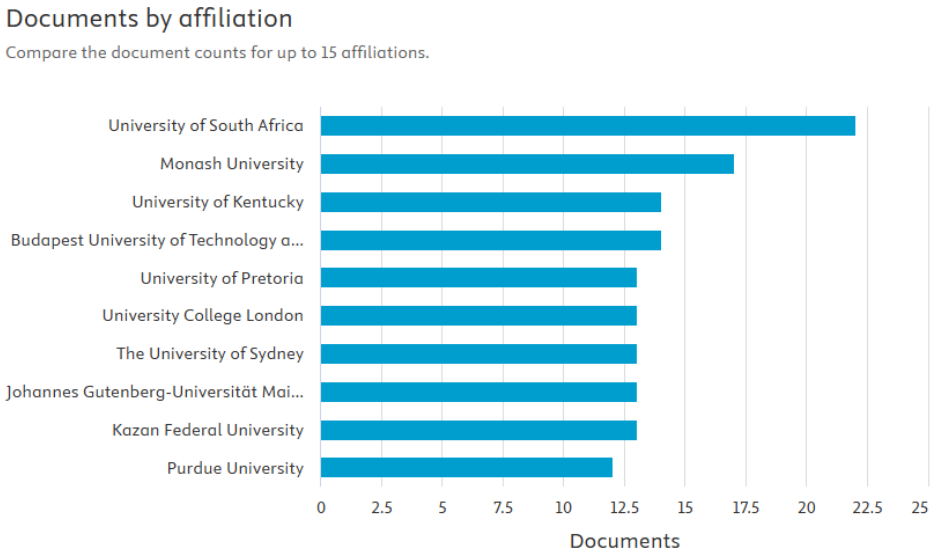


Figure 5: Documents by Affiliation

The landscape of research on economics teaching and learning during 2000-2024 reveals notable institutional contributions with significant geographic diversity. The University of South Africa emerges as the dominant contributor with 22 articles, substantially outpacing other institutions including Monash University (17 articles) and a cluster of universities producing between 11-14 publications each. This institutional distribution spans multiple continents, with representation from South Africa, Australia, Europe (UK, Germany, Hungary, Russia, Spain), and North America (USA), demonstrating the global nature of scholarly interest in economics education despite varying levels of research intensity

The institutional landscape further reveals an interesting mix of established research powerhouses like Harvard University and University College London alongside less globally prominent institutions such as Kazan Federal University and HSE University. This diverse representation suggests that research on economics teaching and learning is not concentrated exclusively among traditionally dominant academic centers, but rather constitutes a field where various institutions across the development spectrum are making meaningful contributions, potentially bringing diverse perspectives and approaches to economics education research based on their unique educational contexts and challenges.

Table 3: Documents by Affiliation

Affiliation	**Documents Published**
University of South Africa	22
Monash University	17
University of Kentucky	14
Budapest University of Technology and Economics	14
University of Pretoria	13
University College London	13
The University of Sydney	13
Johannes Gutenberg Universität Mainz	13
Kazan Federal University	13
Purdue University	12
Harvard University	12
HSE University	12
Universitat de València	11
The University of Arizona	11

University of Wollongong	11
Universidad de Salamanca	11

The data from Scopus database also reveals that Universiti Teknologi MARA and Universiti Pendidikan Sultan Idris are the leading institutions in Malaysia producing articles on Economics teaching and learning, each with 10 publications. This suggests a strong focus on pedagogical research and development within these universities. Following them, Universiti Utara Malaysia contributes a significant 7 articles, indicating a continued interest in this area. Universiti Kebangsaan Malaysia and Universiti Sains Malaysia, with 6 and 5 articles respectively, demonstrate a moderate level of research activity. Overall, the data highlights a consistent output of research in Economics teaching and learning from several Malaysian universities, with a clear concentration of publications from the top two institutions.

Table 4: Documents by Affiliation from Malaysia:

Affiliation from Malaysia	**Documents Published**
Universiti Teknologi MARA	10
Universiti Pendidikan Sultan Idris	10
Universiti Utara Malaysia	7
Universiti Kebangsaan Malaysia	6
Universiti Sains Malaysia	5

RQ 3: What is the co-occurrence, co-citation, and countries' collaboration in economics teaching and learning for year 2000-2024?

Figure 6 illustrates the co-occurrence of terms in articles related to Economics Teaching and Learning from 2000 to 2024, revealing distinct thematic clusters. The largest cluster, centered around "students" and "economics," emphasizes the learner-centric approach, highlighting terms like "student diversity," "learning styles," and "students' interests," suggesting a focus on individualizing instruction and addressing diverse student needs. The "economics education" node connects this cluster to "higher education" and "teaching methods," indicating a strong emphasis on pedagogical strategies and institutional contexts. Another significant cluster revolves around "learning," encompassing "adaptive learning," "critical thinking," and "case study," demonstrating a focus on cognitive development and active learning approaches. The "human" cluster, linked to "male," "procedures," and "cost-benefit analysis," suggests an exploration of practical applications of economics, possibly in healthcare or public policy contexts. The "dental education" and "faculty" nodes, along with "english for specific purposes," form a smaller cluster, indicating research exploring economics education in specialized fields. Overall, the diagram reveals a multifaceted approach to Economics Teaching and Learning, encompassing student-centered pedagogy, cognitive development, practical applications, and interdisciplinary connections.

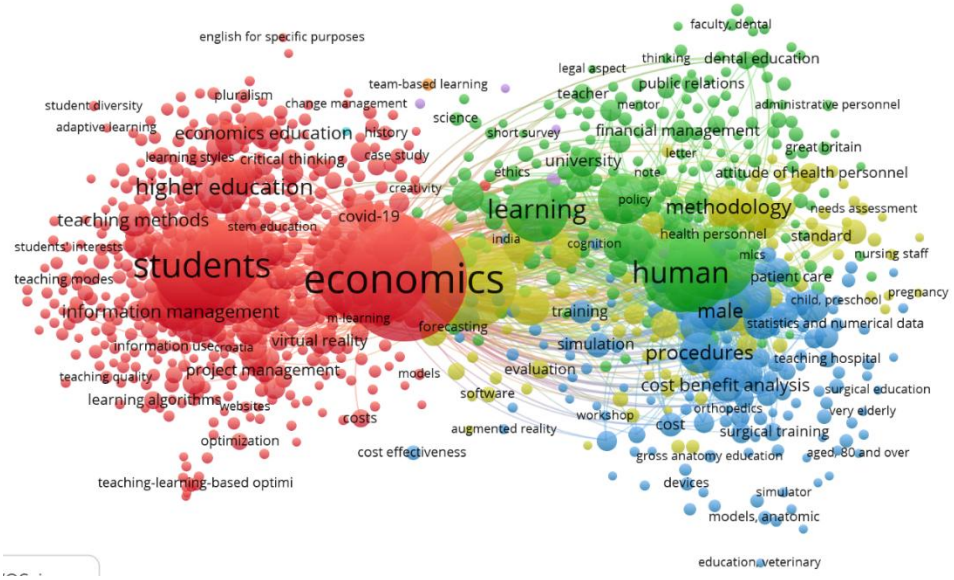


Figure 6: Network visualization map of keywords' co-occurrence of the theme

Cluster 1

Cluster 1, dominated by the nodes "economics," "students," "higher education," "teaching methods," and "economics education," represents the core domain of research focused on the **fundamental aspects of teaching and learning economics within academic settings**. "Economics" serves as the central node, indicating the subject matter itself, while "students" highlights the primary focus on the learners. "Higher education" emphasizes the institutional context in which economics is taught, suggesting research on curriculum design, program development, and the role of economics within universities. "Teaching methods" indicates a strong interest in pedagogical strategies and instructional approaches specifically tailored to economics. "Economics education" acts as a unifying concept, connecting the various elements of the cluster and demonstrating the overall focus on improving the teaching and learning of economics. The presence of terms like "quality control," "costs," and "optimization" suggests a focus on efficiency and effectiveness in economic education, potentially including studies on resource allocation, curriculum evaluation, and the impact of different teaching strategies on student outcomes. Overall, Cluster 1 reflects a research trend that prioritizes the core elements of the field, examining how economics is effectively taught and learned within the landscape of higher education.

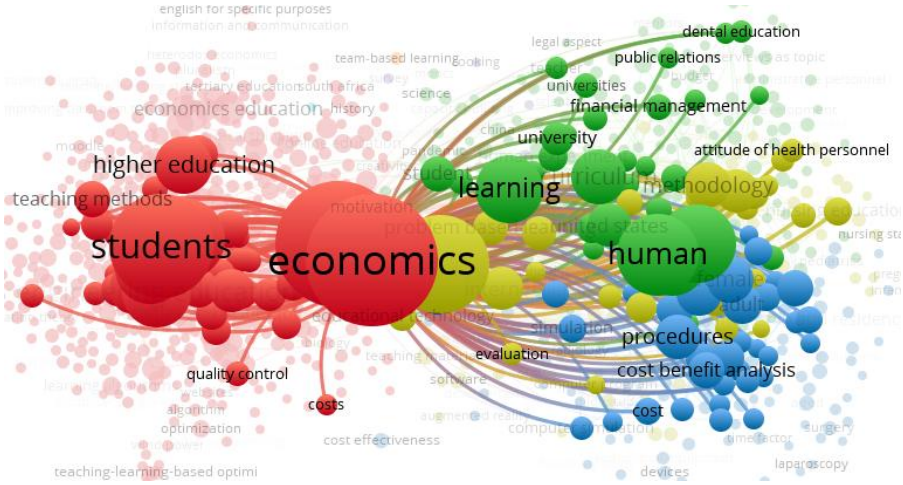


Figure 7: Cluster 1 of Co-occurrence

Cluster 2

Cluster 2, dominated by the terms "learning," "human," "methodology," and "curriculum," represents a focus on the pedagogical and human-centered aspects of Economics Teaching and Learning. "Learning" acts as a central node, signifying research into the cognitive processes and outcomes of students engaged in economics education. "Human" emphasizes the role of the learner and the social context of learning, potentially including factors like motivation, engagement, and the development of human capital. "Methodology" points to a strong interest in the development and evaluation of effective teaching practices, including instructional design, assessment strategies, and the use of various pedagogical approaches. "Curriculum" highlights the importance of content selection, organization, and delivery in economics education, suggesting research on curriculum development and reform. The cluster's connections to "university," "curriculum," and "attitude of health personnel" suggest potential interdisciplinary links, possibly with fields like health economics or public policy, where economic principles are applied to real-world problems and require specific curricular adaptations. Overall, Cluster 2 reflects a research trend that prioritizes the human experience of learning economics, emphasizing the importance of effective pedagogy and well-designed curricula to foster student understanding and application of economic concepts.

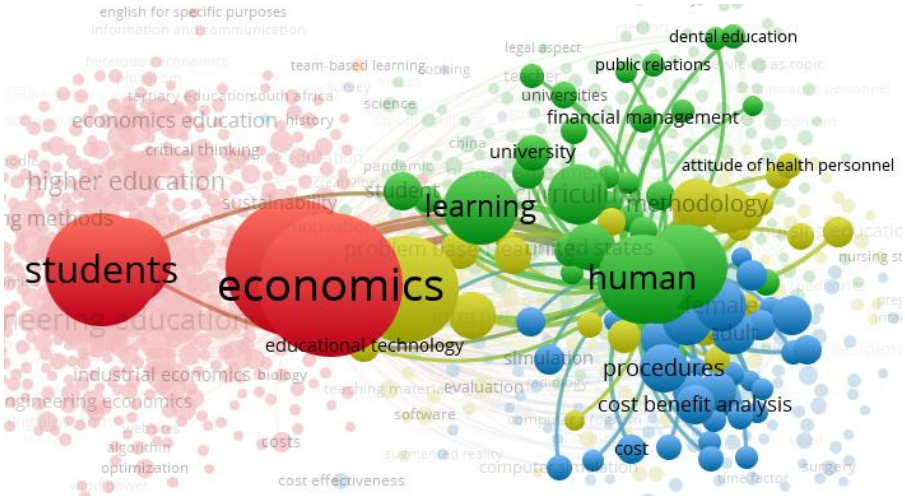


Figure 8: Cluster 2 of Co-occurrence

Cluster 3

Cluster 3, characterized by the large nodes' "economics" and "students," along with "higher education," "teaching methods," and "economics education," represents the core of research in Economics Teaching and Learning. This cluster focuses on the **fundamental relationship between the discipline of economics and the students who learn it, within the broader context of higher education**. "Economics" serves as the central node, indicating the subject matter at the heart of the research. "Students" highlights the learner as the focal point, suggesting studies on student engagement, understanding, and performance in economics courses. "Higher education" emphasizes the institutional setting in which economics is taught, implying research on curriculum design, program development, and the role of economics within universities. "Teaching methods" underscores the importance of pedagogical strategies and instructional approaches tailored to economics. "Economics education" itself acts as a unifying concept, bringing together the various elements of the cluster and demonstrating the overall focus on improving the teaching and learning of economics. In essence, Cluster 3 reflects a research trend that prioritizes the core elements of the field, examining how economics is effectively taught and learned within the landscape of higher education.

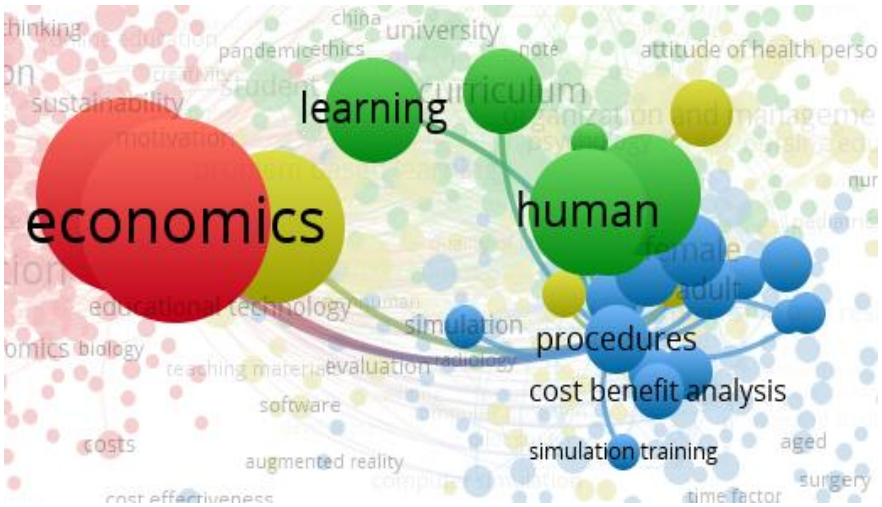


Figure 9: Cluster 3 of Co-occurence

Cluster 4

Cluster 4 in this co-occurrence diagram, characterized by the prominent nodes "human," "learning," "methodology," and "computer-assisted instruction," represents a distinct thematic focus within Economics Teaching and Learning. This cluster emphasizes the human element in the learning process, highlighting the importance of pedagogical methods and technological tools in facilitating effective economic education. "Learning" serves as a central point, suggesting research centered on understanding and improving student learning outcomes. "Methodology" underscores the development and evaluation of various teaching approaches, likely including empirical studies and assessments of instructional effectiveness. "Computer-assisted instruction" indicates a strong interest in leveraging technology to enhance economic education, potentially through online platforms, simulations, or interactive learning resources. The inclusion of "human" suggests a focus on the broader context of learning, encompassing factors like student motivation, engagement, and the social aspects of the learning environment. Overall, Cluster 4 reflects a research trend

that prioritizes evidence-based teaching practices and the integration of technology to optimize the learning experience in Economics education.

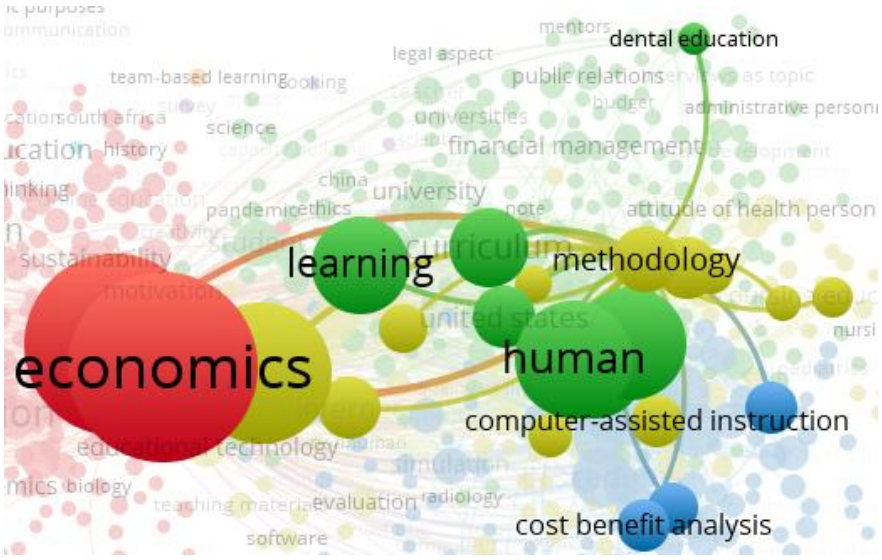


Figure 10: Cluster 4 of Co-occurence

Co-citation

Figure 11 network visualization illustrates the co-citation patterns among researchers in the field of Economics Teaching and Learning from 2000 to 2024, revealing distinct clusters of influential figures. The largest cluster, dominated by "Walstad W.B." and "Watts M.," signifies a core group of researchers focused on empirical studies and assessments of economics education, likely emphasizing quantitative methodologies. Another prominent cluster, centered around "Felder R.M." and "Kolb D.A.," suggests a focus on learning styles and pedagogical approaches, potentially incorporating interdisciplinary insights from education and psychology. The presence of "Bloom B.S." and "Biggs J." further reinforces this emphasis on learning taxonomies and constructive alignment in curriculum design. A distinct cluster featuring "Kahneman D." and "Mankiw N.G." indicates a connection to behavioral economics and mainstream economic principles, suggesting research that integrates these perspectives into economics education. The inclusion of "Freire P." and "Dewey J." highlights a focus on critical pedagogy and experiential learning, indicating research that explores the social and philosophical dimensions of economics education. Finally, figures like "Posner R.A." and "Shavell S." suggest a link to law and economics, potentially reflecting research that applies economic principles to legal education or examines the economic implications of legal frameworks. Overall, the network reflects a diverse field drawing upon various disciplines, with clusters representing distinct research traditions and approaches within Economics Teaching and Learning.

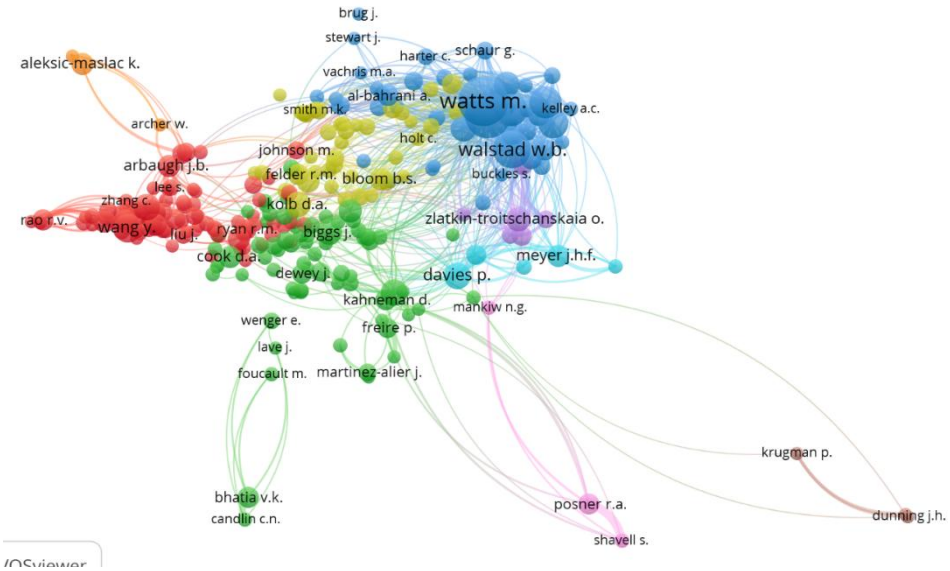


Figure 11: Co-citation

Co-authorship countries

Figure 12 shows a visualization of international co-authorship patterns in the Economics Teaching and Learning field from 2000-2024. The visualization uses a force-directed graph where countries are represented as nodes, and collaborative relationships between them are shown as connecting lines.

The United States appears as the dominant hub in this network, represented by the largest blue node at the center. China forms another significant cluster (in red), while Australia, Spain, and several European countries like the Netherlands form secondary hubs. The size of each node likely represents the volume of publications from that country, while the thickness of connecting lines probably indicates the strength of collaborative relationships.

The network reveals several regional clusters: Southeast Asian countries (Malaysia, Indonesia, Singapore, Vietnam) form one group; Northern European countries (Finland, Norway, Latvia) form another; and there's a visible Eastern European cluster including Czech Republic and Hungary. Countries like South Africa, Peru, and Chile represent the Global South's participation in economics education research.

This visualization suggests that while the field has global participation, research collaboration remains centered around a few dominant countries, with the United States maintaining the strongest international co-authorship network in economics education research over this 24-year period.

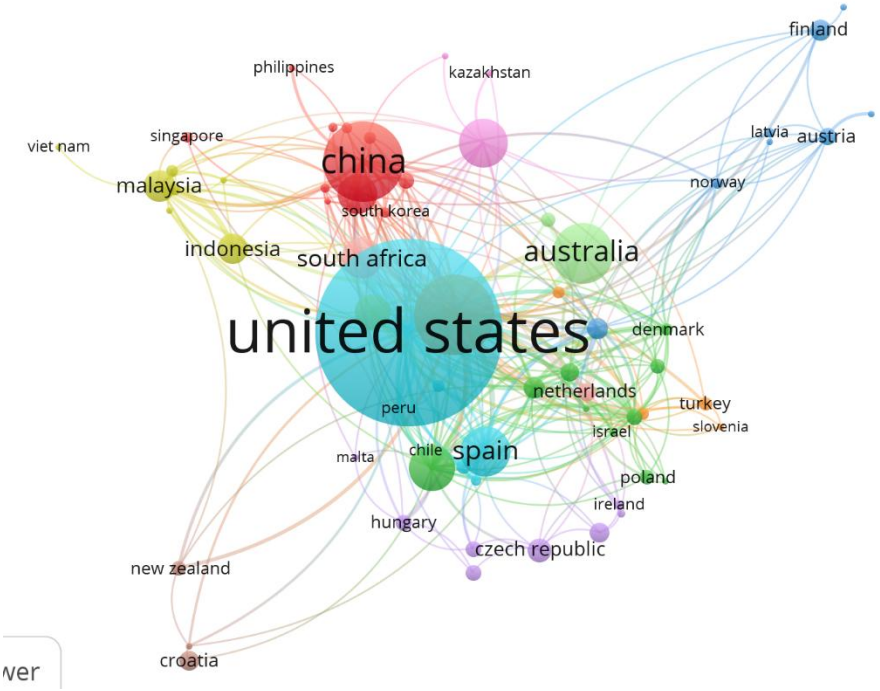


Figure 12: Co-authorship countries

RQ 4: What are the most cited articles for economics teaching and learning for year 2000-2024?

The table 5 shows the most cited articles in Economics teaching and learning from year 2000 until 2024 as indexed in the Scopus database using Harzing software. Contradict to the direct Scopus database, the result from Harzings shows 1554 documents related with the field of economics teaching and learning. The most cited article in this field is "Between science and activism: Learning and teaching ecological economics with environmental justice organisations" by J. Martínez-Alier (2011), published in Local Environment with 62 citations (4.43 citations per year). Following this is J. Caviglia-Harris's "Flipping the undergraduate economics classroom: Using online videos to enhance teaching and learning" (2016) in Southern Economic Journal with 53 citations (5.89 citations per year). S.L. Miller's "Recent research on the teaching and learning of pre-collegiate economics" (2010) ranks third with 40 citations.

Other influential works include N. Reimann's "First-year Teaching-Learning Environments in Economics" (2004) with 36 citations, and K. Hinde's "Using the personal response system to enhance student learning" (2006) with 27 citations. The data shows that research on game-based learning (C. Lew, 2021), simulation methods (J.D. Voss, 2005; J. Sierra, 2020), and blended learning approaches (J. Poon, 2013) have also made significant contributions to the field.

It's noteworthy that works on innovative teaching methodologies such as flipped classrooms, personal response systems, and game-based approaches feature prominently among the most cited articles, suggesting these pedagogical innovations have gained particular attention in economics education research over this period.

Table 5: Most cited works based on based on Scopus database via Harzing's Publish or Perish

Cites	Authors	Title	Year	Source

62	J. Martinez-Alier	Between science and activism: Learning and teaching ecological economics with environmental justice organisations	2011	Local Environment
53	J. Caviglia-Harris	Flipping the undergraduate economics classroom: Using online videos to enhance teaching and learning	2016	Southern Economic Journal
40	S.L. Miller	Recent research on the teaching and learning of pre-collegiate economics	2010	Handbook of Research in Social Studies Education
36	N. Reimann	First-year Teaching-Learning Environments in Economics	2004	International Review of Economics Education
27	K. Hinde	Using the personal response system to enhance student learning: Some evidence from teaching economics	2006	Audience Response Systems in Higher Education: Applications and Cases
24	G. Hoyt	International handbook on teaching and learning economics	2011	International Handbook on Teaching and Learning Economics
20	C. Lew	Game-based learning: Teaching principles of economics and investment finance through Monopoly	2021	International Journal of Management Education
19	J.D. Voss	The Clinical Health Economics System Simulation (CHESS): A teaching tool for systems- and practice-based learning	2005	Academic Medicine
14	A. van der Merwe	Identifying some constraints in first year economics teaching and learning at a typical South African University of Technology	2006	South African Journal of Economics
13	J. Sierra	The importance of simulation in teaching and learning economics: The students' perspective	2020	Innovations in Education and Teaching International
13	S. Erduran	Interactions of Economics of Science and Science Education: Investigating the Implications for Science Teaching and Learning	2013	Science and Education
12	M. Maier	Starting point: Pedagogic resources for teaching and learning economics	2012	Journal of Economic Education
11	G.M. Hoyt	International Handbook on Teaching and Learning Economics	2011	International Handbook on Teaching and Learning Economics
11	J. Poon	An examination of a blended learning approach in the teaching of economics to property and construction students	2013	Property Management

5 CONCLUSION

This bibliometric analysis of economics teaching and learning literature from 2000-2024, using Scopus data processed through VOSViewer and Harzing's Publish or Perish software, reveals several significant trends and patterns in the evolution of this field. The United States has emerged as the dominant contributor to economics education research, with American institutions consistently producing high-impact publications that have shaped pedagogical approaches globally. The citation patterns demonstrate a clear trajectory toward innovative teaching methodologies, with particularly strong interest in technology-enhanced learning environments, experiential approaches, and active learning strategies. The most influential works, such as Martínez-Alier's ecological economics teaching framework and Caviglia-Harris's flipped classroom model, have catalyzed important shifts in economics instruction paradigms.

Co-citation and co-authorship networks reveal growing collaborative relationships between American researchers and international colleagues, though U.S. institutions maintain centrality in these networks. This geographical concentration suggests both a strength in the established research infrastructure of American universities and an opportunity for greater diversification of perspectives in future research.

Thematic evolution analysis indicates that while traditional instructional approaches remain relevant, there has been substantial growth in research clusters focused on digital transformation, inclusive pedagogies, and authentic assessment methods. These emerging themes align with broader educational trends but have been specifically tailored to address the unique challenges of economics education.

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Academic Stress and Its Contributing Factors Among Multimedia Creative Students at Kolej Poly-Tech MARA Students

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ABSTRACT

Students, who represent the upcoming leaders of a nation, play a vital role in shaping future governance. However, their academic journey is frequently burdened by various educational and social challenges that can trigger stress. Such stress may result in dire consequences, including suicidal tendencies, substance abuse, and college withdrawal. Academic-related stress, often caused by lecturers, assignments, and peer dynamics, is a key contributor to serious conditions like anxiety and depression. This research investigates the extent of academic stress among Diploma students enrolled in the Multimedia Creative program at Kolej Poly-Tech MARA Ipoh. The analysis of the collected survey data aimed to measure stress levels linked to specific stressors. The study revealed that high levels of academic stress are commonly tied to performance, examinations, social pressure, and self-driven expectations. These findings serve as valuable references for students, lecturers, and institutions to understand and mitigate academic stress, while also guiding future investigations.

KEYWORDS: Academic Stress, Multimedia Students, Peer Pressure, Test Anxiety, Time Management, Group Work Challenges, Mental Health, Stress Intervention Strategies

1 INTRODUCTION

Students are regarded as the driving force behind a nation's future development, and their academic journey plays a crucial role in shaping the country's future leaders. However, the journey is often accompanied by intense academic and social pressures (Barbayannis et al, 2022). These pressures, if unmanaged, may lead to academic stress; a psychological condition that affects students' mental health, academic performance, and overall well-being. In severe cases, prolonged academic stress can result in consequences such as anxiety, depression, burnout, substance abuse, or even dropping out of college.

Therefore, understanding the sources and severity of academic stress among students is a pressing concern, especially in the context of higher education (Kashif et al., 2024)

1.1 Definition of Academic Stress

Academic stress refers to the emotional distress resulting from academic demands that exceed a student's adaptive capacity. It is influenced by various factors, including workload, assignments, examinations, peer expectations, and interactions with lecturers. In recent years, the mental health of students in Malaysian higher education institutions has attracted significant attention, with many studies indicating that students experience substantial stress throughout their academic journey. Students often face unique challenges ranging from meeting creative deadlines to mastering technical skills under pressure. These challenges may contribute to elevated levels of stress compared to students in non-creative disciplines.

1.2 Research framework

This research framework is adapted from the study by Yikealo et al. (2018) entitled "The Level of Academic and Environmental Stress among College Students: A Case in the College of Education." Their framework categorizes student stress into two main domains: academic stressors and environmental stressors. Academic stressors include factors such as exam pressure, assignment deadlines, lecturer expectations, peer competition, and time management, all of which are internal to the learning process. Environmental stressors, on the other hand, refer to external conditions such as living arrangements, campus facilities, financial burdens, and social interactions that indirectly affect students' academic performance and psychological well-being.

Drawing from this dual-dimensional model, the present study however, focuses primarily on the academic domain, tailoring the framework to assess stress levels among Diploma in Multimedia students at Kolej Poly-Tech Mara Ipoh. Seven constructs—lecturers, examination and test pressure, academic results, group work, peer interaction, time management, and self-imposed pressure—are used to represent the key academic stressors identified in the Yikealo et al. model. By applying this structured framework, the research aims to gain a comprehensive understanding of how specific academic elements contribute to students' overall stress levels, allowing for more targeted recommendations and interventions.

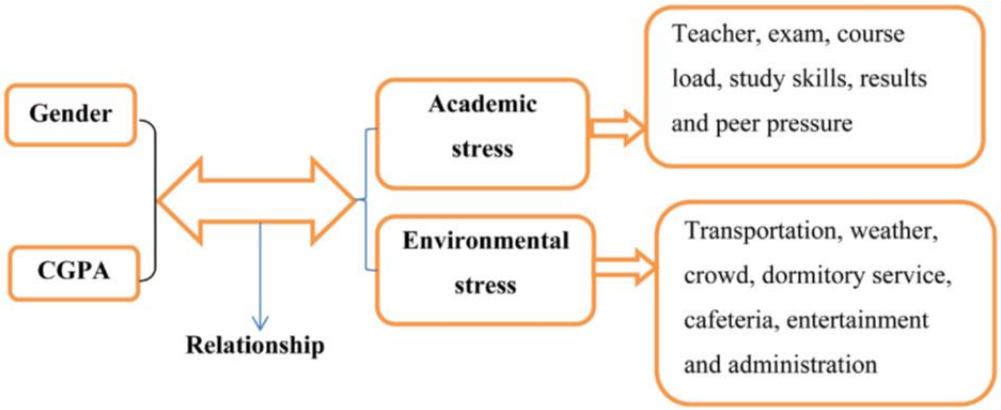


Figure 1. The Level of Academic and Environmental Stress among College Students: A Case in the College of Education (Yikealo et al, 2018)

1.3 Research Objectives

This study is guided by the following objectives:

RO1: To measure the level of academic stress among students enrolled in the Diploma in Multimedia program at Kolej Poly-Tech MARA (KPTM) Ipoh.

RO2: To identify the primary sources or contributing factors that influence the academic stress levels among these students.

Here are two research questions based on the stated objectives:

RQ1: What is the level of academic stress experienced by students enrolled in the Diploma in Multimedia program at Kolej Poly-Tech MARA (KPTM) Ipoh?

RQ2: What are the main sources or contributing factors that influence the academic stress levels among these students?

By achieving these objectives, the study hopes to provide valuable insights for educators, counsellors, and academic administrators to develop better support systems and stress intervention strategies tailored to students' specific academic needs and emotional challenges.

2 LITERATURE REVIEW

2.1 Academic Stress

The psychological health of students has become a critical concern due to the widespread issue of academic stress. Stress is described as the physiological and neurological response of the body to life changes as it adjusts to new circumstances (Pascoe et al., 2022). Academic stress is linked to adverse outcomes like poor academic achievement, psychological problems, and school dropout. Hence, various intervention programs have been introduced to help tertiary students cope with academic stress (Conley, 2015).

Stress impacts students differently and tends to vary during their academic journey. Studies show that the initial year at university is particularly stressful (Abdallah & Gabr, 2014), largely due to the transition into a new educational setting and the personal identity development that occurs during this period. Another study discovered that stress levels peaked during the first semester and declined in the second (Bewick, 2010). Conversely, some research observed steady stress levels throughout the year (Barker et al., 2018). These inconsistencies imply that student stress levels are affected by diverse academic stressors both interpersonal and intrapersonal (Pitt et al., 2018).

Interpersonal stress arises from challenges in relationships with peers, faculty, and roommates, typically due to academic load and emotional fatigue during adjustment. Intrapersonal stress, on the other hand, reflects internal struggles with managing stress. Stress from lecturers is particularly notable when they fail to consider students' adjustment periods. Intense peer competition and favouritism can heighten this stress. Even though peer-related stress is often underestimated, lack of connection or shared identity may lead to disinterest among students who already lack motivation (Yikealo et al., 2018).

2.2 Effects of Academic Stress

A study by Ramachandiran and Dhanapal (2018) found that 88% of students cited studies as the major cause of their academic stress, with 78% reporting moderate stress. While some academic stress can promote learning, it may also lead to negative emotional states such as anxiety or hopelessness, which in turn affect students' academic and social lives (Zhao et al., 2015).

Chronic academic stress can also result in health concerns, including fatigue, appetite loss, headaches, sleeping difficulties, and stomach issues. In the same study, 54% of respondents suffered from sleep disturbances. Excessive academic pressure may contribute to mental disorders like anxiety, depression, or even suicidal ideation. It is therefore vital to address these stressors, as many students find it difficult to cope with academic demands. Unrealistic parental expectations, academic rivalry, and challenging curricula are all contributing factors. Raising awareness about academic stress is essential to cultivating a healthy academic atmosphere and a more promising future for students.

3 METHODOLOGY

This study adopts a quantitative approach, building on the methods of previous researchers (Yikaelo et al., 2018). The total number of participants was 82 students who were enrolled in the Diploma in Multimedia program at KPTM Ipoh. A set of questionnaires, adapted from Lin and Chen's (2019) academic stress inventory, serves as the research instrument. The questionnaire, designed to evaluate students' academic stress levels, includes 33 items divided into seven constructs from the academic stress inventory. These constructs address stress related to several areas: lecturers, results, tests, group study, peers, time management, and self-inflicted stress. Descriptive statistics are used to analyse the data, calculating the average mean score for each construct. These mean scores are then interpreted based on the mean interpretation levels provided in Table 2 (Marlissa et al., 2019).

4 FINDINGS AND DISCUSSIONS

4.1 Demographic Profile

Table 1 presents the distribution of respondents across academic years. There were 82 respondents and the majority of respondents were male (71.1%), while female students made up 27.7% of the sample. Most students were in their first year (51.8%), followed by second-year (39.8%) and third-year students (7.2%). In terms of academic qualification, 60.2% of students had obtained 5 or more credits in their SPM examination, while 38.6% had 3 to 4 credits.

Table 1. The distribution of respondents across academic years.

		Frequency	Percentage
Gender	Male	59	71.1
	Female	23	27.7
Year	1	43	51.8
	2	33	39.8
	3	6	7.2
SPM Qualification	3 To 4 credits	32	38.6
	5 Above credits	50	60.2
	Total	82	100.0

4.2 Stress Constructs

Table 4.2 presents a descriptive analysis of seven constructs of academic stress experienced by 82 students enrolled in the Diploma in Multimedia program at KPTM Ipoh. Each construct, peer, test,

achievement, groupwork, lecturer, time management, and self—is measured using a scale of 1 to 4, with higher mean scores indicating higher levels of stress perceived by students in that particular area. The analysis includes the number of respondents (N), minimum and maximum scores, mean values, and standard deviations.

Table 4.2. Seven constructs of academic stress experienced by 82 students enrolled in the Diploma in Multimedia program at KPTM Ipoh.

	N	Min	Max	Mean	Standard deviation
Lecturer	82	1	4	2.18	0.507
Achievement	82	1	4	2.56	0.503
Test	82	1	4	2.56	0.503
Groupwork	82	1	4	2.45	0.654
Peer	82	1	4	2.60	0.568
Time management	82	1	4	2.12	0.615
Self	82	1	4	2.20	0.580

Based on the analysis of the stress constructs among Diploma in Multimedia students at KPTM Ipoh, the data revealed varying degrees of stress across seven dimensions. Each construct was rated on a scale from 1 to 4, with higher means indicating higher stress levels. Below is a narrative interpretation of the findings, from the highest to the lowest mean score.

4.2.1 Mean score for stress from peer item construct

The most prominent source of stress was peer pressure, which recorded the highest mean score of 2.60 (SD = 0.568). This suggests that students frequently feel stressed due to expectations, comparisons, or judgments from their classmates or social circles. Peer influence may manifest in the form of competition, fear of being left out, or pressure to conform academically and socially. Many students reported being distracted by noisy peers during lessons, which disrupted their concentration and personal study efforts. Some noted that classroom environments were often tense due to academic competition, with visible rivalries and underlying resentment among classmates. Others felt demotivated and anxious because their academic performance did not match that of their peers. These factors combined to create a stressful atmosphere that affected students' emotional well-being and learning experiences.

To address the issue of peer pressure as a leading cause of academic stress, institutions could implement structured peer support programs and promote a more collaborative rather than competitive learning environment. Teachers and administrators should actively foster classroom cultures that value individual growth over comparison by encouraging teamwork, peer mentoring, and inclusive group discussions. Counselling services and mental health awareness campaigns can also help students manage stress and develop healthy coping strategies. Furthermore, educators should be trained to identify signs of stress related to peer dynamics and intervene early with constructive guidance. Regular classroom discussions about respect, empathy, and emotional well-being can empower students to create a more supportive and less judgmental academic community.

4.2.3 Mean scores for stress from test anxiety and achievement constructs

Following closely were test anxiety and achievement concerns, both with a mean of 2.56 (SD = 0.503). These constructs indicate that students experience considerable stress related to examinations and their academic performance. Such stress may stem from high self-expectations, fear of failure, unclear evaluation criteria, or previous academic struggles. Such stress may stem from high self-expectations, fear

of failure, unclear evaluation criteria, or previous academic struggles. Many students revealed that their sleep patterns are negatively affected by academic pressure some admitted they often sleep late to revise for exams, while others confessed that they struggle to get adequate rest at night due to constant worries about upcoming tests. A number of students also expressed concern about the possibility of having to retake core subjects they might fail, which adds to their anxiety. Additionally, the lack of clarity in the class syllabus and test outlines further exacerbates their stress, as they feel uncertain about how to prepare effectively.

To curb the growing issue of test anxiety and achievement-related stress, institutions should implement a multifaceted support system that includes clearer communication of syllabus content and test expectations, regular academic counselling, and structured stress-management programs. Educators must ensure transparency in evaluation criteria and provide timely feedback to reduce uncertainty. Moreover, workshops on time management, study skills, and mental health awareness can help students develop healthier academic routines and coping strategies. Institutions could also establish peer mentoring or tutoring systems to build academic confidence and reduce the fear of failure. Importantly, promoting a balanced academic culture that values effort and progress over perfection can significantly ease the pressure students feel to perform.

4.2.4 Mean score for stress from peer group construct

Groupwork was another notable stressor, with a mean score of 2.45 (SD = 0.654), showing not only moderate stress but also the highest variability among all constructs. This indicates that while some students may find group tasks manageable or enjoyable, others experience significant challenges, such as unequal participation, conflict, or ineffective communication.

Several students shared concerns about collaborative tasks, indicating that they often encountered difficulties when it came to dividing work among group members for exercises or reports. Some expressed anxiety about not being able to find suitable peers for group assignments. Others mentioned feeling uneasy about public speaking, as they feared being ridiculed by classmates for underperforming during speeches or presentations. There were also remarks about the emotional impact of peer interactions, with some students stating that they felt hurt when vulgar language was directed at them. Additionally, nervousness before delivering a speech or presentation was a common sentiment.

To address these issues, institutions could implement structured group work guidelines and assign roles to ensure fair contribution from all members, reducing conflict and anxiety over task division. They might also introduce peer-matching systems based on student preferences or complementary strengths to help students find compatible group partners. To ease fears related to public speaking, institutions should incorporate confidence-building workshops, provide supportive feedback environments, and promote a classroom culture that discourages mockery and encourages empathy. Moreover, strict policies against the use of vulgar or hurtful language, coupled with awareness campaigns on respectful communication, can help create a safer emotional climate that supports all learners.

4.2.5 Mean score for stress from self-related construct

The self-related stress construct yielded a mean of 2.20 (SD = 0.580), reflecting internal pressures such as low self-confidence, lack of motivation, or negative self-talk. While this construct ranked lower, it still highlights the importance of addressing students' psychological well-being. Supportive counselling services, self-development workshops, and opportunities for students to reflect and build confidence can help mitigate this stress.

Several students expressed concerns about their academic experiences, noting that they perceived their study abilities to be lower than those of their peers. Some indicated that the number of courses they were required to take felt overwhelming and beyond their capabilities. Others shared a lack of interest in certain academic subjects, which further affected their motivation. Additionally, there was a sense of

disappointment among a few students who felt that their academic performance did not meet the expectations they had set for themselves upon entering university.

4.2.6 Mean score for stress from lecturer construct

Lecturer-related stress, with a mean of 2.18 (SD = 0.507), indicates that most students did not perceive lecturers as a major source of stress. However, stress may still arise due to miscommunication, unclear instructions, or perceived strictness. Lecturers are encouraged to maintain open lines of communication, be approachable, and regularly seek student feedback to improve their teaching and rapport.

Some students expressed concerns that certain lecturers may be overly strict in their expectations and delivery, making the coursework feel overwhelming. They also indicated that the assignments and reports given by some lecturers are not only too challenging but also excessive in quantity. In addition, there were remarks suggesting that the content delivered during lectures is sometimes difficult to grasp, leading to a lack of understanding among students.

To address these concerns, the institution could implement a more structured system for monitoring teaching practices by encouraging regular peer reviews and student feedback to ensure balanced and supportive instructional delivery. Professional development workshops focusing on empathetic pedagogy, effective communication, and appropriate workload design should be conducted to help lecturers align their teaching with students' learning capacities. Additionally, setting clear guidelines on the volume and complexity of assignments across courses can prevent excessive academic burden. Incorporating periodic curriculum reviews to ensure content is accessible and scaffolded appropriately may also help students better understand and engage with the material.

4.2.7 Mean scores for stress due to time management items

Finally, time management had the lowest mean score at 2.12 (SD = 0.615), suggesting that students generally felt capable of managing their time or were less aware of its impact on stress. Despite this, time-related issues often become more prominent during assignment deadlines or exam seasons. Embedding time management skills in the curriculum and offering productivity tools or seminars could further strengthen students' ability to plan and organize effectively.

The respondent expressed difficulty in managing time effectively, indicating challenges in adjusting and scheduling to balance academic responsibilities with social engagements. They mentioned struggling to find equilibrium between their studies and social life, noting that involvement in social activities and participation in student associations had negatively impacted their academic performance.

To address this issue, institutions could implement structured time management workshops and mentorship programs aimed at helping students develop practical scheduling skills and prioritize their responsibilities effectively. These initiatives should be embedded early in the academic calendar, especially for new students, to foster a balanced approach to academic and social commitments. Additionally, academic advisors and student affairs units can collaborate to guide students in setting realistic goals and offer regular check-ins to monitor progress. Promoting a campus culture that values academic discipline alongside healthy social involvement can also encourage students to make more mindful choices about their time and commitments.

In summary, the analysis indicates that the highest stressors stem from social and academic performance pressures, while internal and lecturer-related factors contributed to a lesser extent. Institutions should therefore prioritize emotional and academic support strategies that target peer dynamics, exam preparedness, and group collaboration, while also fostering students’ self-awareness and time management skills.

5 CONCLUSION

In conclusion, this study highlights that academic stress among KPTM Ipoh students, particularly those in the Diploma in Multimedia program, is significantly influenced by peer pressure, test anxiety, and performance expectations, with additional concerns arising from groupwork dynamics and internal self-doubt. While stress related to lecturers and time management appeared less severe, they still warrant attention due to their potential cumulative effects. These findings underscore the importance of implementing holistic institutional strategies that include peer support systems, clear academic guidance, mental health resources, and skill-building workshops. By addressing the multifaceted sources of stress through targeted interventions, institutions can foster a healthier academic environment that promotes both well-being and academic success among students.

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Penentuan *Had Al-Kifayah* Dalam Mencapai Maqasid Syariah

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ABSTRAK

Pengagihan zakat kepada golongan asnaf memfokuskan kepada dua perkara utama iaitu kutipan dan agihan. Kutipan zakat daripada golongan yang wajib membayar zakat adalah melalui asnaf-asnaf yang dilantik mahupun melalui Majlis Agama Islam bagi setiap negeri-negeri di Malaysia. Manakala dalam agihan zakat pula, penentuan pengagihan juga melalui pelbagai kaedah antaranya ialah melalui kaedah *had al-kifayah*. Penentuan *had al-kifayah* adalah salah satu mekanisme dalam menentukan keperluan seseorang dari sudut kewangan bagi memenuhi tuntutan untuk menyara kehidupan seharian. Melalui penentuan *had al-kifayah* ini adalah untuk mencapai objektif pengagihan serta pengurusan zakat ini secara lebih efektif kepada golongan asnaf zakat. Maka kajian ini adalah untuk mengenalpasti kadar penentuan *had al-kifayah* di Negeri Perak dan pendekatan maqasid syariah yang perlu diterapkan dengan menilai tahap keperluan masyarakat berdasarkan tahap *daruriyyat, hajiyyat* dan *tahsiniyyat*. Implikasinya adalah dapat dijadikan panduan dan rujukan dalam penentuan *had al-kifayah* kepada institusi-institusi zakat di Malaysia.

Kata kunci*: Had Al-Kifayah, Maqasid Syariah, Zakat, Negeri Perak*

ABSTRACT

The study of Zakat has two main focus areas, namely selection and distribution. The collection of zakat from those who are obliged to pay the zakat is through appointed by asnaf or through by Islamic Religious Council for each state in Malaysia. While the distribution of zakat, the determination of distribution also through by various methods such as had al-kifayah method. Had al-Kifayah is one of the mechanisme to determining a person's needs from a financial factor for support in their daily life. Determination the limitation of had al-kifayah is one of the mechanisms to achieve the objective in distribution and zakat administration in effective to the asnaf zakat group. In this article is to identify the rate of determining the limitation of had al-kifayah in Perak State and the methods of maqasid shariah can be apply by assessing the level of community needs based on the level of daruriyyat, hajiyyat and tahsiniyyat. This implication

can be used as a guide and reference to determining the limititaion of had al-kifayah to another zakat institutions in Malaysia.

KEYWORD*: Had al-Kifayah, Maqasid Shariah, Zakat, Perak State*

1 PENGENALAN

Had al-kifayah adalah merujuk kepada suatu penetapan garis panduan dalam mengukur tahap kadar atau had keperluan bagi seseorang individu mahupun sesebuah keluarga. Ini merujuk kepada kecukupan minimum bagi keperluan asasi seseorang individu dan tanggungan mereka berdasarkan kos sara hidup semasa. Dalam konteks kajian ini, kajian adalah tertumpu kepada garis panduan yang telah ditetapkan oleh Majlis Agama Islam Negeri Perak berdasarkan kos sara hidup masyarakat pada masa kini. Segala perkara yang ditetapkan dalam had al-kifayah perlu disaring dengan terperinci menurut pandangan Islam dan disesuaikan dengan Maqasid Syariah

1.1 Definisi Had Al-Kifayah

Had al-kifayah secara umumnya adalah kadar (keupayaan ekonomi) yang selayaknya bagi menjamin kelangsungan hidup seseorang individu serta mereka yang berada di dalam tanggungannya. Ia bukan sekadar penentuan had minimum semata-mata tetapi ia menjangkaui persoalan tahap yang selayaknya bagi memastikan kelangsungan kehidupan seseorang serta tanggungannya (Uwais, 2004). Tahap pengukuran *had al-kifayah* merupakan tahap yang lebih tinggi berbanding *had al-kafaf* dalam kehidupan dan boleh berubah berdasarkan perubahan peringkat kemajuan mengikut sesuatu tempat dan zaman (Al-Fanjari, 2010). *Had al-kafaf* merupakan tahap terendah bagi kehidupan seseorang. Iaitu keupayaan memiliki makanan, pakaian dan tempat tinggal yang paling minimum, sehinggakan sekiranya seseorang itu berada di bawah tahap ini, nescaya seseorang itu tidak boleh hidup dan tidak berupaya menghasilkan sesuatu.

Sabda Nabi SAW:

"*Bukanlah miskin itu seorang yang mendatang-datangi manusia, lalu diberikan kepadanya sesuap dua makanan dan sebutir dua buah kurma, tetapi miskin itu ialah seorang yang tidak memiliki sesuatu yang mengkayakannya dan dalam masa yang sama tidak melakukan sesuatu yang membuatkan orang bersedekah kepadanya, dan tidak juga dia bangun di hadapan orang dan meminta-minta daripada mereka*"

(Hadis Muttafaq 'Alaih)

Maka secara umumnya, *had al-kifayah* adalah menjadi garis pemisah antara mereka yang layak menerima zakat dan mereka yang perlu membayar zakat. Bagi sesiapa yang mempunyai pendapatan melebihi *had al-kifayah* maka ia perlu mengeluarkan zakat manakala mereka yang kurang daripada penentuan had ini pula selayaknya menerima zakat sehingga memenuhi tahap tertentu yang didefinisikan sebagai *had al-kifayah* itu sendiri. Oleh itu, penentuan *had al-kifayah* yang relevan akan mendorong kea rah pengagihan yang adil, saksama dan cekap kepada golongan asnaf serta dapat memastikan bantuan zakat yang diterima benar-benar efektif dalam mengurangkan beban asnaf.

1.2 Definisi Maqasid Syariah

Maqasid Syariah mempunyai peranan yang penting dalam kerangka pembinaan hukum. Maqasid merupakan wacana yang mengalami perkembangan dari semasa ke semasa sebagaimana disiplin ilmu Islam

yang lain. Maqasid Syariah bukan sekadar penentuan hukum semata-mata, bahkan ia berperanan dan berkepentingan dalam sistem pembangunan sesebuah negara Islam bagi menggubal dasar-dasar dan polisi-polisi yang berkaitan dengan sosial dan ekonomi agar ianya selati dengan tuntutan syarak.

Takrif maqasid merujuk kepada objektif kenyataan atau fakta sebenar. Ia juga adalah tujuan yang dikehendaki sama ada perbuatan atau percakapan. Manakala Syariah pula bermaksud segala perkara yang merangkumi keseluruhan yang diturunkan oleh Allah SWT kepada umat manusia melalui rasul-Nya iaitu Nabi Muhammad SAW. Terdapat beberapa dalil yang menjadi petunjuk kepada maqasid Syariah di dalam Al-Qur'an.

Firman Allah SWT yang bermaksud:

"Allah tidak mahu menjadikan kamu menanggung sesuatu kesusahan(kepayahan), tetapi ia berkehendak membersihkan (menyucikan) kamu dan hendak menyempurnakan nikmat-Nya kepada kamu, supaya kamu bersyukur"

(Surah Al-Ma'idah: Ayat 6)

Imam al-Ghazali mendefinisikan maqasid Syariah adalah sebagai tujuan untuk memelihara lima perkara asas manusia iaitu dikenali sebagai *usul al-khams*. Asas kepada lima perkara tersebut ialah memelihara agama (*hifz ad-Din*), memelihara jiwa (*hifz al-Nafs*), memelihara akal (*hifz al-'Aql*), memelihara keturunan (*hifz al-Nasb*) dan memelihara harta (*hifz al-Mal*). Setiap perkara bertujuan untuk memelihara *usul al-khams* sebagai maslahah manakala perkara yang memudaratkan *usul al-khams* pula dikenali sebagai mafsadah (Al-Ghazali, 2000)

Ibnu 'Ashur menjelaskan bahawa maqasid Syariah sebagai makna-makna dan hikmah-hikmah yang diambil perhatian oleh syarak dalam keseluruhan atau sebahagian besar situasi penurunan syariat yang tidak mengkhususkan kepada mana-mana hukum syarak yang tertentu. Pembahagian maqasid Syariah ini terbahagi kepada dua kategori iaitu maqasid umum dan maqasid khusus ('Ashur, 2001). Maqasid umum ialah maqasid yang dapat dilihat dalam hukum-hukum yang wajib dan melibatkan semua individu secara amnya, manakala maqasid khusus pula ialah cara yang digunakan oleh Syariah bagi merealisasikan kepentingan umum melalui tindak-tanduk manusia.

2 ISTILAH-ISTILAH BERKAITAN MAQASID SYARIAH

Maqasid Syariah juga mempunyai istilah-istilah yang lain yang mempunyai maksud yang sama dengan istilah tersebut. Istilah al-Hikmah juga sering digunakan oleh para fuqaha' sebagaimana yang dimaksudkan oleh Ibn Rusyd yang menyifatkan maqasid sebagai hikmah pensyariatan hukum yang membawa erti yang sama dengan maqasid. Istilah ini juga merujuk sama ada maqasid sesuatu hukum atau kesesuaian sesuatu hukum seperti mengelakkan kesukaran adalah hikmah kepada adanya hukum rukhsah.

Istilah Al-Munasabah juga dikaitkan dengan maqasid syariah iaitu kesesuaian di antara sifat dengan hokum iaitu penetapan sesuatu hokum berdasarkan sifat yang membawa tercapainya maslahah dassn ternafinya mafsadah daripada manusia.

Semua ulama' usul menganggap sesuatu yang tidak sejajar dengan kehendak syarak tidak dianggap maslahah hakiki. Imam al-Ghazali mendefinisikan maslahah sebagai suatu pernyataan terhadap pencapaian manfaat dan penolakan kemudaratan (Al-Ghazali, 2000). Namun, apa yang dimaksudkan oleh beliau bukanlah mencapai manfaat dan menolak kemudaratan demi memenuhi kehendak dan tujuan manusia, tetapi untuk memelihara tujuan-tujuan syarak iaitu menjaga agama, jiwa, akal, keturunan dan harta. Oleh itu, maksud maqasid dan maslahah adalah dua istilah yang membawa maksud yang sama.

3 PENENTUAN *HAD AL-KIFAYAH*

Kaedah untuk mengenalpasti sama ada pemohon layak untuk menerima bantuan adalah berdasarkan kepada pengiraan *had al-kifayah*. Kaedah pengiraan *had al-kifayah* adalah seperti berikut:

Jumlah Pendapatan – Jumlah Keperluan
Lebihan @ Berkurangan

Penentuan *had al-kifayah* adalah berdasarkan kepada beberapa item yang perlu diambil kira iaitu pengiraan pendapatan isi rumah. Pengiraan pendapatan isi rumah adalah bergantung kepada sumber pendapatan yang diperolehi daripada isi rumah sama ada pendapatan suami sebagai ketua keluarga, pendapatan isteri atau pasangan mahupun pendapatan lain atau sampingan. Perincian sumber pendapatan tersebut dapat dilihat dari kategori yang ditetapkan (Garis Panduan Had al-Kifayah, MAIAMPk, 2016):

3.1 Pendapatan suami atau ketua keluarga

Pendapatan yang diambil kira seperti pekerjaan bergaji, pendapatan daripada bekerja sendiri, pendapatan daripada sumber-sumber lain seperti pencen dan perkeso, pendapatan daripada harta benda mahupun penetapan jumlah daripada Majlis Agama Negeri.

3.2 Pendapatan isteri atau pasangan

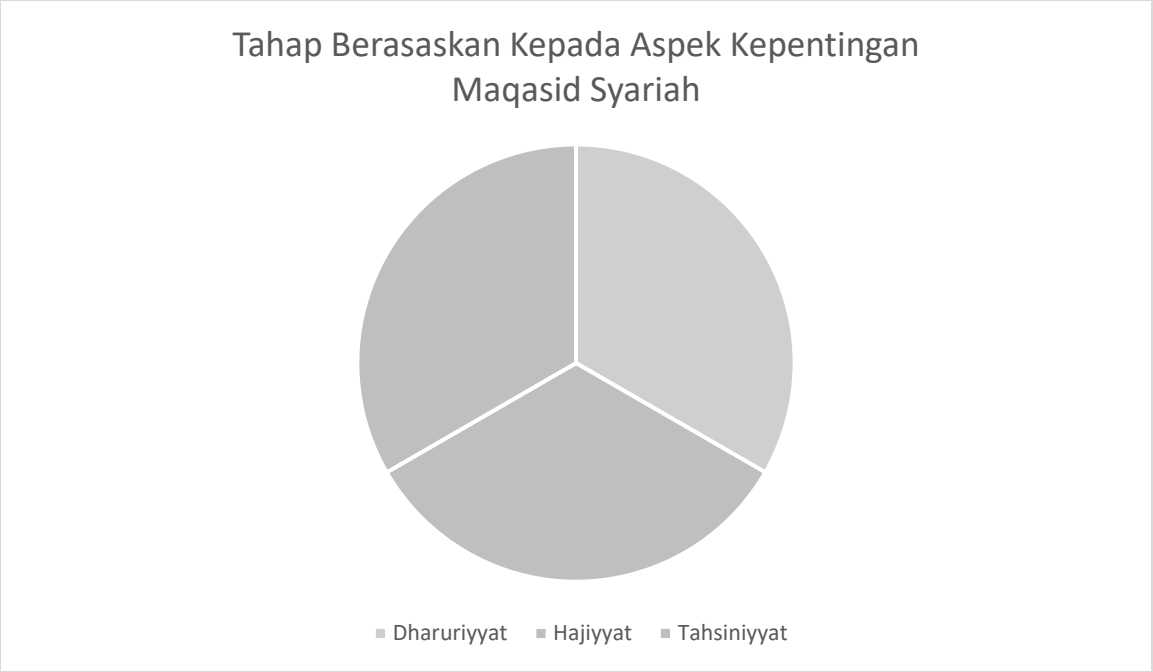
Pendapatan bergaji, pendapatan daripada bekerja sendiri, pendapatan daripada harta benda, pendapatan daripada sumber-sumber lain seperti pencen dan perkeso mahupun penentapan jumlah daripada Majlis Agama Negeri.

3.3 Pendapatan lain.

Pendapatan yang diambil kira sebagai pendapatan isi rumah untuk kiraan had al-kifayah seperti pemberian anak-anak, bantuan kewangan bulanan daripada mana-mana agensi secara tetap, pendapatan ahli isi rumah yang lain seandainya turut menyumbang mahupun penetapan jumlah sebenar pendapatan ketua keluarga berdasarakan soal selidik daripada Majlis Agama Negeri.

4 MAQASID SYARIAH BERASASKAN KEPADA ASPEK KEPENTINGAN

Syariah Islamiyyah mengambil berat akan perkara-perkara yang bersifat keperluan asasi (daruriyyat), keperluan penting (hajiyyat) dan keperluan keselesaan atau kesempurnaan (tahsiniyyat) (Al-Shatibi, 1996). Berikut adalah carta berkenaan maqasid syariah dalam penilaian Tahap Berasaskan Kepada Aspek Kepentingan:



Imam Al-Ghazali mendefinisikan daruriyyat sebagai suatu yang semestinya dipelihara dalam rangka menjaga kemaslahatan agama dan dunia. Pembahagian maqasid ini juga telah dijelaskan oleh Imam Al-Shatibi seperti berikut:

Matlamat Penjagaan Agama (Hifz Al-Din)
Matlamat Penjagaan Nyawa (Hifz Al-Nafs)
Matlamat Penjagaan Akal (Hifz Al-'Aql)
Matlamat Penjagaan Keturunan (Hifz Al-Nasb)
Matlamat Penjagaan Harta (hifz Al-Mal)

Maqasid hajiyyat pula ialah suatu keperluan yang membawa kepada kelapangan hidup seperti kelonggaran dalam melaksanakan ibadah, sistem akad kehartaan dan mauamalat dan seumpamanya. Manakala maqasid tahsiniyyat pula ialah suatu keperluan yang tidak mendesak tetapi ia memberi kesempurnaan dalam kehidupan. Ini adalah seperti amalan-amalan sunat, adab-adab yang dianjurkan dalam Islam terhadap kehidupan seharian manusia.

5 PENETAPAN HAD AL-KIFAYAH DALAM MENCAPAI MAQASID SYARIAH

Had al-kifayah memainkan peranan penting dalam menentukan tahap keperluan yang diperlukan oleh isi rumah untuk menampung keperluan harian. Ianya dikira berdasarkan pemboleh ubah seperti bilangan ahli dalam isi rumah, kumpulan umur dan lain-lain. Jabatan Wakaf, haji dan Zakat (JAWHAR) telah menggariskan beberapa komponen utama dalam menentukan keperluan had al-kifayah sepereti tempat tinggal, makanan, pakaian, kesihatan, pengangkutan dan Pendidikan berdasarkan maqasid Syariah (JAWHAR, 2007).

Pendekatan maqasid syariah juga dilihat mampu mewujudkan satu model *had al-kifayah* yang bertepatan dengan kehendak Islam dan keperluan semasa. Penentuan *had al-kifayah* berasaskan maqasid syariah boleh diwujudkan dengan mengkategorikan kepada beberapa bahagian seperti keperluan asasi kepada item *dharuriyya*t, item keperluan tambahan kepada item *hajiyyat* dan item keperluan pelengkap kepada item *tahsiniyyat*.

Terdapat enam keperluan asasi dalam had al-kifayah dengan mengambil kira aspek keperluan hidup manusia bersesuaian dengan keutamaan maqasid Syariah. Keperluan tersebut merangkumi:

1. Tempat tinggal,
2. Makanan,
3. Pakaian,
4. Pendidikan,
5. Rawatan
6. Pengangkutan.

5.1 Dharuriyyat

Dharuriyyat adalah perkara-perkara yang termasuk dalam keperluan asasi yang mesti dipenuhi oleh setiap individu. Kemaslahatannya perlu dipenuhi untuk menegakkan kemaslahatan agama dan dunia. Jika maslahah ini tiada, maka kemaslahatan dunia tidak akan bergerak dengan lancer bahkan kemaslahatan di akhirat akan hilang dan tidak selamat.

Perbincangan prinsip maqasid Syariah semestinya bersandarkan kepada lima konsep maqasid Syariah dalam memantapkan lagi Islam sebagai satu cara hidup. Pemeliharaan terhadap maslahah manusia terangkum di bawah lima kategori utama (*Dharuriyyat al-Khams*) yang mesti dipelihara.

Menurut Ibn ‘Ashur, maqasid dharuriyyah adalah maslahah yang sangat penting untuk didapatkan bagi umat secara keseluruhan dan individu, di mana peraturan akan cacat tanpanya. Apabila ia tidak dilaksanakan, maka keadaan umat akan rosak dan kacau-bilau (Ibn ‘Ashur, 2001). Antara perkara dharuriyyat adalah terdiri daripada perkara-perkara utama dalam agama yang disebut sebagai *al-daruriyyat al-khamsah*, iaitu memelihara agama (*hifz ad-din*), memelihara jiwa (*hifz al-naf*s), memelihara akal (*hifz al-`aql*), memelihara keturunan (*hifz al-nasl*) dan memelihara harta (*hifz al-mal*).

Keperluan asas (*daruriyyat*) termasuklah elemen seperti makanan, pakaian, tempat tinggal, penndidikan dan pengangkutan. Kelima-lima elemen tersebut merupakan perkara asas yang amat diperlukan bagi setiap individu untuk mencapai maksud syarak. Contohnya, makanan dan tempat tinggal adalah sesuatu yang amat penting bagi pemeliharaan agama dan nyawa seseorang, manakala keperluan pakaian dan pengangkutan penting bagi memelihara keturunan dan harta. Demikian juga dalam aspek pendidikan yang sangat penting kepada manusia untuk memelihara akal.

5.2 Hajiyyat

Maqasid hajiyyat ialah satu keperluan yang membawa kepada kelapangan hidup seperti kelonggaran ibadah, kelonggaran sistem akad kehartaan dan muamalat dan seumpamanya. Imam Al-Ghazali mendefinisikan hajiyyat sebagai sebuah maslahah yang tidak wajib, akan tetapi tetap diperlukan dalam rangka menjaga kemaslahatan. Maqasid ini bersifat tidak wajib kerana ketiadaan maqasid ini tidak sampai mempengaruhi kestabilan kehidupan manusia, namun keperluan ini tetap harus dijaga demi menghilangkan kesukaran dan kesulitan seorang mukallaf dalam mewujudkan kemaslahatan yang diinginkan oleh syarak (Al-Ghazali, 2000).

Tahap maqasid ini dijamin dalam Islam bagi tujuan menghindarkan manusia daripada kesusahan dan kesulitan, memudahkan sesuatu perkara serta menyediakan saluran kesenangan dan kemudahan kepada

manusia. Tanpa maqasid ini, ia tidaklah merosakkan sistem hidup manusia namun akan menghadapi suasana kesukaran, kepayahan dan keperitan dalam sesuatu perkara.

Perubatan, utiliti dan komunikasi merupakan perkara yang dikategorikan sebagai keperluan tambahan kepada seseorang individu. Ketiga-tiga perkara ini memberikan kemudahan dan keselesaan kepada manusia. Sebaliknya, jika ketiga-tiga perkara tersebut tidak dipenuhi akan mendatangkan kesulitan dan kesusahan kepada manusia namun tidak membawa kepada kemudaratan yang boleh mengancam agama, nyawa, akal, keturunan dan harta secara langsung.

5.3 Tahsiniyyat

Maqasid tahsiniyyat ialah suatu keperluan yang tidak mendesak tetapi memberi kesempurnaan dalam pengurusan kehidupan manusia. Antaranya adalah seperti mengerjakan amalan-amalan sunat serta adab-adab yang dianjurkan oleh syarak yang dikerjakan oleh umat manusia dalm kehidupan seharian.

Sebagaimana menurut Imam Al-Shatibi, tahsiniyyat merupakan perbuatan dengan melakukan sesuatu amalan atau adat yang baik dan terpuji serta menjauhi perkara-perkara yang dianggap tidak baik oleh akal yang sempurna (al-Syatibi, 1997). Imam Al-Ghazali berpendapat bahawa

Tahsiniyyat sebagai kemaslahatan yang tidak termasuk dalam kategori darurah mahupun hajah (hajiyyat), akan tetapi ianya bersifat untuk memperelok, memperindah dan mempermudahkan demi mencapai keistimewaan dan nilai tambah.

Kepentingan tahsiniyyat juga dapat membantu dan menampung dalam usaha mencapai keperluan biasa dan kepentingan asas, iaitu bersifat pelengkap kepada pencapaian hajiyyat dan daruriyyat serta menjaga sesuatu yang terbaik berkaitan kebiasaan dalam kehidupan. (Al-Ghazali, 2000).

Individu yang menanggung hutang kerana ditimpa musibah, membantu menjaga kemaslahatan ummah atau perkara-perkara yang dibenarkan oleh syarak boleh dikategorikan sebagai keperluan pelengkap kepada seseorang individu. Hal ini adalah kerana Islam tidak menggalakkan umatnya berhutang kecuali atas faktor-faktor yang tidak dapat dielakkan.

6 PENGAGIHAN ZAKAT BERDASARKAN MAQASID SYARIAH

Pelbagai skim bantuan agihan zakat yang telah diperuntukkan oleh Pusat Zakat dan Majlis Agama Islam Negeri (MAIN) bagi membantu golongan asnaf yang berhak menerima zakat. Skim bantuan ini meliputi bantuan dari sudur kebajikan dan pembangunan asnaf seperti keperluan asasi, pendidikan, agama, perubatan, perumahan dan sebagainya. Maka, secara umumnya skim bantuan yang disediakan oleh pihak Majlis Agama Islam dan ‘Adat Melayu Perak contohnya telah meliputi segala konsep maqasid syariah. Ini berdasarkan pembahagian skim bantuan yang disediakan dan pengkelasannya mengikut maqasid syariah.

Bil.	**Skim Bantuan**	**Maqasid Syariah**
Skim Bantuan Pembangunan Asnaf (Sosial dan Ekonomi)		
1.	Bantuan Bina Rumah	Keturunan, Nyawa dan Harta
2.	Bantuan Kewangan Bulanan	Agama dan Nyawa
3.	Bantuan Hari Raya	Agama dan Nyawa
4.	Bantuan Baikpulih Rumah	Keturunan dan Harta
5.	Bantuan Sewa Rumah	Nyawa dan Harta
6.	Bantuan Perubatan	Nyawa
7.	Bantuan Hemodialisis	Nyawa
8.	Bantuan Kecemasan Segera	Nyawa

9.	Bantuan Pengurusan Jenazah	Agama dan Nyawa
10.	Bantuan Penyelesaian Hutang	Nyawa dan Harta
11.	Bantuan Bencana	Nyawa dan Harta
12.	Bantuan Kebajikan Anak Yatim	Agama
13.	Bantuan Tambang Perjalanan Domestik	Nyawa
14.	Bantuan Bank Makanan	Nyawa
15.	Bantuan Modal Perniagaan	Harta
16.	Bantuan Latihan Keusahawanan Asnaf	Agama dan Akal
Skim Bantuan Pemerkasaan Asnaf (Pendidikan Akademik dan Kemahiran) dan Modal Insan		
1.	Bantuan Persekolahan	Akal
2.	Bantuan Am Pelajaran	Akal
3.	Bantuan Biasiswa Pelajaran Baitulmal	Akal
4.	Bantuan Tambang Perjalanan Sehala Belajar Luar Negara	Akal
5.	Bantuan Dermasiswa Dalam dan Luar Negara	Akal
6.	Bantuan Perkapita Sekolah Agama Rakyat	Agama dan Akal
7.	Bantuan Perkapita Sekolah Latihan Wanita	Akal
8.	Bantuan Pembangunan Modal Insan	Akal
9.	Bantuan Pemurnian Akidah dan Akhlak	Agama dan Akal
10.	Bantuan Penyelenggaraan Rumah Anak Yatim	Harta

Maka dapat disimpulkan bahawa kelima-lima pembahagian prinsip maqasid Syariah memainkan pernana yang penting dalam mengukur tahap keberkesanan sesuatu skim bantuan yang diperuntukkan oleh MAIN dalam meningkatkan kepercayaan masyarakat terhadap institusi agama Islam.

7 KESIMPULAN

Secara umumnya, pendekatan maqasid Syariah dalam pengurusan zakat adalah sesuatu yang amat sesuai untuk dijadikan asas dan panduan dalam pengurusan zakat di Malaysia. Walaupun penjelasan tentang had al-kifayah zakat tidak disebut dengan jelas dalam Islam, namun penetapan had kifayah zakat adalah sesuatu perkara yang menjadi tanggungjawab pemerintah dalam melaksanakannya agar dapat dijadikan ukuran dalam penetapan dan penyaluran zakat kepada golongan asnaf serta sentiasa berubah mengikut kesesuaian keadaan, masa dan tempat. Oleh itu, pendekatan maqasid syariah dalam penentuan had al-kifayah zakat adalah amat penting bagi memastikan pengurusan kutipan dan agihan zakat bersesuaian mengikut syariat Islam.

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A Feasibility Study of The Digital Gallery Walk Flipped Classroom for Student Engagement Among Diploma Students

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ABSTRACT

This paper aims to implement a feasibility study of the Digital Gallery Walk Flipped Classroom (Digital GWFC) for student engagement (SE) among diploma students. The Digital Gallery Walk is a presentation method in which students present their digital works. In the Flipped Classroom, students view online lecture videos or notes before class time, complete their work during class time and attend class discussions. The study utilized a quantitative research methodology to evaluate student engagement in the combination of teaching and learning strategies called the Digital Gallery Walk Flipped Classroom. The sample involved were 25 Animation and 26 TESL diploma students of Kolej Poly-Tech MARA Ipoh. The data was obtained via survey methodology and subjected to an analysis procedure utilizing various statistical techniques including descriptive statistics, Pearson's correlation coefficient, independent t-tests and multiple regression analysis. It is found that the implementation of Digital GWFC has a positive impact on student engagement among diploma students mostly in cognitive skills. The study concludes that as higher student engagement is associated with higher learning outcomes, the Digital GWFC approach can be effective for student learning. Thus, it offers wide market potential for engaging and interactive training experiences. The findings are followed by implications, limitations and directions for future research

KEYWORDS: gallery walk, flipped classroom, digital gallery walk flipped classroom, student engagement

1 INTRODUCTION

The Sustainable Development Goals (SDGs) and 21st-century education are closely linked, as education is fundamental to achieving the SDGs and addressing contemporary global challenges. The SDGs recognize the transformative power of education to foster economic growth, social inclusion and

environmental stewardship. Quality Education is dedicated to ensuring that all students acquire the knowledge and skills needed to promote sustainable development (Leal Filho, Simaens, Paço, Hernandez-Diaz, Vasconcelos, Fritzen & Mac-Lean, 2023). Advancements in technology and innovation (Goal 9) are increasingly seen as crucial for achieving the SDGs. There is growing recognition of the role that digital technologies, data, and innovation can play in addressing global challenges and driving sustainable development. The digital revolution of education has been augmented by the COVID-19 pandemic. Digital tools and platforms are increasingly used to enhance learning and broaden access to education (Makinde, Ajani & Abdulrahman, 2024).

21st-century education emphasizes skills necessary for thriving in a complex, rapidly changing world. These skills include critical thinking, creativity, collaboration, and digital literacy. Innovative pedagogical approaches, such as project-based learning, experiential learning, and the flipped classroom model, align with the 21st-century education framework and support the SDGs by fostering deeper engagement and practical problem-solving skills (Garg & Agarwal, 2023). The integration of 21st-century skills into education is crucial for advancing the SDGs. By focusing on critical thinking, digital literacy, lifelong learning, and global citizenship, education can contribute significantly to sustainable development. The ongoing efforts to align educational practices with the SDGs reflect a commitment to preparing students for a rapidly evolving world and addressing global challenges effectively.

The flipped classroom is an innovative pedagogical approach that has gained prominence in 21st-century education. It represents a significant shift from traditional teaching methods, leveraging technology to enhance student learning and engagement. The flipped classroom model aligns with 21st-century education principles by fostering active learning, collaboration, and personalized instruction (Latorre-Cosculluela, Suárez, Quiroga, Sobradiel-Sierra, Lozano-Blasco & Rodríguez-Martínez, 2021). While it presents opportunities for enhancing student engagement and learning outcomes, the flipped classroom also poses challenges related to technology access, content creation and effective assessment. Continued research and practice are necessary to refine this approach and maximize its benefits in diverse educational contexts.

The Gallery Walk is a dynamic and interactive teaching strategy that promotes active learning and student engagement. It involves students rotating around the classroom to explore and discuss different "exhibits" or stations that display information, ideas, or projects. This approach aligns well with 21st-century education principles, which emphasize collaboration, critical thinking, and hands-on learning. The Gallery Walk is an effective instructional strategy that aligns with 21st-century education principles by promoting active learning, collaboration, and critical thinking (Papasarantou, Alimisi & Alimisis, 2023). Its dynamic, interactive nature makes it a valuable tool for engaging students and enhancing their learning experiences. By thoughtfully implementing and adapting the Gallery Walk, educators can create rich, participatory learning environments that support diverse educational goals.

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1.1.1 Problem Statement

Learners in the flipped classroom obtained higher scores in emotional engagement with learning compared to learners in the traditional classroom (Jdaitawi, 2020). The combination of Learner-centered Learning Theory and Triple E framework has accelerated the language acquisition performance of high-achievers (Nawi, Rahim, Fadzil, Ramli & Ab Rahman, 2023). Gallery need to be more intrinsic to the digital landscape between physical and digital reality in the midst of cultural and social revolution (Giannini & Bowen, 2022)

The innovation of Digital GWFC will accommodate learning among technology savvy, particularly for Gen-Z learners. According to Schendel et. al., (2008) integrating traditional gallery walk with digitalization makes a better learning environment for student engagement and students have better access to the learning materials.

There are a lot of studies in flipped classroom and gallery walk but so far no studies has been conducted on the digital gallery walk flipped classroom.

1.1.2 Research Questions

a) To examine the relationship between student engagement in DGWFC influence the course learning outcome 2 (CLO2)
b) To examine the student dimension of student engagement to the learning outcome (CLO 2).
c) To examine the differences in student engagement between junior students (DTE 0101) and senior students (DIA 0601) in topic 5 MPU 2183

1.1.3 Research Objective

The following are the research questions implement a feasibility study of Digital Gallery Walk Flipped Classroom (Digital GWFC) for student engagement (SE) among diploma students:

a) What is the relationship between SE in Digital GWFC influence CLO2?
b) How does the dimension of student engagement; behavior, cognitive or emotional influence CLO2?
c) Is there any difference in SE between Semester 1 TESL students and Semester 6 Animation students in CLO2?

2 LITERATURE REVIEW

Research has shown that gallery walks can be an effective activity to incorporate into the in-class portion of a flipped classroom. In a study by Strayer and Planchon (2018), learners in a flipped classroom were assigned to small groups and asked to create a poster or visual display summarizing the key concepts from the pre-class instructional materials. During class, the groups then participated in a gallery walk where they viewed and discussed each other's displays, providing feedback and asking questions to deepen their understanding of the material. The results of the study indicated that the gallery walk activity was effective in promoting learner engagement and collaborative learning. Learners reported that the activity helped them to clarify their understanding of the material and that they enjoyed the opportunity to interact with their peers and receive feedback on their work.

The theory of constructivism says that learners acquire and construct knowledge rather than passively taking in information (Vygotsky, 1978). Flipped classroom requires students to work in a group and combined with Gallery Walk learning which increases opportunities for discussion, engagement, and collaborative learning. Learning becomes an interactive and active process for the learners through the teacher's guidance the student's cognitive development is mediated through their social interactions. The combination of Gallery Walk learning and flipped classroom resulted in learners acquiring and experiencing learning through collaborative learning.

Lo and Hew (2017) investigated the use of gallery walks in a flipped classroom context to promote critical thinking skills. In this study, learners in a flipped classroom were assigned to small groups and asked to create a poster or visual display that presented arguments for and against a controversial issue. During class, the groups participated in a gallery walk where they viewed and discussed each other's displays, using critical thinking skills to evaluate the arguments presented. Research on the use of gallery walks in a flipped classroom context in Malaysia is relatively limited. However, a few studies have investigated the effectiveness of this strategy in promoting learner engagement and learning outcomes in Malaysian classrooms.

Gallery walks were used as a learning activity in a flipped classroom for a group of Malaysian secondary school learners (Alias & Ali, 2019). The learners were asked to create posters summarizing the key concepts from their pre-class learning materials and then participated in a gallery walk where they viewed and discussed each other's posters. The results of the study showed that the gallery walk activity was effective in promoting learner engagement and collaboration, as well as improving their understanding of the subject matter. The researchers also noted that the flipped classroom approach was well-received by the learners, who reported that they enjoyed the opportunity to take ownership of their learning and engage in meaningful discussions with their peers.

Another study by Mohamed, Rahman, Yahya and Abdullah (2019) investigated the effectiveness of a flipped classroom approach that incorporated gallery walks in a Malaysian university setting. Learners in a statistics course were assigned to small groups and asked to create posters summarizing the key concepts from their pre-class instructional materials. During class, the groups participated in a gallery walk where they viewed and discussed each other's posters, providing feedback and asking questions to deepen their understanding of the material. The results of the study showed that the flipped classroom approach was effective in promoting learner engagement and improving learning outcomes, with learners reporting increased motivation and a deeper understanding of the subject matter.

2.1 The Gallery Walk and Student Engagement

Recent studies have proven that the gallery walk has many positive impacts on students' engagement in various educational settings. The gallery walk approach is considered an active learning strategy where students will be actively participating in the lessons. Insani (2020) claimed that this type of learning had significantly increased the students' engagement specifically in complex courses such as science and mathematics. This approach encourages students to collaborate and work together in small groups changing and sharing ideas among them (Satriani,2022). The researcher also claimed that this approach had changed the pattern of passive learning to active learning where students no longer quietly listen to the information given by the educators instead, they become actively involved during the learning experience.

Other than that, the gallery walk approach inspires students to think and process the information analytically and collectively (Vale & Barbosa, 2021). Lanuza, Hilario, Arroyo & Lara (2022) studied the impact of gallery walk exposure on high school students in mathematics settings. The researchers found that this approach had shown a significant improvement in students' problem-solving skills and theoretical comprehension compared to the traditional lecture-based method. The researchers also claimed that students were able to understand the lessons effectively due to the gallery walk's nature which was able to provide multiple visual and interactive representations of mathematical theories.

In the 21st century, critical thinking and creativity are crucial abilities. Sunarti and Septiana (2019) claimed that the gallery walk creates a dynamic environment for students to cultivate essential skills. It prompts them to thoroughly analyze information, challenge assumptions, and cultivate innovative ideas. In addition, the purpose of gallery walks is to elevate creativity, particularly in the arts and humanities. When the students are allowed to present their work using inventive methods like visual displays, posters, and multimedia presentations, the gallery walk promotes thinking in unconventional ways and the expression of ideas in original ways. This approach may boost students' creativity and also enrich students' comprehension of the subject matter.

Essentially, the gallery walk approach not only caters to different subjects it also caters to different learning styles. Putri, Kartini & Yuanita (2020) stated that for visual students, gallery walks gave them benefits in terms of the visual materials exhibited at each station. The researchers also added that other learning styles students such as auditory students can actively engage in discussion and listen to their peer's presentations.

2.2 The Flipped Classroom and Student Engagement

Numerous academic studies have examined the impact of flipped classrooms on various dimensions of student engagement, encompassing behavioural, emotional, and cognitive engagement. According to Alebrahim & Ku (2020), the flipped classroom approach was well-received by students, who found that this method effectively enhanced their engagement, understanding of the lesson, and ultimately led to improved performance and grades. Wong (2024) found the implementation of the flipped classroom model yielded a notable enhancement in calculus proficiency following the intervention, with sustained efficacy observed over time. Consequently, the findings indicate the heightened suitability of the flipped classroom model for the cultivation of cognitive skills. Hence, it is recommended to integrate the flipped classroom

model into higher education institutions to enhance students' preparedness for forthcoming challenges in science and technology.

Emotional engagement involves students' attitudes, interests, and emotional responses to learning. A study by Lee and Wallace (2018) found that students in flipped classrooms reported higher levels of interest and motivation, as the in-class activities were more interactive and engaging than traditional lectures. However, the study also noted that the success of a flipped classroom in enhancing emotional engagement depends heavily on the quality of the pre-class materials and the design of in-class activities. The analysis of student responses provides evidence of the enthusiasm exhibited by students towards the learning activities carried out in the flipped classroom. This was attributed to their existing knowledge acquired before the class sessions. Consequently, students demonstrated a heightened readiness to engage in class discussions, eagerly participated in the learning tasks, and showcased the ability to pursue independent study (Sunway, Arapah & Muth'im, 2024).

Cognitive engagement refers to the investment in learning and the willingness to exert the necessary effort to comprehend complex ideas. The research by Say and Yildirim (2020) demonstrated that flipped classrooms encourage deeper cognitive engagement, as students are required to actively process and apply the knowledge, they acquired from the pre-class materials. Hao, Tian, Mohd, Hai, Ge & Cheng (2024) found their study suggested that both project-based learning and flipped classrooms had a substantial influence on enhancing critical thinking and fostering creativity among students. Furthermore, the combination of project-based and flipped classrooms exhibited an even more pronounced effect on promoting critical thinking skills and nurturing creativity, underscoring its potential as a highly effective instructional method for reshaping the current educational curriculum and teaching practices. This comprehensive study adeptly incorporates a variety of engaging and interactive classroom activities, designed to enhance critical thinking, problem-solving, and decision-making abilities among students in the higher vocational education context. Furthermore, it offers comprehensive and practical guidance to educators and instructional leaders, outlining effective strategies to identify, nurture, and develop the diverse talents and aptitudes present within this educational domain.

2.3 Triple E Framework

According to learning styles theories, individuals' unique learning styles with matching learning experiences enhance academic achievement. Derived from Lewin, Dewey and Piaget, Kolb's theory of experiential learning develop Kolb's model of learning styles. Kolb's four learning styles are given by the permutations of two embedded dimensions: perception and processing in a universal learning cycle (Bishop & Verleger, 2013).

The Triple E Framework measures how technology can help instructors to select tools and design learning experiences thus further guiding learners to the tools to meet and exceed learning goals (Kolb, 2017). The framework is based on three factors that instructors need to be clear about when using technology in order to further the goals of the lessons. As an engagement factor, technology allows learners to focus on the learning process. As an enhancement factor, technology allows learners to develop more understanding of concepts and ideas. Meanwhile, as the extension factor, technology allows learners to connect learning.

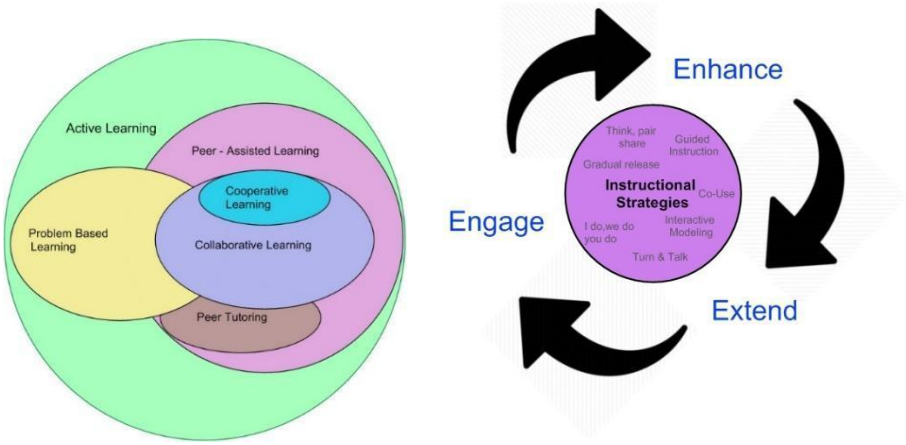


Figure 1: Triple E Framework

2.4 Student Engagement and Learning Outcome

Rivera & Garden (2021) stated that the achievement of learning outcomes can be a measurable consequence of the state of student engagement which spans affective, cognitive and behavioural domains. Other studies such as in Xu et al., (2023) mentioned that emotional engagement is the most effective in promoting learning outcome in basic medical knowledge and clinical skills. The same notion is also shared by Yu et al., (2022) which the researchers argued that mobile learning technologies could significantly improve behavioural, social, cognitive and emotional engagements and English learning outcomes compared with social media tools. The traditional teaching tools did not improve behavioural, social, cognitive and emotional engagements and learning outcomes.

From these studies, the researcher hypothesised that the students' engagement in the implementation of DGWFC can increase the learning outcome of the subject. This is because digital gallery walk is effective for students in their learning compared to traditional gallery walk (Makmum, et. al., 2019).

Based on the review here, this study tries to examine the implementation of student engagement in DGWFC method and its relation to the learning outcome.

3 METHODOLOGY

This study is purely quantitative which implements the causal research design. According to Hair et al. (2018), the research design selected will (i) provide relevant information on the research questions and hypotheses and (ii) complete the job efficiently. The formulation phase of the research process is based on the choice of research design. The quantitative research design does not consider the opinion of the researcher, although there is some influence of the researcher in the research question and objective (Hair et al., 2018). The advantage of using quantitative research design over qualitative is that it is more useful in theory testing and has more structured data collection techniques and objective ratings. Descriptive research describes a situation by providing measures in which descriptive statistics is used for data analysis. Finally, the causal research design. Causal research tests whether one relationship means that a change in one event led to a corresponding change in another. In other words, it tests how a change in x makes a change in y. According to Hair et al. (2019), this type of research design must have theoretical support, require precise decision and planning, and is the most complex. In the context of this study, a causal research design will be implemented, and data will be collected cross-sectional. This research design is used to answer research questions and achieve the objectives.

3.2 Research Sample

A sample must represent the population, and the characteristics of the sample and population must be the same (Hair et. al., 2016). Thus, the appropriate sampling must be designed to achieve the research objective.In this study, the convenience sampling is implemented. Justification for this sampling is that the convenience sampling is inexpensive, efficient and simple to implement although it lacks generalizability (Jager et al., 2017). Furthermore, it is convenient due to the role of the researchers as the class facilitator, so the access to the respondents is easy.

51 Diploma students of KPTM Ipoh are selected for this study; consisted of 25 students enrolled in Diploma in Animation (DIA) and 26 students enrolled in Diploma Teaching English as Second Language (DTESL) taking MPU2183 Penghayatan Etika dan Peradaban course during session April 2024.

3.3 Data Collection

Table 1 below indicates how the Digital GWFC was administered. In the Flipped Classroom teaching methods, students were assigned to view online lecture videos and learning modules on Topic 5 which is assessed as Course Learning Outcomes 2 (CLO2) before they come to class. During class time, students were divided into groups and instructed to discuss the given assignment of Topic 5. The group assignment was to upload and present a digital infographic or poster via the Gallery Walk learning strategy under the lecturer's supervision. After class, solutions and feedback were shared for class discussion. For the next sessions, the same method and procedures are followed but with different group members. At the end of the session, the surveys are distributed to the students.

Table 1: Digital GWFC Procedure

Before	During	After
View online instructional videos and refer to learning modules.	Present digital work and view other groups' work under the lecturer's supervision.	Solutions and feedback are shared for class discussion.

The research instrument in this study is developed from the theories in the conceptual framework. The survey is divided into four parts; (i) respondents' details such as class section, program, gender and year of study; (ii) measurement for student engagement and the items are adapted from Suppasetseree, Kumdee & Ho Minh (2023). Student engagement is measured based on three dimensions - behavioural, cognitive, and emotional. The other part of the instruments is; (iii) learning outcome which the measurement is based on CLO2 based on the document syllabus of the MPU2183 course provided by Kolej Poly-Tech MARA. The last one is (iv) measurement for Digital GWFC which is adapted from Keong, Kian & Aquino (2016).

The measurement scale for the research instrument is a 10-point scale. The normal practice for business research uses a 5-point scale or a 7-point scale for construct measurement. However, the use of a 10-point scale is on the rise since the more points there are, the more precise the agreement or disagreement level is recommended (Hair, Celsi, Money, Samouel & Page, 2016). Dawes (2008) proved that the measurement using a 10-point scale has better variance results compared to a 5-point and 7-point scale. It also proved that the 10-point scale provided more variance responses in the study when the respondents were given the more-point scale

3.4 Data Analysis

Data was analyzed through descriptive analysis and inferential analysis. Before the analysis of the data, it went through data screening to weed out the unengaged responses and missing values. Before the data can proceed to the analysis, the normality test and reliability analysis will be implemented. This is to ensure the normality of the data to use parametric statistical analysis. Parametric statistical techniques are

chosen due to the normal distribution of variable data (Pallant, 2020). The normality test used the Kolmogorov-Smirnov and Shapiro-Wilk Test, where p-value < .05.

Demographic variables such as class, program and gender were analyzed with simple descriptive analysis for frequency and percentage. Data analyses are represented based on the research objectives. In inferential analysis, Pearson correlation was used to achieve research objective 1, multiple regression analysis to achieve research objective 2 and t-test to achieve research objective 3. All the tests will be analyzed using IBM SPSS 23.

4 RESULTS AND FINDINGS

4.1 Normality Test

Table 2 shows the result of the Normality Test for each construct; SE (.011), CLO2 (0.005) and Digital GWFC (0.002). The significant value is not more than .05 thus data are considered normal.

Table 2: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SE	.143	51	.011	.934	51	.007
CLO2	.152	51	.005	.935	51	.008
DGWFC	.160	51	.002	.894	51	.000

a. Lilliefors Significance Correction

4.2 Reliability Test

Table 3 shows the result of the Reliability Test for each construct; SE (.854), CLO2 (0.918) and Digital GWFC (0.910). Since the Cronbach's Alpha values for all constructs are higher than 0.70, the data has very good internal consistency reliability.

Table 3: Reliability Analysis

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
SE	.854	.862	10
CLO2	.918	.920	7
DGWFC	.910	.911	10

4.3 Descriptive Analysis

Descriptive statistics were used to analyze the demographic data of respondents in terms of gender and program enrollment. Table 4 shows that the number of male respondents is 16(31.4%) which is less than female respondents, 35(68.6%). Also included, 49% of respondents enrolled Animation diploma program and 51% are from the TESL diploma program.

Table 4: Respondents According to Gender and Program

		Frequency	Percentage
Gender	Male	16	31.4
	Female	35	68.6
Program	Animation	25	49.0

	TESL	26	51.0
	Total	51	100.0

4.4 Correlation Analysis

Correlation Analysis was used to examine the relationship between SE in Digital GWFC influence the Course Learning Outcome 2 (CLO2). In Table 5, the r-Pearson Correlation coefficient shows that there was a strong positive correlation between student engagement in Digital GWFC ($r = 0.757$, $p < 0.001$). Also shown is a moderate positive correlation between Digital GWFC influence the Course Learning Outcome 2 (CLO2) ($r = 0.556$, $p < 0.001$).

Table 5: Pearson Correlation Coefficient

		r -Pearson	p
DGWFC	SE	.757	.000
	CLO2	.556	.000

4.5 Multiple Regression Analysis

Multiple regression analysis was used to determine how the dimension of student engagement; behavior, cognitive or emotional influence CLO2. The assumptions are normal plots of regression standardized residual shows the normality and data are continuous as explained in the methodology section.

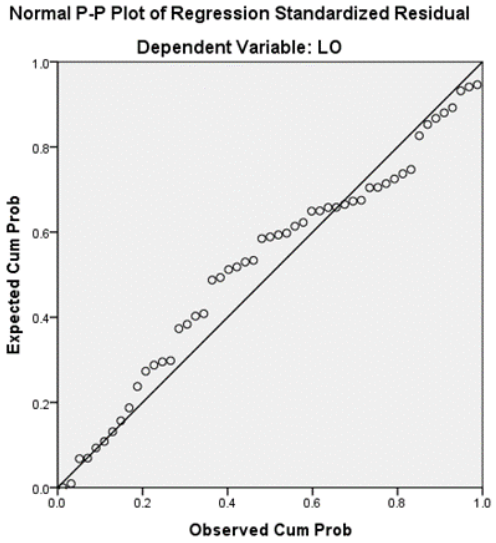


Figure 2: Normality Test for Regression

According to Table 6, the value of the multiple correlation coefficient R is 0.693 can be considered to be one measure of the quality of the prediction of student engagement. R square 0.480 means only 48% of learning outcomes can be explained by the variance Behavior, Cognitive and Emotional.

Table 6: Model Summary of Regression Model

R	R square	Adjusted R square
.693	.480	.447

Table 7 shows the coefficient for the regression model. Based on the result, the p-value of Behavior is $0.373 > 0.05$ which is considered insignificant. The p-value for cognitive is $0.007 < 0.05$ which is significant. The p-value for emotional engagement is $0.066 > 0.05$ is insignificant. The prediction of learning outcome which is explained by Student Engagement dimensions is as follows:

Prediction of LO = 0.219 Behavior + 0.981 Cognitive +0.646 Emotional

This means that a 1 unit increase in Behavior means a 0.219 increase in LO, a 1 unit increase in Cognitive will be a 0.981 increase in LO and a 1 unit increase in Emotional will increase 0.646 in LO

Table 7: Coefficients for Regression Model

	B	Std error	Beta	t	Sig
Behavior	.219	.243	.124	.899	.373
Cognitive	.981	.347	.409	2.831	.007
Emotional	.646	.343	.263	1.884	.066

4.6 Independent sample T-test

Independent Samples t-test is conducted to compare the difference in SE between Semester 1 TESL students and Semester 6 Animation students in CLO2. Table 8 shows the sig value is 0.654 (> 0.05), assuming equal variances among populations. Based on the Independent Sample T-Test, t = -0.685, df =49 where k> 0.05, there is no significant difference between Animation and TESL programs for student engagement.

Table 8: Independent Samples t-Test

	Levene test		T-test			
SE	t	df	Sig (2-tailed)	Mean difference	Lower	Upper
	-.685	49	.497	1.078	-4.242	2.085

5 DISCUSSION

To answer Research Question 1: What is the relationship between SE in Digital GWFC influence CLO2? Based on the analysis, the Pearson Correlation Coefficient revealed that there was a strong positive correlation between student engagement in Digital GWFC ($r = 0.757$, $p<0.001$). The analysis also pointed out that the correlation between Digital GWFC and Course Learning Outcome 2 (CLO2) is a moderate positive with the value of ($r = 0.556$, $p <0.001$).

The correlation of student engagement in this context involves how actively students interact with the digital content and with each other during the gallery walk. High student engagement typically means students are not just passively consuming information but are critically analyzing, discussing, and reflecting on it. A significant difference from the traditional classroom in four dimensions: freedom of choice, variety of teaching resources, effective learning from peers and a favorable flipped classroom. These findings also indicate that the change in the learning environment affects students' learning attitudes and classmates' relationships (Oh, Chan, Kong & Ma, 2022).

Findings on the Digital GWFC and course learning outcomes are found to be moderately positive. This means that while most of the reviewed studies reported a positive correlation, in a flipped classroom, students are expected to come prepared, which allows for a deeper exploration of topics during class, viewing pre-recorded videos before coming to class enabled students to comprehend course content better and easier (Hava, 2021). The active and reflective learning that DGWFC facilitates engages students in active learning. (Howell, 2021). A digital gallery walk further enhances this by encouraging active engagement with diverse perspectives and materials. Findings also reveal the importance of incentivizing

pre-class preparation using infographics and videos, which additionally helped students understand/remember content, and gave confidence about contributing in class.

Next, to answer Research Question 2: How does the dimension of student engagement; behavior, cognitive or emotional influence CLO2? In the examination of the student dimension of student engagement to the CLO2, the variance predetermined are Behavioral, Cognitive and Emotional. It was found that based on the model result of coefficients for regression, the variance of Cognitive is the highest with 0.981 > 0.05 in CLO2.

Cognitive processes play a crucial role in shaping learning outcomes. Innovative approaches such as the Digital GWFC are more effective than the traditional method in terms of using deep learning strategies and increasing the levels of cognitive engagement (Hava, 2021). Cognitive factors such as attention, memory, understanding, metacognition, cognitive load, prior knowledge, and problem-solving skills significantly affect how well individuals learn and apply new information, cognitive judgments are affected directly by learning environments (Tugtekin & Odabasi, 2022). Addressing these factors through targeted strategies can improve learning outcomes.

It is imperative to deliver high-quality classes using a Digital GWFC learning approach to satisfy students' expectations of improving learning outcomes. The relevance for learning also affected students' perceived usefulness of Digital GWFC classes and indirectly influenced their future intention to use it. The results emphasize that students should be given opportunities to recognize the relevance of innovative cognitive learning approaches based on their expected learning achievement (Doo & Bonk, 2021)

Lastly, to answer Research Question 3: Is there any difference in SE between Semester 1 TESL students and Semester 6 Animation students in CLO2? Based on the Independent Samples t-test, the differences in student engagement between TESL Semester 1 students and Animation Semester 6 students in CLO2 valued at $p = 0.497 > 0.05$, at this value there is no significant difference between Animation and TESL programs for students' engagement.

What this proves is the Digital GWFC approach can be equated as being universal and may be effectively applied to cross-field courses. Regardless of the nature and the technicality of the said courses. The comparative study between a language-based course (TESL) and a meta-cognitive course (Animation) resulted in no significant difference in students' engagement. The flipped classroom instructional model helps students improve their cognitive learning across a wide-reaching synthesis of currently available interdisciplinary subjects (Yinghui, Yanqiong, MacLeod & Hao Harrison, 2020). Understanding this significance can help tailor the digital gallery walk experience to better meet the needs and strengths of each group, ultimately enhancing their learning outcomes.

6 CONCLUSION

It is found that the implementation of Digital GWFC has a positive impact on student engagement among diploma students mostly in cognitive skills. The study concludes that as higher student engagement is associated with higher learning outcomes, the Digital GWFC approach can be effective for student learning. Thus, it offers wide market potential for engaging and interactive training experiences.

6.1 Research Implications

The flipped classroom model, combined with digital gallery walks, is increasingly seen as a powerful tool to enhance learning outcomes. Several studies emphasize its ability to foster higher-order thinking, collaboration, and personalized learning (1). Higher-order thinking and Critical Reflection, research has shown that flipped classrooms can significantly improve higher-order thinking skills (Samadi, Jafarigohar, Saeedi, et al, 2024). Students engage more deeply with the content through pre-class activities, such as instructional videos and quizzes, which prepare them for in-class discussions and peer feedback.

This structure promotes the analysis, evaluation, and synthesis of ideas, central components of higher-order thinking, as highlighted by research on flipped learning in various subjects.

6.2 Research Limitation

Introverted students may struggle with active participation in class discussions and activities. Students with introverted tendencies might be less inclined to participate in traditional classroom discussions but may engage more effectively through alternative digital tools or smaller group interactions (Molloy, 2021). Digital formats can facilitate distractions and off-task behavior, reducing overall engagement the use of digital devices in educational settings is linked to increased off-task behavior. Their research suggests that integrating structured, interactive activities can help maintain student focus and mitigate distractions (Ravizza, 2021).

The other limitation of this study is the low sampling. This is due to the short period of semester which is in April session where the academic session only for 7 weeks. The larger sampling is needed to ensure that the framework of the Triple E can be immersed longer in the students' engagement.

6.3 Future Works

Comparative studies should be conducted to analyze student responses to this model in different fields. For example, a study might compare how students in STEM disciplines (such as biology or engineering) and those in the humanities or arts (such as literature or visual arts) engage with and benefit from this model. Key metrics for evaluation would include engagement levels, learning outcomes, and overall satisfaction with the learning experience. Longitudinal studies are needed to determine how well knowledge retention compares to traditional methods. Comparative studies between STEM and humanities students reveal significant differences in engagement and learning outcomes with interactive teaching models (Lee & Kim, 2024).

The future works also can involve other programmes of students in KPTM Ipoh such as from Diploma in Digital Marketing students, Diploma in Digital Business students, Diploma in Game Designs and Diploma in Multimedia. DGWFC can be implemented in larger sample. Furthermore, the DGWFC can be tested for specific topics to assess the student engagement in other variables from other frameworks.

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Peranan Huffaz Dalam Penyebaran Dakwah Di Institusi Pendidikan

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ABSTRAK

Pendidikan tahfiz di Malaysia merupakan sebuah institusi pendidikan yang melahirkan para pelajar huffaz yang berjaya. Perkembangan pusat pengajian tahfiz juga telah menjadi satu isu yang sangat penting dalam konteks pendidikan agama di Negara ini. Ini berdasarkan peningkatan permintaan daripada pelbagai latar belakang masyarakat sama ada berlatar belakang daripada golongan kurang berkemampuan sehinggalah golongan professional yang ingin mempelajari Al-Qur'an dalam kehidupan mereka.

Objektif kajian ini bertujuan untuk mengkaji peranan para pelajar tahfiz dalam penyebaran dakwah di institusi pendidikan. Kajian juga adalah untuk mengenalpasti peratusan para pelajar tahfiz yang memainkan peranan sebagai seorang huffaz dalam memberi pengaruh positif kepada para pelajar serta cabaran-cabaran yang dihadapi oleh mereka.

Kajian ini menggunakan kaedah kualitatif iaitu dengan menemu bual dan pemerhatian terhadap para pelajar serta asatizah di pusat-pusat pengajian tahfiz swasta di Malaysia ini. Kajian ini diharap dapat memberikan maklumat tentang hala tuju para pelajar tahfiz selepas menamatkan pengajian di institusi-institusi tahfiz di Negara ini.

KATA KUNCI*: Al-Qur'an, Huffaz, Pendidikan Tahfiz, Institusi Pendidikan,*

1 PENGENALAN

Menghafal al-Quran merupakan amalan tradisi umat Islam sejak era Rasulullah SAW. Ia amat digalakkan dalam Islam dan penghafal al-Quran diberi ganjaran yang besar di sisi Allah SWT. Menghafal al-Quran yang menjadi budaya masyarakat Islam di Malaysia selari dengan era dakwah Islam di alam Melayu. Menghafal surah al-Fatihah menjadi kewajipan setiap Muslim sebagai keabsahan solat dengan diiringi hafalan surah pendek dalam menyempurnakan ibadat solat. Justeru, pengajian al-Quran dari aspek tajwid dan hafalan menjadi budaya dalam masyarakat Islam di Nusantara secara umumnya. Antara pengajaran dan pembelajaran yang disampaikan oleh tuan guru adalah Feqah, Tilawah, Tasawuf, Tafsir, Hadis, serta adab-adab dalam pergaulan seharian.

Setiap pendidikan yang berlangsung sama ada daripada guru al-Quran di kampung, golongan ulama dan pendakwah, serta tuan guru tidak terpisah daripada menghafaz sekurang-kurangnya surah al-Fatihah. Surah al-Fatihah diajar kepada masyarakat kerana surah ini sebagai asas dalam mengerjakan solat. Namun demikian, pendidikan tahfiz al-Quran bukan menjadi pendidikan teras, sebaliknya hanya sebahagian daripada intipati pelajaran. Lazimnya pendidikan tahfiz dijalankan secara individu dan tidak rasmi. Kaedah mengajar yang digunakan adalah berdasarkan pengalaman guru al-Quran.

Pengajian Al-Qur'an di Malaysia pula telah bermula sejak abad ke-15 lagi dengan penerapan pengajian asas dalam Islam antaranya mempelajari penulisan huruf Al-Qur'an seperti tulisan jawi, asas Rukun Iman dan Rukun Islam. Pendidikan asas Islam juga telah berkembang dari semasa ke semasa dengan berlakunya penghijrahan golongan para ulama dan pendakwah Islam dari Timur Tengah ke Alam Melayu. Seiring dengan perkembangan positif pendidikan Al-Quran, pusat pengajian Al-Qur'an semakin bertambah telah dan beroperasi di beberapa buah masjid, surau dan istana. Pengajian al-Quran secara tradisi juga terus berevolusi sehingga tertubuhnya institusi pondok di beberapa buah negeri terutamanya di bahagian Timur dan Utara semenanjung.

1.1 Objektif

Terdapat beberapa objektif kajian yang ingin dicapai dalam kajian ini iaitu:

1. Peranan sebagai seorang pelajar huffaz di institusi pengajian.
2. Cabaran sebagai seorang pelajar huffaz di institusi pengajian.
3. Persediaan oleh pelajar dalam kehidupan sebagai seorang huffaz.

2 METODOLOGI KAJIAN

Penulisan kajian ini berbentuk kajian kualitatif yang mana kajian ini menjadikan kaedah temu bual dan kaji selidik untuk mendapatkan data kajian. Seramai 11 orang informan yang merupakan para pelajar tahfiz di beberapa buah institusi pengajian dan sekolah di negara ini. Dapatan daripada kaji selidik dan temu bual tersebut dianalisis seterusnya dihuraikan dengan sokongan kajian-kajian yang dibuat oleh pengkaji.

2.1 Perkembangan Pengajian Tahfiz di Malaysia

Pengajian tafsir Al-Quran adalah salah satu perkara penting yang membawa kepada perkembangan pendidikan tahfiz al-Quran. Ini adalah berdasarkan kepada dapatan kajian menunjukkan bahawa bidang tafsir merupakan bidang pengajian al-Quran yang terawal berkembang di Tanah Melayu. Pengajian ini dikesan berbentuk lisan dan tidak bertulis sebelum kurun ke-16. Sejarah ini adalah berdasarkan kepada catatan yang menunjukkan bahawa ulama-ulama di Nusantara yang lahir selepas kedatangan Islam ke Kepulauan Melayu seawal abad ke-7 Masihi.

Berdasarkan perkembangan bidang tafsir yang semakin meluas di Negara ini, maka terdapat pengkaji menjelaskan bahawa pengajian tafsir Quran secara spesifik dimulakan pertama kali di Malaya pada akhir abad ke-17 dengan diajar di pondok-pondok pengajian. Sistem pendidikan baru ini berkembang pesat pada pertengahan abad ke-19, terutama di negeri-negeri Kelantan, Terengganu, Perak dan Kedah yang diajar daripada ulama'-ulama' tempatan.

Umat Islam saban hari telah menyedari akan keberkesanan, kebaikan dan martabat orang-orang yang menghafal Al-Quran. Perkara ini telah mendorong ibu bapa untuk menempatkan anak-anak mereka ke sekolah aliran tahfiz. Bagi mereka, sistem pengajian tahfiz yang memiliki dwi sistem iaitu sistem akademik dan sistem keagamaan atau hafalan Al-Quran adalah setanding dengan kehendak pasaran global.

Pendidikan Tahfiz Negara telah dilaksanakan dengan lebih sistematik, tersusun dan bersifat formal. Ini dapat dilihat dengan penubuhan beberapa buah institusi tahfiz di peringkat negeri seperti di Kelantan

yang ditubuhkan pada tahun 1979, manakala di negeri Perak, Selangor, Terengganu, Perlis dan Kedah pada tahun 1980-an. Seterusnya di Negeri Sembilan, Melaka, Pahang dan Sabah dilaksanakan pada awal 1990-an, manakala Pulau Pinang dan Johor pada tahun 1996.

Kebanyakan institusi tahfiz di Negara ini bernaung di bawah kelolaan kerajaan mahupun swasta. Institusi tahfiz di bawah kelolaan kerajaan sama ada Kerajaan Persekutuan mahupun negeri, hanya membuat pengambilan pelajar di peringkat tinggi terutamanya pelajar lepasan Sijil Persekolahan Malaysia (SPM) dan mempunyai pencapaian akademik yang cemerlang. Ini adalah kerana pihak kerajaan mempunyai sumber kewangan yang terhad dalam menawarkan biasiswa kepada para pelajar yang ingin menyambung pengajian sebagai para huffaz kelak.

2.2 Dapatan Kajian

Berdasarkan data kajian yang dijalankan terhadap 11 orang pelajar tahfiz di seluruh Negara sama ada Maahad tahfiz swasta mahupun di bawah kelolaan kerajaan Negeri dengan kajian berdasarkan kepada para pelajar yang masih berada dalam pengajian di institusi masing-masing. Terdapat beberapa tema yang diperoleh berdasarkan persoalan kajian. Berdasarkan hasil soal selidik yang dijalankan, sebanyak 54.5 peratus maklum balas daripada pelajar lelaki dan 45.5 peratus daripada pelajar perempuan. Berdasarkan purata daripada jumlah tersebut, sebanyak 36.4 peratus adalah daripada kalangan pelajar yang menghafal 30 juzuk penuh Al-Qur'an.

Antara soal selidik yang dijalankan adalah seperti berikut:

2.2.1 Peranan sebagai seorang pelajar huffaz di institusi pengajian.

Soal selidik yang dijalankan adalah dengan membuat kajian bilangan para pelajar yang berperanan sebagai seorang pelajar huffaz di institusi pengajian masing-masing sama ada di sekolah, kolej mahupun universiti.

Jadual 1

Peranan sebagai seorang pelajar huffaz	Peratus
Menyemak bacaan Al-Qur'an para pelajar	18.2%
Menjadi rujukan persoalan agama oleh para pelajar	9.1%
Berdakwah dengan para pelajar (bimbingan dan nasihat) di sekolah atau kampus	45.5%
Menjadi imam solat fardhu dan sunat di surau sekolah atau kampus	27.3%

Berdasarkan dapatan kajian di atas, ini menunjukkan bahawa sebanyak 45.5 peratus pelajar telah menggunakan kepakaran dan hafazan mereka dalam berdakwah danmemberi nasihat serta bimbingan kepada para pelajar di tempat mereka belajar. Sebanyak 27.3 peratus pelajar yang menggunakan kepakaran huffaz mereka sebagai imam bagi solat fardhu di surau-surau dan pusat Islam di tempat mereka belajar, manakala sebanyak 18.2 peratus pelajar huffaz menggunakan peluang sebagai penghafal Al-Qur'an dengan menyemak bacaan Al-Qur'an setiap para pelajar yang berkemahuan bacaan mereka disemak.rata-rata dalam kalangan para pelajar yang telah menghafal Al-Qur'an di institusi-institusi pendidikan masing-

masing. Para pelajar huffaz juga menjadi rujukan persoalan beerkaitan agama oleh para pelajar sebanyak 9.1 peratus. Ini menunjukkan bahawa para pelajar huffaz memainkan peranan yang sangat penting dalam memberi khidmat dan nasihat kepada masyarakat terutamanya para pelajar.

2.2.2 Cabaran sebagai seorang pelajar huffaz di institusi pengajian.

Kajian soal selidik juga dilakukan terhadap para pelajar tahfiz dengan menyelidik isu cabaran yang dihadapi oleh para pelajar huffaz semasa mengikuti pengajian di institusi masing-masing. Ini berdasarkan kajian yang telah dibuat kepada informan yang terpilih serta temu duga yang dilakukan.

Jadual 2

Cabaran sebagai seorang pelajar huffaz di institusi pengajian	Peratus
Kesuntukan masa yang terhad	9.1%
Menjaga akhlak diri yang sentiasa menjadi ikutan para pelajar lain	18.2%
Memelihara ayat hafazan dengan sentiasa muroja'ah	54.5%
Penggunaan gajet dan media sosial	18.2%

Berdasarkan hasil kajian yang dibuat, peratusan pelajar dalam memelihara ayat hafazan Al-Qur'an dengan bermuroja'ah paling tinggi berbanding yang lain iaitu sebanyak 54.5 peratus. Ini menunjukkan bahawa mengekalkan hafazan yang telah dihafaz oleh para pelajar huffaz merupakan cabaran utama apabila bergelar sebagai pelajar mahupun murid. Tambahan pula, terdapat pelbagai subjek yang perlu dipelajari di samping menghafaz Al-Qur'an.

2.2.3 Persediaan oleh pelajar huffaz dalam kehidupan seharian.

Jadual 3

Persediaan oleh pelajar huffaz dalam kehidupan seharian	Peratus
Persediaan ilmu pengetahuan	27.2%
Persediaan mengulang hafazan bacaan Al-Qur'an	36.4%
Persediaan emosi dan mental	36.4%
Persediaan fizikal dan jasmani	0%

Para pelajar huffaz juga telah bersedia dalam kehidupan mereka bagi mengahdapi kehidupan yang mencabar apatah lagi dalam mengekalkan bacaan hafazan mereka sentiasa terpelihara. Kajian menunjukkan

bahawa sebanyak 26.4 peratus yang memilih untuk bersedia bagi mengulang hafazan bacaan Al-Qur'an mereka dalam kehidupan seharian. Ini adalah satu proses rutin harian mereka bagi memastikan bacaan mereka ini sentiasa berada dalam ingatan. Pelajar juga memilih persediaan dari segi emosi dan mental dengan peratus yang sama seperti persediaan mengulang hafazan iaitu sebanyak 36.4 peratus. Manakala, sebanyak 27.2 peratus pelajar huffaz yang bersedia dari segi ilmu pengetahuan.

3 KESIMPULAN

Berdasarkan kajian yang telah dibuat, hasil dapatan kajian menunjukkan bahawa kebanyakan para pelajar huffaz berperanan sebagi mediuam berdakwah kepada para pelajar di sekolah mahupun di university. Ini dapat dijadikan panduan kepada para pelajar untuk bertanya berkenaan segala persoalan agama. Walaubagaimanapun, kebanyakan para pelajar huffaz mempunyai cabaran yang tinggi rata-rata cabarannya adalah hendak mengekalkan tahap hafazan masing-masing. Para pelajar huffaz juga sentiasa bersedia dalam kehidupan mereka dengan sentiasa muroja'ah hafazan masing-masing setiap hari serta perlu kepada persediaan mental dan emosi. Ini kerana, hafazan Al-Qur'an memerlukan kepada hafazan dari segi mental, apatah lagi cabaran untuk mengekalkan hafazan mereka yang sangat tinggi.

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Stress and Student Well-Being: A Quantitative Investigation Among TESL Students at Kolej Poly-Tech MARA Ipoh

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ABSTRACT:
This research investigates the level and underlying sources of academic stress among students enrolled in the Diploma in Teaching English as a Second Language (TESL) program at Kolej Poly-Tech MARA (KPTM) Ipoh. Recognizing academic stress as a growing concern that affects student performance and psychological well-being, this study aims to provide empirical insights into the specific stressors that impact TESL students across different years of study. Using a quantitative research design, data were collected from 421 respondents through a structured questionnaire adapted from established academic stress inventories. The instrument examined seven core domains contributing to academic stress: lecturer-related stress, pressure related to academic performance, test anxiety, difficulties with group work, peer-related stress, time management challenges, and self-inflicted stress. Findings indicate that peer pressure and anxiety surrounding examinations are the most dominant stressors, particularly among final-year students. Factors such as unclear test instructions, fear of failure, and challenges in collaborative tasks were highlighted as significant contributors to heightened stress levels. The study further emphasizes that third-year students tend to experience more acute stress, likely due to heavier academic demands and graduation-related pressures. These results underline the urgent need for targeted interventions, including stress management workshops, improved academic guidance, and peer mentoring initiatives, to enhance students' resilience and academic performance. Ultimately, the study contributes valuable evidence to support institutional efforts in improving student support services and promoting mental wellness within the academic setting.

KEYWORDS:
Academic stress, TESL students, test anxiety, peer pressure, time management, group work, higher education, student well-being

1 INTRODUCTION

Stress is a universal condition that impacts people across all demographics, including differences in age, gender, education level, and socio-economic background (WHO, 2023). It is generally defined as a physical, emotional, or psychological strain that creates tension in the mind or body. When persistent and unmanaged, stress can lead to severe mental and physical health conditions that threaten a person's overall quality of life. According to Yikaelo et al. (2018), stress is a complex phenomenon that may yield either positive or negative effects depending on how it is handled. On one hand, stress can hinder decision-making and impair performance; on the other hand, it can also lead to constructive, adaptive responses that help people function more effectively. For example, when someone encounters a difficult or high-pressure situation, they may become more attentive, driven, and capable of overcoming challenges, thereby enhancing their performance under stress. From a medical angle, stress triggers the "fight or flight" response a built-in survival system that helps individuals either confront or evade perceived threats. For instance, immediate danger can activate fear, pushing people to either face the threat or escape it quickly. This instinct illustrates that while stress can be harmful, it also serves an important function in aiding people to react positively to challenges (Yikealo et al., 2018).

With aspirations to thrive in an increasingly globalized world, Malaysia seeks to develop a competent and creative workforce across all disciplines. Higher education students are crucial in this effort. However, they often face considerable obstacles as they navigate the transition from adolescence to early adulthood, especially with academic responsibilities. Buchanan (2012) highlights that this life phase presents distinct stress factors that affect emotional and psychological well-being. Academic stress, in particular, has been widely researched due to its impact on both well-being and academic success. Marlissa et al. (2019) noted that the pressure to maintain a high CGPA for future job opportunities, along with societal demands, adds to students' emotional burden and intensifies academic stress. If not addressed, this stress can diminish cognitive function, disrupt decision-making, and lower academic achievement. Chronic stress may also lead to mental health problems, including anxiety and prolonged depression. It is thus essential to identify the primary factors contributing to academic stress. Recognizing challenges like heavy workloads, exam pressure, poor time management, and fear of failure is key to helping institutions implement systems such as counseling and stress-relief programs. Such proactive measures can significantly reduce student stress, leading to better academic experiences and preventing burnout. This study, therefore, aims to explore the academic stress levels among TESL diploma students at KPTM Ipoh, guided by these questions:

RQ1. What are the main causes of academic stress among KPTM students?
RQ2. How does academic stress vary according to the students' academic year?

2 LITERATURE REVIEW

2.1 Academic Stress

Students' mental health is increasingly being seen as a major public concern, particularly due to its connection with academic stress. Academic stress results from high expectations involving exams, assignments, and academic duties, and it activates biological and psychological responses as students try to adapt (Franken, 1994). Prolonged stress often leads to poor academic results, mental health issues like anxiety and depression, and even student dropouts. Therefore, various stress management strategies have been introduced in universities to support students (Conley, 2015). Although stress levels vary among individuals and over time, the first year of college tends to be the most difficult. The shift from school to

the new university environment can bring confusion and identity issues (Abdallah & Gabr, 2014). One study reported that students experienced their highest stress during the first semester, which decreased later (Bewick, 2010). However, other studies found that stress levels remained stable during the first year (Barker et al., 2018). These varying findings suggest that stress is influenced by many factors, including social and personal stressors (Pitt et al., 2018). Social or interpersonal stress includes tension with peers, lecturers, and staff, which often stems from academic demands and emotional exhaustion. Intrapersonal stress relates to students' self-efficacy and confidence in managing pressure. Pressure from lecturers, especially when expectations are high without acknowledging students' adjustment period, further increases stress. Moreover, competition for approval or academic recognition adds to the strain. While stress from social relationships may appear less serious, issues like the desire for acceptance and lack of peer motivation can lead to disengagement (Yikaelo et al., 2018).

2.2 Effects of Academic Stress

According to Ramachandiran and Dhanapal (2018), 88% of students in their study linked academic stress to their studies, with 78% describing their stress levels as moderate. While some level of stress can drive students to improve, too much of it causes anxiety, hopelessness, and reduced academic performance. These effects can also extend to social interactions, affecting students' relationships with both peers and lecturers (Zhao et al., 2015). Physically, stress can result in symptoms such as exhaustion, lack of appetite, headaches, sleep problems, and stomach issues. In the same study, 54% of students experienced sleep disturbances due to stress. Excessive academic pressure may even lead to serious psychological problems like anxiety, depression, and suicidal ideation. With more students struggling to manage academic pressure, addressing this issue has become urgent. Common causes include pressure from parents, academic competition, and demanding syllabi. Increasing awareness of academic stress and its implications is vital for creating a more supportive and mentally healthy educational environment.

3 METHODOLOGY

This study adopts a quantitative research design, drawing upon methods previously employed by researchers in the field, such as Yikaelo et al. (2018). A key instrument in this study is a questionnaire, adapted from the academic stress inventory developed by Lin and Chen (2019). The questionnaire was administered to a total of 421 participants, comprising students from first-year to third-year cohorts. Table 1 provides a breakdown of the number of respondents according to their academic year.

The questionnaire is designed to evaluate the level of academic stress among students and consists of 33 items, categorized into seven key constructs. These constructs reflect different sources of stress, including stress caused by lecturers, concerns about results, test-related stress, stress from group study, peer-related stress, time management difficulties, and self-imposed stress. Descriptive statistical techniques are used to analyse the data, calculating the mean score for each construct. These mean scores are then interpreted using a mean interpretation scale, as outlined in Table 2 (Marlissa et al., 2019), to provide insights into the severity of each type of academic stress experienced by the students.

Table 2. Mean Interpretation Level Score

AVERAGE MEAN	INTEPRETATION
3.50 – 4.00	Very High
3.00 – 3.49	High
2.00 – 2.99	Average
1.50 – 1.99	Low
1.00 – 1.49	Very Low

4 FINDINGS AND DISCUSSION

4.1 Academic Stress Levels among TESL Students of Kolej Poly-Tech MARA Ipoh Based on Sources of Academic Stress

This survey was meant to investigate the level of academic stress experienced by students enrolled in the Diploma in Teaching English as a Second Language (TESL) program at Kolej Poly-Tech MARA Ipoh. Its primary objective was to provide some insights into the students' extent of academic stress, identifying the key contributors and the possible potential effects to their well-being. A total of 421 students, ranging from Semester 2 to Semester 6 (Years 1 to 3), participated in the online survey. Students in their first semester were excluded because the survey was conducted at the beginning of the academic term, and Semester 7 students, who were involved in their Teaching Practicum at various schools within the district, were also excluded due to logistical challenges.

The survey focused on examining the different sources which caused the students' academic stress. Based on the framework proposed by Lim & Chen (2019), seven distinct stressors were examined: stress related to lecturers, academic results, tests, group studying, peers, time management, and self-imposed stress. The data garnered was analysed using the Statistical Package for the Social Sciences (SPSS), with the findings presented in terms of mean (M) and standard deviation (SD), as summarized in the tables below.

Table 3 illustrates the average scores for various items under the stressor "lecturers." Factors included the difficulties of tasks, clarity of lecturer explanations, the amount of time spent on research, language barriers, teaching methods, and pace of instruction. Among these, the highest mean score (2.54) was associated with item L3: "I feel that I cannot understand the contents delivered by some lecturers." Meanwhile, item L1, which represents "I feel that some lecturers assign extraordinarily difficult tasks," received the lowest mean score (2.31). This data sheds light on how various aspects of the teaching process contribute to the academic stress experienced by students.

Table 3. Mean Scores for Stress from Lecturer

NO	ITEMS	MEAN	STD. DEVIATION
L1.	I feel that some of the lecturers give extraordinarily difficult assignments.	2.31	0.717
L2.	I feel that some of the lecturers give too many assignments.	2.38	0.786
L3.	I feel that I cannot understand the contents delivered by some of the lecturers	2.54	0.779
L4.	I feel that I cannot adapt to some of the lecturers' methods of instruction.	2.36	0.812

Table 4 outlines the average scores related to stress levels based on the second construct, examination results. The analysis includes parental expectations, the contrast between high school and current academic performance, and the pressure caused by not achieving ideal outcomes. Notably, Item A48, which portrays, "I worry that my academic results will not meet my parents' expectations," recorded the highest mean score (M=3.12, SD=0.973), indicating that many students experience significant stress related to parental expectations. On the other hand, Item A46, which refers to conflicts with parents due to academic performance, showed the lowest mean score (M=1.72, SD=0.878), suggesting fewer students face direct familial conflicts over grades. However, the disparity between previous academic performance in high school and current results was also found to contribute to stress, as evidenced by Item A47, which received an average score of 2.86 (SD=0.965). This means that a large number of students experience the pressure of not performing well in higher education compared to their performance during high school.

Table 4. Mean Scores for Stress from Results Items

NO.	ITEMS	MEAN	STD. DEVIATION
A5.	I feel that my parents think that I did not take my studies seriously	1.97	1.015
A6.	Due to my academic performance, I have conflicts with my parents.	1.72	0.878
A7.	I feel that there is a significant difference between my current results and high school results.	2.86	0.965
A8.	I worry that my academic results will not meet my parents' expectations.	3.12	0.973

Table 5 provides the average stress scores associated with the third construct, which encompasses the various test-related factors. This construct evaluates how students are impacted by few aspects including staying up late to study, fear of failure, and the clarity of test content. The highest mean score in this category was related to item T11, with an average score of 3.11, reflecting students' anxiousness about the possibility of retaking core subjects if they fail. This suggests that the fear of failing crucial subjects plays a significant role in heightening their stress levels. On the other hand, the lowest mean of 2.33 corresponded with item T12, where students expressed that they faced difficulties in preparing for the exams due to lack of clarity with the course syllabus and test outlines. These findings highlight that some of the students often experience anxiety about test performance, fearing failure or lower scores compared to their peers. Importantly, this excessive self-imposed pressure tends to lead to heightened academic stress, impacting their overall well-being and performance.

Table 5. Mean Scores for Stress from Tests Items

NO.	ITEMS	MEAN	STD. DEVIATION
T9.	I often could not sleep at night worrying for the exam.	2.63	0.952
T10.	I always sleep late studying for exams.	2.83	0.850
T11.	I worry that I have to retake the core subjects which I fail.	3.11	0.979

T12.	I feel that the course syllabus and test outlines are not clear enough to help me prepare effectively	2.33	0.812

Table 6 presents the average scores related to stress stemming from the fourth construct, which focuses on group work. This construct highlights the difficulties students face when collaborating with team members who may lack competence. The highest mean score, 2.97, is linked to item GW15, which states, "I worry that my group members will not complete their part in completing a group-work assignment." On the other hand, the lowest mean score, 2.34, corresponds to item GW13, which expresses, "I often find it hard to distribute tasks fairly with my classmates in completing group assignments." The data suggests that students who experience anxiety over group assignments may become easily frustrated, leading to self-imposed stress as they struggle to maintain their personal expectations of performance. This highlights the importance of effective collaboration and the potential stress caused by the uncertainty of relying on others in academic group work.

Table 6. Mean Scores for Stress from Studying in Group Items

NO.	ITEMS	MEAN	STD. DEVIATION
GW13.	I often find it hard to distribute tasks fairly with my classmates in completing group assignments.	2.34	0.887
GW14.	I worry that I could not find the right group members for group assignments	2.75	0.966
GW15.	I worry that my group members will not complete their part in completing a group work assignment	2.97	0.932

Table 7 presents the average scores related to stress from the fifth construct—peer-related stress. This construct encompasses factors such as disruptions in the classroom environment and the perceived inability to achieve results comparable to peers. Among the various items, it is notable that item P16, "I always feel nervous when I need to make a speech or give a presentation in front of my peers," has the highest mean score of 3.14. In contrast, item P19, "I am stressed because my academic results are not as good as my classmates'," shows the lowest mean score of 2.57. These scores suggest that students should be more aware of the root causes of their stress and anxiety, which can help them better understand and address these challenges. The findings also highlight those students experience higher stress levels in performance-based situations, such as presentations, where their abilities are assessed by instructors and observed by their classmates. This suggests that the pressure of being evaluated in front of peers is a significant factor contributing to their anxiety.

Table 7. Mean Scores for Stress from Peers Items

NO.	ITEMS	MEAN	STD. DEVIATION
P16.	I always feel nervous when I need to make a speech or give a presentation in front of my peers.	3.14	0.918

P17.	I worry that my classmates will laugh at my inability to perform well when I give a speech or presentation.	2.97	1.015
P18.	I often find it hard to focus on studying by myself when my friends are being noisy.	2.80	0.963
P19.	I am stressed because my academic results are not as good as my classmates'.	2.57	0.999

Table 8 displays the average scores for the sixth construct related to time management, highlighting the difficulties students face in balancing their social and academic commitments. The highest average score comes from item T20, which states, "I often struggle to balance my academic and social activities effectively," with a mean of 2.32. On the other hand, item T21, "My academic work is always impacted by my social activities and students' association," recorded the lowest mean score at 1.97. These results indicate that students who perceive themselves as managing their time well tend to experience greater satisfaction in both their academic and personal lives. Additionally, students who feel in control of their time tend to report lower stress and pressure levels, underscoring the importance of effective time management in promoting overall well-being.

Table 8. Mean Scores for Stress Due to Time Management Items

NO.	ITEMS	MEAN	STD. DEVIATION
T20.	I often struggle to balance my academic and social activities effectively.	2.32	0.877
T21.	My academic work is always impacted by my social activities and students' association	1.97	0.766

Table 9 presents the average scores from the final construct, self-induced stress, which includes factors related to participants' confidence in their academic performance, their interest in the subjects, and their struggles in keeping up with coursework. This construct is measured through several items, such as statements about their self-assessed confidence in learning, interest in particular subjects, and difficulties in managing course loads. Among these, item S22, "I feel that my study skills are not as good as my peers," recorded the highest mean score of 2.82, indicating a prominent source of stress. Conversely, item S24, "I feel that I have no interest in some academic courses," had the lowest mean score of 2.22. These results suggest that a significant number of students experience disinterest in certain courses, prompting concerns about their motivations for enrolment. This lack of engagement could be attributed to factors such as family expectations or other underlying reasons not explicitly addressed in the study.

Table 9. Mean Scores for Self-Inflicted Stress Items

NO.	ITEMS	MEAN	STD. DEVIATION
S22.	I feel that my study skills are not as good compared to my peers.	2.82	0.925
S23.	I feel that I have so many courses that are beyond my capability.	2.27	0.817
S24.	I feel that I have no interest in some courses in academics.	2.22	0.882

S25.	I felt that my performance was not as good as I had expected after I entered university,	2.27	0.962

The final section of this article presents the average minimum scores for each source of stress identified in the study. The data shows that peer pressure stands out as the highest stress factor, with a minimum score of 2.87. This is followed closely by stress related to tests, which scores 2.72, and stress arising from group work with a score of 2.69. Achievement-related stress ranks next with an average of 2.42, while stress caused by pressure from lecturers has a mean of 2.40. Lastly, time management stress has the lowest minimum score, recorded at 2.14. From these findings, it is clear that peer pressure is the most significant contributor to student stress, while difficulties in managing time appear to have the least impact. These findings are summarized in Table 10 for reference.

This analysis highlights the varying levels of stress students face, emphasizing that peer interactions and test-related anxiety are dominant stressors, whereas personal time management presents less of a challenge for students.

Table 10 - Total Average Mean Scores

NO.	SOURCES OF STRESS	AVERAGE MEAN SCORES	LEVEL OF STRESS
1.	Stress from Lecturers	2.40	Average
2.	Stress from Achievements	2.42	Average
3.	Stress from Tests	2.72	Average
4.	Stress from Groupwork	2.69	Average
5.	Stress from Peers	2.87	Average
6.	Stress due to Time Management	2.14	Average
7	Self-inflicted Stress	2.40	Average
	Total Average Mean	2.21	**AVERAGE**

4.2 Academic stress levels among TESL students of Kolej Poly-Tech Mara Ipoh by year of study

The subsequent portion of the findings focuses on the second research question, examining the academic stress levels among KPTM Ipoh's TESL students based on their year of study. The data presented in Figure 11 illustrates the comparisons of average mean scores corresponding to the various academic years.

Table 11. Average Mean Scores Based on Year of Study

NO.	YEAR	AVERAGE MEAN SCORES	LEVEL OF STRESS
1.	Year 1 (Semester 2)	2.50	Average
2.	Year 2 (Semester 3 & 4)	2.50	Average
3.	Year 3 (Semester 5 & 7)	2.56	Average

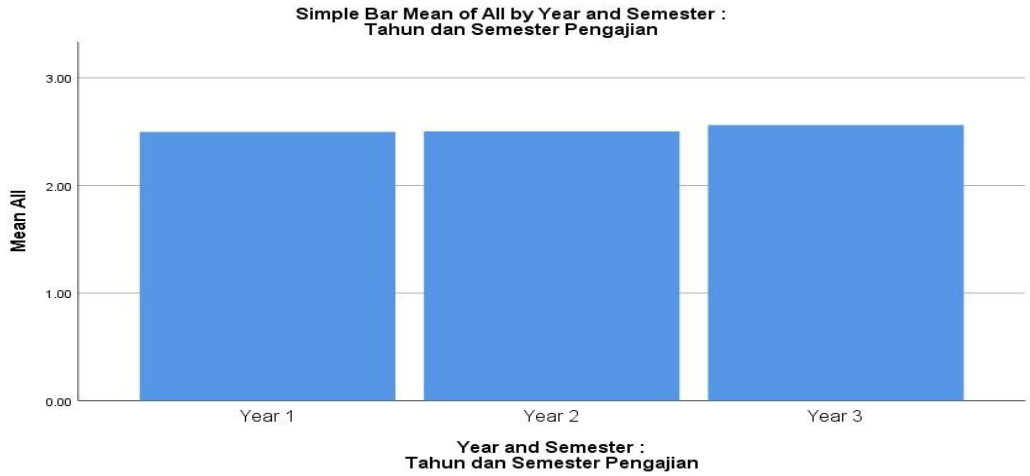


Figure 1. Comparisons of Average Mean Scores Based on Year of Study (Graph)

As illustrated in Figure 1, a subtle yet significant difference is noted between the average scores of students in year 1 compared to those in years 2 and 3. The data indicates that year 3 students recorded the highest mean score of 2.56, while students in both year 1 and 2 scored slightly lower, with a mean score of 2.5. These results suggest that students in their third-year experience higher levels of perceived academic stress compared to their peers in earlier years.

In today's world, stress has become a widespread issue, affecting individuals at various stages of life. It is a common part of daily experiences, with significant implications for mental well-being. Psychologists describe stress as a prolonged state of tension that impairs one's ability to function effectively. Stress can present itself through physical or mental symptoms, often resulting from work pressures or personal challenges.

This study utilized a quantitative research design, employing a survey method to assess academic stress among students from the Teaching English as a Second Language (TESL) program at Kolej Poly-Tech Mara Ipoh. While many studies have examined the causes and effects of stress in higher education, academic stress remains a persistent issue. It is now recognized as a widespread lifestyle crisis, challenging the assumption that academic life should be free from undue stress.

University students are particularly vulnerable to stress due to the numerous demands they face. A significant source of this stress comes from feeling a lack of control over academic pressures. While deadlines and exams are inevitable, students can reduce stress by effectively managing their time and avoiding last-minute study habits. Many students also suffer from inadequate sleep, which has been linked to both lower academic performance and increased stress levels.

While individuals may respond to stress similarly, the specific triggers of stress can vary. Common stressors in college include poor time management, social conflicts, and peer-related issues. Taking care of oneself through regular exercise, adequate sleep, and a healthy diet is essential for managing stress and maintaining focus on academic responsibilities.

Stress can have both positive and negative effects. Properly managing stress can provide numerous benefits, but failure to do so can lead to issues like anxiety. Students must learn to handle stress effectively, understanding that it can be controlled and even harnessed to support their growth. The process of growing up often involves stress, and it is crucial to develop the skills to manage it constructively.

5 CONCLUSION

In summary, stress has become an unavoidable aspect of contemporary life, especially for university students who often juggle academic demands, personal responsibilities, and future career concerns. This is clearly reflected in the study of academic stress among TESL students at Kolej Poly-Tech MARA Ipoh, which highlights the persistent and multifaceted challenges that learners in higher education face. A key takeaway from this research is the critical need for students to develop an awareness of their own capacity to manage stress. Rather than perceiving stress solely as a negative experience, students should be encouraged to reframe it as a potential catalyst for growth, self-awareness, and personal transformation.

Integrating structured stress management strategies into students' academic journeys is not just beneficial but essential. Such strategies whether through formal workshops, peer support systems, or curriculum-based mental health education can equip students with the tools to cope with pressure more constructively. By fostering emotional resilience, time management, and problem-solving abilities, students can become more adaptable and confident in facing life's academic and personal challenges. Ultimately, empowering students with these lifelong skills ensures they are not merely surviving university life, but actively thriving within it.

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Sustaining Quality Education: Technological Barriers in Blended Learning for IPTS Students in Klang Valley

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ABSTRACT

This concept paper explores the technological challenges faced by students in private higher education institutions (IPTS) in Malaysia when engaging in blended learning, which combines face-to-face classes with online learning. Blended learning offers students increased flexibility and opportunities for self-directed study. However, several technological issues have been identified. Key challenges include limited access to reliable devices and internet connectivity, difficulties navigating online learning platforms, and inadequate digital skills among some students. This research aims to analyze the challenges and propose practical solutions to support IPTS students and lecturers. The study will collect data through surveys targeting IPTS students in the Klang Valley, utilizing a quantitative research method to analyze the data. The research will explore how technological barriers differ across student groups, influenced by factors such as academic program, year of study, and level of education. Based on previous study, a significant portion of students reported issues with device availability and internet connectivity, making it difficult to fully engage in online learning. The findings of this study are expected to inform recommendations on improving technological access and enhancing digital skills among students, ultimately aiming to improve motivation and create a more conducive learning environment. The research highlights the need for institutions to address these technological barriers to sustain quality education in the blended learning model.

KEYWORDS: Sustaining quality education, blended learning, technological challenges, student engagement, device accessibility, internet connectivity, digital skills.

1 INTRODUCTION

Blended learning, an educational approach that combines traditional face-to-face classroom methods with online digital media, has gained significant traction in recent years. This approach aims to provide a more flexible and personalized learning experience, leveraging the benefits of both online and offline learning environments (Samuel, 2023). In Malaysia, particularly among private institutions of higher learning (IPTS), blended learning has become an essential strategy for enhancing educational quality and accessibility.

The impetus for this study arises from the growing need to understand the challenges that IPTS students face in adapting to blended learning environments. While the blended learning model offers numerous advantages, such as increased accessibility and convenience, it also presents unique challenges that can affect the quality of education and student outcomes. These challenges may include technological issues, lack of digital literacy, and difficulties in maintaining motivation and engagement. This research seeks to identify and analyze these challenges, providing insights into how IPTS can better support their students in navigating blended learning environments.

2 PROBLEM STATEMENT

Objective: To see the relationship between technological barriers towards blended learning among IPTS students.

3 LITERATURE REVIEW

Blended learning is a method of delivering learning that more or less combines face-to-face training with computer-based training. Interestingly, the concept of blended learning has received considerable interest in Malaysia's education system especially focusing on higher learning institutions where face-to-face teaching is augmented with online components. In addition, it helps in improving the learning experience as well as meet the needs of different students.

The literature reveals that blended learning has received positive reception, and at the same time a set of obstacles in Malaysia, which is quite typical when it comes to the global advances in educational technologies. This approach enables a rich learning experience that is felt by both parties and felt to have a strength of both modalities as noted by Garrison and Vaughan (2008). The form of blended learning can significantly differ from courses that only have a small portion of face-to-face instruction with a large amount of online content to courses, which have significant portions of both face to face and online components. This allows the educators to help the students get what they need from the learning process since student needs vary. Hybrid or blended learning has turned out to be one of the important learning delivery modalities in higher education where face-to-face training is combined with online learning. This approach has been embraced because it can be adapted to accommodate different student needs and as a result increasing the students' interest as well as their achievements. This is according to Fionasari (2024), Jeffrey et al. (2014) and Kumar & Moral (2023).

A review shows that, blended learning models can help overcome the shortcomings of traditional teaching environment, making it easier to teach the students in an interactive manner. This is supported by Geng et al., (2019) who opine that the centre of the challenge when delivering blended learning courses is the effective combination of face to face and online based elements. In addition, affirm that the application of blended learning enriches teaching and learning experiences while at the same time empowering learners with the skills that will enable them to meet the challenges of the twenty-first century and further argue that the value of blended learning is also founded on equity, in as much as it seeks to offer access to online learning to as many people as possible.

The outbreak of the COVID-19 pandemic has made blended leaning popular, as it permitted flexibility to reduce the impact of the pandemic without compromising the quality of learning. Muchtar et

al. (2021) explore how blended learning has become as essential norm of education in ensuring continued learning.

3.1 Technological Barriers

In the context of sustaining quality education through blended learning in Malaysia, several technological barriers significantly impact the effectiveness of this educational model. These barriers include internet connection issues, device compatibility, software and platform accessibility, digital literacy, technical support, and cost barriers. Each of these factors plays a crucial role in determining the success of blended learning initiatives.

3.1.1 Internet Connection

The availability and reliability of internet connectivity are paramount for effective blended learning. Research indicates that many students experience poor or intermittent internet access, which hampers their ability to participate fully in online learning activities. Cereno and Borlio emphasize that limited internet access is a major concern, particularly in rural areas, where students often have to rely on unstable connections (Cereno & Borlio, 2021). This is corroborated by Istiqomah, who notes that inadequate internet connectivity and a lack of knowledge about learning resources among instructors and students are significant obstacles to implementing blended learning effectively (Istiqomah, 2021). Furthermore, Maharani highlights that unstable internet networks and high data costs further complicate the situation, necessitating a more robust infrastructure to support blended learning (Maharani, 2022). Furthermore, Zhang discusses how the legal education system in Malaysia faces similar challenges, indicating that the need for robust internet infrastructure is critical across various educational sectors (Zhang, 2023).

3.1.2 Device Compatibility

Device compatibility is a critical factor affecting the effectiveness of blended learning. Many students may lack access to suitable devices capable of running the necessary software for online learning platforms. Aboagye et al. (2020) note that in developing countries like Malaysia, limited access to portable, internet-enabled devices poses a significant challenge. Maharani (2020) adds that devices with limited memory capacity further restrict students' ability to engage effectively with online learning tools. Similarly, Yaccob et al. (2022) highlight that disparities in access to compatible devices hinder the integration of technology into education.

3.1.3 Software and Platform Accessibility

The accessibility of learning platforms and software is essential for the successful implementation of blended learning. Adedoyin and Soykan discuss the necessity for faculty to assist students in recognizing the value of blended learning tools and integrating them into their learning processes (Adedoyin & Soykan, 2020). However, many educators and students face challenges in navigating these platforms due to a lack of training and familiarity with the technology (Nartiningrum & Nugroho, 2021). This lack of familiarity can lead to frustration and disengagement, as noted by Shah, who highlights that technological expertise is a major issue in online teaching (Shah, 2023).

3.1.4 Digital Literacy

Digital literacy among both educators and students is crucial for the effective use of blended learning technologies. Nartiningrum and Nugroho emphasize that teachers must deliver lessons effectively to promote independent learning, which is vital in a blended learning environment (Nartiningrum & Nugroho, 2021). However, many educators lack the necessary digital skills to facilitate this type of learning, leading to ineffective teaching practices (Cruzado et al., 2021). The need for professional development in digital literacy is further supported by Cruzado et al., who argue that teachers' lack of preparation significantly limits the potential of technological resources in education (Cruzado et al., 2021).

3.1.5 Technical Support

Technical support is essential for addressing the challenges that arise during the implementation of blended learning. Students often require assistance with technical issues, such as software malfunctions or connectivity problems. As highlighted by Rianto, the lack of adequate technical support can hinder the learning experience, making it difficult for students to engage fully with the material (Rianto, 2020). Additionally, effective technical support can alleviate some of the stress associated with using new technologies, thereby enhancing the overall learning experience.

3.1.6 Cost Barriers

Finally, cost barriers present a significant challenge to the widespread adoption of blended learning. The financial burden associated with acquiring devices, internet access, and educational software can be prohibitive for many students and their families. Maharani notes that the high costs of internet quotas can deter students from participating in online learning (Maharani, 2022). This financial aspect is critical, as it can exacerbate existing inequalities in access to quality education, particularly for students from low-income backgrounds (Aboagye et al., 2020). Finally, cost barriers present a significant challenge to the widespread adoption of blended learning. The financial burden associated with acquiring devices, internet access, and educational software can be prohibitive for many students and their families. Rahman notes that the high costs of internet quotas can deter students from participating in online learning (Rahman, 2023). This financial aspect is critical, as it can exacerbate existing inequalities in access to quality education, particularly for students from low-income backgrounds.

In conclusion, addressing these technological barriers is essential for sustaining quality education through blended learning in Malaysia. A multifaceted approach that includes improving internet infrastructure, enhancing device compatibility, providing comprehensive training for educators, and ensuring affordable access to technology is necessary to create an inclusive and effective blended learning environment.

4 RESEARCH METHODOLOGY

This study employs a quantitative research approach, collecting data from students enrolled at Klang Valley private higher education institutions (IPTS) through the use of a structured questionnaire. The purpose of the questionnaire is to examine the relationship between technological barriers towards blended learning among IPTS students.

This study employed a quantitative research design to investigate the impact of technological barriers on the quality of blended learning among students in private higher education institutions (IPTS) in Klang Valley. Data was collected through a structured questionnaire distributed online.

The survey instrument was designed using a combination of nominal and ordinal Likert-scale items, measuring one independent variable—Technological Barriers—and its impact on learning quality. The construct for technological barriers included 7 items assessing students' experiences with internet access, device limitations, platform usability, digital resource accessibility, technical issues, and infrastructure support.

A pilot study with a small sample of IPTS students was conducted to ensure the reliability and clarity of the instrument. The internal consistency of the technological barriers construct was verified using Cronbach's alpha, with values above 0.70 indicating acceptable reliability.

A total of 52 valid responses were collected and analyzed using SPSS. Data analysis included descriptive statistics (mean, frequency, standard deviation) and inferential statistics such as Pearson correlation.

Ethical approval was granted, and all participants provided informed consent. The study upheld strict confidentiality and anonymity throughout the process.

5 DATA ANALYSIS AND FINDINGS

5.1 Demographic Profile

A total of 52 respondents from IPTS in Klang Valley participated in the survey. The respondents consisted of a diverse demographic profile:

Variable	Category	Percent
Age	18 - 25	23.1%
	26 and above	76.9%
Gender	Female	46.2%
	Male	53.8%
University	Universiti Geomatika Malaysia (UGM)	23.1%
	Universiti Poly-Tech Malaysia (UPTM)	32.7%
	Others	44.2%
Level of Education	Postgraduate	76.9%
	Undergraduate	23.1%

The demographic profile of the 52 respondents reveals that the majority, 76.9%, were aged 26 and above, while 23.1% were within the 18–25 age range. In terms of gender distribution, 53.8% were male and 46.2% were female. Regarding university affiliation, 32.7% of the participants were from Universiti Poly-Tech Malaysia (UPTM), 23.1% from Universiti Geomatika Malaysia (UGM), and 44.2% from other institutions. As for academic level, 76.9% were postgraduate students, while 23.1% were undergraduate students. - Academic Level: 76.9% postgraduate or other; 23.1% undergraduate.

5.2 Correlation Analysis

The Pearson Correlation analysis was conducted to examine the relationship between technological barriers (IV_Mean) and the quality of education (DV_Mean) in blended learning. Below are the result revealed:

- Pearson Correlation Coefficient (r): 0.368
- Significance Level (p): 0.020 ($p < 0.05$)

This result indicates a moderate positive and statistically significant relationship. Students who reported higher technological barriers were more likely to perceive a decrease in the quality of their blended learning experience.

6 DISCUSSION

The findings confirm that technological barriers—including unstable internet, lack of devices, limited access to platforms and resources, and poor institutional infrastructure—pose significant challenges to the effectiveness of blended learning. The correlation result ($r = 0.368$, $p = 0.020$) demonstrates a clear need for intervention.

These outcomes are consistent with findings from earlier studies, such as Adarkwah (2021), which identified technological limitations as a key factor negatively influencing student engagement and learning quality. Addressing these barriers is not only critical for enhancing academic success but also for reducing inequality among IPTS students.

In alignment with SDG 4 (Quality Education) and SDG 9 (Industry, Innovation and Infrastructure), the study emphasizes the need to:

- Improve digital infrastructure within educational institutions
- Ensure affordable access to reliable internet and devices
- Promote policies under the ESG framework that support inclusive technology adoption

7 CONCLUSION

This study establishes that technological barriers significantly impact the quality of blended learning among IPTS students in Klang Valley. The moderate but significant correlation underscores the urgent need for educational stakeholders to enhance infrastructure and access to technology.

To sustain quality education in blended learning environments, institutions must:

- Upgrade digital infrastructure and internet connectivity
- Provide equitable access to learning devices
- Deliver ongoing technical support to students

These initiatives, aligned with global SDG and ESG principles, will contribute to a more inclusive, resilient, and effective blended learning system. Future research should explore long-term impacts and scalable solutions tailored to the needs of private higher education students.

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Lecturers' Perception on Blended Teaching and Learning in Post Covid-19

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ABSTRACT

The Covid-19 pandemic accelerated the global shift toward blended teaching and learning, combining online and face-to-face instruction. This study explores lecturers' perceptions of this blended approach in the post Covid-19 era, focusing on its effectiveness, challenges, and potential for sustainable integration into higher education. Using a quantitative research design, data were collected through a structured questionnaire administered to 60 respondents among lecturers at Kolej Poly-Tech MARA Ipoh using convenience sampling. The study analysed the data using Microsoft Excel for descriptive statistics and SPSS for inferential statistical analyses. The study concludes that all four variables—skills and experience, motivation, interaction and communication, and effectiveness and flexibility—significantly influence lecturers' perceptions of blended teaching and learning in the post Covid-19 era. These factors collectively shape how educators adapt to and perceive the effectiveness of integrating digital and face-to-face teaching methods. Addressing these variables is crucial for optimizing the implementation and sustainability of blended learning in a rapidly evolving educational landscape. The results also indicate a variance in perception based on lecturers' experience with online teaching prior to the pandemic. Younger educators and those with prior exposure to technology were more optimistic about the long-term feasibility of blended teaching. Despite these differences, there was a consensus that blended learning requires continued investment in professional development and infrastructure to be a sustainable model for the future. This study contributes to the growing body of knowledge on post-pandemic educational strategies by highlighting key areas for improvement in blended teaching. It underscores the need for higher education institutions to address technological disparities and provide targeted support to ensure the successful adoption of blended learning in a post Covid-19 educational landscape.

KEYWORDS: blended teaching and learning, post Covid-19, lecturers' perceptions, educational technology

1 INTRODUCTION

The year 2020 has brought unfamiliar and unseen testing times for the entire world due to the coronavirus disease 2019 (Covid-19) pandemic. The teaching community too has been severely impacted; be it from reopening of educational institutions to conducting lessons for students, there has been uncertainty in everything (Reid, 2020, Rabiya Saboowala, Pooja Manghirmalani Mishra, 2021). A big concern amid Covid-19 pandemic and the ensuing lockdown is education, which is at stand still affecting the learning of millions of students worldwide. In the absence of any medical treatment and vaccine, social distancing emerged as a potent mitigating factor. The public places across nations have been shut to prevent the spread of this deadly disease and amid all, institutionalized education becomes the biggest casualty. (Naziya Hassan, Naved Hassan Khan, 2020).

The emergence of the Covid-19 pandemic has impacted education, with most countries around the world temporarily closing educational institutions in an attempt to contain the spread of the pandemic (Ivan Lopez Fernandez, Rafael Burgueno, Francisco Javier Gil Espinaso, 2021). January 2021, one year into the Covid-19 pandemic, over 800 million students, more than half the world's student population, still faced meaningful disruptions to their education—ranging from full school closures in 31 countries to reduced or part-time academic schedules in another 48 countries (UNESCO Education, 2021).

The Covid-19 situation is ushering educational systems to a "new normal." The crisis is becoming a turning point that directs educational institutions to new modalities of instructional implementation. This challenge calls for an extensive preparation for changes in the educational landscape to ensure the continued learning in this new period in human history. (Jeorge Louie D. Anoba, Michael B. Cahapay, 2020).

Blended learning (BL) is a methodology that was introduced over a decade ago that is used in the field of education and combines (or blends) online learning with traditional place-based classroom methods (face-to-face learning). It requires the physical presence of both teacher and student, with some elements of student control over time, place, path or pace and also educational materials and technology for online interaction (Rabiya Saboowala, Pooja Manghirmalani Mishra, 2021). Through blended learning all learning resources that can facilitate learning for people who learn are developed. Blended learning can combine face-to-face learning with computer-based learning. That is, learning is carried out with a learning technology approach, in combination with face-to-face learning resources with instructors and those published in computer media, cell phones, satellite television, video conferencing and other electronic media. Students and instructors work together to improve the quality of learning the primary objective. Blended learning is providing opportunities for students to learn independently, continuously, and develop (Leni Mariani Nst, 2020).

As the years progressed, higher education has moved towards implementing Blended Learning which is a combination of face-to-face and online modes of teaching and learning which have continued to advance in institutions all over the world. (Bokolo Anthony Jnr, 2021). While referring to the Covid-19 pandemic as the greatest challenge the education systems across the world have currently faced, (Daniel. J ,2020) mentioned how several governments have ordered institutions to switch, almost overnight, from F2F to online teaching and virtual education for the learners. Assuming the possibility of future recurrence of Covid-19, he urged all educational institutions, educators/lecturers and students to continuously explore flexible ways to repair the damage already caused by the coronavirus.

Technology in the world of education has transformed conventional learning systems into modern learning systems, demanding to innovate in the delivery of learning. This is a big challenge to implement changes in the learning environment and facilitate all learning processes as well as contribute to the improvement of learning for educational institutions. Studies examining that perception and readiness of lecturers towards blended teaching and learning post Covid-19, to some extent has an impact on the teaching and learning process. This study also aims to know the lecturer's opinion about challenges faced by lecturers in implementing blended teaching and learning after Covid-19.

The following research questions will guide this study:

i. What is lecturer's perception towards the implementation of blended teaching and learning in post Covid-19?

ii. What challenge do lecturers encounter in implementing blended teaching and learning after Covid-19?

The findings of the current study will contribute to the current literature on lecturers' perceptions on blended teaching and learning in post Covid-19. More importantly, the current study may know the lecturer's opinion and identify the challenges faced by lecturers in implementing blended teaching and learning after Covid-19. The study was made by obtaining random sampling of 60 lecturers from KPTM Ipoh. Instruments used by giving questionnaires. Questionnaire instruments were developed to obtain the information to be obtained in the form of structured questions and open-ended questions.

2 METHODOLOGY

This study adopted a quantitative approach using an online survey to collect data from participants. The survey shows how lecturers view blended learning at one of private college in Ipoh, along with the obstacles and opportunities that come with putting it into practice. A structured questionnaire was designed and distributed through email and social media platforms to a targeted sample of 60 respondents. The survey consisted of closed and open-ended questions. The former measure participants' behaviour and preferences by utilizing Likert scales and multiple-choice formats, while the latter more on getting participants' opinions on the topic of study. The survey was conducted over a three-week period to ensure a sufficient response rate.

2.1 Participants

This study involved a total of 60 lecturers from different departments in Kolej Poly-Tech MARA Ipoh. These lecturers were selected using a convenience sampling technique to gather information from participants in an efficient and affordable way (Etikan et al., 2016).

2.2 Instrument

To collect the quantitative data, the current study adapted a five point of Likert scale questionnaire modified from Albiladi and Alshareef's (2019). Briefly, 20 out of the 39 original items relevant to the objectives of the current research were selected and classified into 5 subscales comprising of 1) Personal Details 2) Skill and Experience 3) Motivation 4) Interaction and Communication 5) Effectiveness and Flexibility. The Likert scale for this study is from 1 to 5 with 1 means ''Strongly Disagree" and 5 which means ''Strongly Agree".

Several changes to the items were made, including rewording and reversing negative prepositions. The distribution of items in each subscale is presented in Table 2.1.

Table 2.1: Details of questionnaire subscales and items

Subscale	Item	Code
Skill and Experience	I understand my role in blended learning well.	SE1
	I am able to align online course materials with their face-to-face counterparts.	SE2
	I incorporate more resources when teaching in a blended learning as compared to traditional learning.	SE3
	Adopting a blended teaching approach will result in positive evaluations of my teaching abilities / skill.	SE4
	Technical difficulties make the online component of blended teaching frustrating. ^{R}	SE5

	I did not receive sufficient training to design a blended course. [R]	SE6
	I did not receive sufficient training to manage a blended course. [R]	SE7
Motivation	Having course materials and learning resources ready before the semester starts encourages me to apply blended teaching.	M1
	I am more satisfied with teaching in blended environments compared to other delivery methods.	M2
	I am looking forward to teaching my next blended course.	M3
Interaction and Communication	My students always pay attention in class although they have already got the course material online. [M]	IC1
	I am able to provide better feedback to my students on their performance in blended learning.	IC2
	The rate of my interaction in blended learning is higher than in a traditional face-to-face class.	IC3
	Not meeting my students face-to-face in a blended setting prevents me from knowing them. [R]	IC4
	It is difficult for me to motivate my students in the online environment than in the traditional setting. [R]	IC5
Effectiveness and Flexibility	Blended learning affects learning becomes more efficient because of its simple planning design.	EF1
	The flexibility provided by blended learning benefits me as the teacher.	EF2
	I can access online course material anytime and anywhere with the implementation of blended learning.	EF3
	I observed that the implementation of blended learning allows my students to access the online course material anytime and anywhere.	EF4
	I have a higher workload when teaching a blended course as compared to traditional learning.	EF5

Note: R symbol indicates the score of the signed R item is reversed to ease the quantitative data analysis, while M refers to modified items.

The instrument also included two open-ended questions focusing on the challenges aspect and four demographic questions.

2.3 Data Analysis

The collected data were securely stored in an online database and later analyzed using a three-stage data analysis procedure of Mulyono et al. (2020). First the collected data were coded and tabulated using Microsoft Excel software. Then, another file format was produced from the tabulation which is .csv file. Specifically, the *.csv file was used to help the researcher compute the quantitative data in statistical software like SPSS. Descriptive and inferential analyses were conducted, with key metrics such as mean, standard deviation, and frequency distribution calculated. Additionally, correlations between variables were tested to identify significant relationships. Next, the two open-ended questions were analysed using a thematic analysis as suggested by Naeem et al. (2023).

3 RESULT AND DISCUSSION

3.1 Introduction

To effectively complete this study, it is essential to analyze the collected data to test the hypothesis and address the research questions. As mentioned in the previous chapter, the data is interpreted

descriptively. This chapter focuses on the analysis, presentation, and interpretation of the study's findings. The data analysis and interpretation are based on the questionnaire results, emphasizing a quantitative approach. The questionnaire applied to a sample of 60 participants or lecturers from KPTM Ipoh with 20 items in the questionnaire. Table 3.1 below shows the result of a reliability test for a survey in measuring lecturers' perception on blended learning in post Covid-19 and the result shows Cronbach's alpha were acceptable for every item.

Table 3.1: Lecturers' Perception on Blended Teaching and Learning in Post Covid-19 Statistics

Reliability Statistics		
Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**No of Items**
.723	.765	20

Next, table 3.2 presents the Cronbach's Alpha reliability test results for different sections of a questionnaire, evaluating the internal consistency of the items within each section. Cronbach's Alpha values indicate the reliability of each section based on the number of items it contains. All the sections were tested to make certain for the reliability of the items within the sections by using Cronbach's Alpha reliability analysis. Table 3.2 exhibits that there is consistency for the entire item or Cronbach's Alpha among the items in the study. Motivation section shown acceptable level of internal consistency. This section performs well in terms of reliability, showing that the item is highly correlated. The reliability value of 0.372 for the Interaction and communication section is very low, indicating poor internal consistency for this section. A value of 0.621 and 0.651 for Effectiveness and flexibility and Skill and Experiences sections indicates a moderate level of reliability, which is just below the acceptable threshold of 0.7. This table highlights variability in the reliability of different sections of the questionnaire. While some sections are reliable, others require improvements to enhance their internal consistency. This analysis is critical for ensuring the validity and reliability of the study's findings.

For the conclusion, the results obtained indicate that the scores of the Cronbach's Alpha for all the constructs exceeded the level 0.723, indicating that the measurement scales of the construct are reliable and acceptable for this research. This means that questionnaire questions are appropriate and can be applied in this study.

Table 3.2: Cronbach's Alpha Reliability Test for each Section of Question

Section	**Cronbach's Alpha Coefficient**	**Number of items**
Skill and Experience	0.621	7
Motivation	0.732	3
Interaction and Communication	0.372	5
Effectiveness and Flexibility	0.651	5

Survey questionnaire will be given randomly to 60 lecturers at KPTM Ipoh. The researcher reassures the respondent that their response is anonymous and confidential. Therefore, it encourages the respondents to be more truthful in answering the survey. Times taken to answer the questionnaires will be approximately 5 to 8 minutes. The data analysis was conducted in three steps as follows:

i. Frequency statistics were examined to determine the respondents' characteristics based on demographic analysis.

ii. Descriptive analysis data for all items using descriptive analysis of mean (M) and standard deviation (SD) on Lecturers' Perception on Blended Teaching and Learning in Post Covid-19.

3.2 Demographic Analysis

Table 3.3 shows a detailed analysis of participant's demographic information and other related data such as gender of participants, age, educational background, and computer level. The results of the study found that about 35% of the students in the sample reported gender were men while 64% were female. The largest group of participants (43.3%) were aged between 31 and 40 years. The smallest group (6.7%) were over 50 years. The distribution reflects a diverse age range, with the majority being under 40 years.

Based on table shows most participants involved in this survey (63.3%) held a Master's degree, indicating a highly educated sample. A significant proportion also had a Bachelor's degree (35.0%) and only one participant had a Ph.D. (1.7%).

For the computer proficiency level, the majority of participants (71.7%) identified as having intermediate-level computer skills. About 28.3% of the participants were experts, suggesting a relatively high overall level of computer proficiency among the group.

The sample is predominantly composed of female, middle-aged participants (31–40 years) with Master's-level education and intermediate computer skills. The demographics suggest a well-educated and technologically capable group, which may influence the findings of the study.

Table 3.3: Participant demographic information and other related features

Variable	Characteristic Participants Descriptive	Frequency	Percentage
Gender	Male	21	35.0%
	Female	39	65.0%
Age	21 – 30	18	30.0%
	31 – 40	26	43.3%
	41 – 50	12	20.0%
	➢ 50	4	6.7%
Educational Background	Bachelor	21	35.0%
	Master	38	63.3%
	PhD	1	1.7%
Computer Level	Intermediate	43	71.7%
	Expert	17	28.3%

3.3 Data Analysis

This question attempts to analyze lecturers' perception on blended teaching and learning in post covid-19 in detail. Quantitative data from participants acquired in the several classifications identified during data analysis and the classification includes skill and experience, motivation, interaction and communication, and effectiveness and flexibility.

Participants in this study were 60 lecturers randomly at KPTM Ipoh. Researchers then collected the results of the questionnaire before entering all the data into the SPSS. The results of the questionnaire sample presented for each item of lecturer's perceptions answered by 60 lecturers are presented in Table 3.3. The result was interpreted using descriptive analysis of mean (M) and standard deviation (SD).

Table 3.3 also presents a summary of statistics for the 20 items of perceptions of lecturers where researchers produce survey mean and standard deviation on the findings. All mean values are above 2.92, proving that participants have a positive perception on blended teaching and learning. The standard deviation values are within the range 0.500 to 1.175, which indicate that the data is close to the mean. Statistical analyzes revealed that alpha reliability of attitudes toward the system was highly accepted.

Table 3.4: Analyzed Result Descriptive Analysis of Mean (M) and standard deviations (SD) of Lecturers Perception. (N = 60)

Construct	Lecturers Perception Item	N	Mean	Std. Deviation
Skills and Experience	B1- I understand my role in blended learning well.	60	4.43	0.500
	B2- I am able to align online course materials with their face-to-face counterparts	60	4.43	0.621
	B3- I incorporate more resources when teaching in a blended learning as compared to traditional learning	60	4.05	0.790
	B4- Adopting a blended teaching approach will result in positive evaluations of my teaching abilities / skill	60	4.13	0.700
	B5- Technical difficulties make the online component of blended teaching frustrating	60	3.93	1.056
	B6- I did not receive sufficient training to design a blended course	60	3.08	1.124
	B7- I did not receive sufficient training to manage a blended course	60	3.10	1.175
Motivation	C1- Having course materials and learning resources ready before the semester starts encourages me to apply blended teaching	60	4.40	0.616
	C2- I am more satisfied with teaching in blended environments compared to other delivery methods	60	3.82	0.930
	C3- I am looking forward to teaching my next blended course	60	4.05	0.675
Interaction and Communication	D1- My students always pay attention in class although they have already got the course material online	60	3.22	0.976
	D2- I am able to provide better feedback to my students on their performance in blended learning	60	3.58	0.962
	D3- The rate of my interaction in blended learning is higher than in a traditional face-to-face class	60	2.92	0.996
	D4- Not meeting my students face-to-face in a blended setting prevents me from knowing them	60	3.90	0.951
	D5- It is difficult for me to motivate my students in the online environment than in the traditional setting	60	3.92	0.926
Effectiveness and Flexibility	E1- Blended learning affects learning becomes more efficient because of its simple planning design	60	3.85	0.732
	E2- The flexibility provided by blended learning benefits me as the teacher	60	4.23	0.647
	E3- I can access online course material anytime and anywhere with the implementation of blended learning	60	4.20	0.860
	E4- I observed that the implementation of blended learning allows my students to access the online course material anytime and anywhere	60	4.18	0.833
	E5- I have a higher workload when teaching a blended course as compared to traditional learning	60	3.48	1.127

It was also found that the correlation value between the items showed all the items correlated positively and was significant at the level of 0.01 as shown in Table 3.5. The positive value between the

constructs in the correlation matrix between the items also indicates that the items in the constructs measure similar characteristics of the structure.

Table 3.5: Correlation between Constructs

		Skills and Experience	**Motivation**	**Interaction and Communication**	**Effectiveness and Flexibility**
Skills and Experience	Coefficient	1.000			
	p-value	0.0			
	N	60			
Motivation	Coefficient	.745	1.000		
	p-value	0.0	0.0		
	N	60	60		
Interaction and Communication	Coefficient	.705	.699	1.000	
	p-value	0.0	0.0	0.0	
	N	60	240	240	
Effectiveness and Flexibility	Coefficient	.816	.736	.722	1.000
	p-value	0.0	0.0	0.0	0.0
	N	60	60	60	60

After presenting the quantitative data relevant to this question, we shifted to the qualitative data collected. This data is obtained from a detailed analysis of lecturers' reviews on three things in the survey. Among the open-ended questions given to lecturers are:

i. What challenges have you encountered in implementing blended teaching and learning post?
ii. How have you addressed these challenges?

Lecturers' responses to these open-ended questions can help reinforce the results obtained from quantitative data. Lecturers revealed that blended learning increases learner autonomy because they take control of their own learning. Some of these themes reflect the positive aspects of Lecturers' Perception on Blended Teaching and Learning in Post Covid-19. Lecturers expressed their comment samples are listed below:

• What challenges have you encountered in implementing blended teaching and learning post?

" Infrastructure, and students' ability to follow or attend the class. "

" Some of the online learning apps does not applicable for unlimited usage, means have to pay extra price to utilized them well. "

Most of the lecturers raised a few challenges they need to encountered which is learning application tool and about the attendance. Lecturers also mentioned the lack of infrastructures like computer and internet used affect students negatively.

Other lecturers added the following comment:

" As a lecturer, one of the main challenges I've encountered in implementing blended teaching and learning post COVID-19 is getting students to focus and engage during online classes. Many students are reluctant to turn on their cameras or participate actively, which makes it difficult to gauge their understanding and maintain interaction. "

The above statement seems to suggest that a few students do not take an online class seriously

• How have you addressed these challenges?

" Use a variety of assessment methods, including quizzes, exams, projects and discussions, to assess student progress and provide timely feedback."

" Advised on timing management for students and try to make more activities during offline and online class to attract attention from students "

" We should provide a complete Infra & Infostructure, especially for learning activities such as software, WIFI etc. "

In summary, we can conclude that there are two main problems faced Lecturers' Perception on Blended Teaching and Learning in Post Covid-19 that give negative perception. The first major is accessibility internet and the second is an uninteresting user interface design.

4 CONCLUSIONS

The study reveals that lecturers generally view blended teaching and learning as a promising approach to education in the post-COVID-19 era, albeit with significant challenges. While they recognize its potential to enhance flexibility, accessibility, and student engagement, they also express concerns about infrastructure limitations, digital literacy, and the additional workload involved in designing and delivering effective blended lessons.

Lecturers emphasized the importance of professional development, institutional support, and equitable access to technology to optimize the blended learning experience. The transition to blended teaching has highlighted the need for innovative pedagogical practices and greater collaboration between educators and policymakers to create sustainable frameworks.

In conclusion, while blended teaching offers numerous advantages, its long-term success requires addressing key barriers and fostering a supportive environment for lecturers and students. Future research should explore strategies to mitigate challenges, measure the impact on student outcomes, and investigate best practices across diverse educational contexts.

Conclusions should state concisely the most important propositions of the paper as well as the author's views of the practical implications of the results.

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Leveraging TikTok as an Edutainment Tool: Enhancing Students Understanding of Finance Theory

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ABSTRACT

The integration of digital tools in education has transformed traditional teaching methods, providing innovative approaches to engage learners with complex concepts. TikTok has become one of the most popular social media sites in recent years, especially among younger generations. The video sharing application has become a cultural phenomenon, with over a billion active users globally, offering users a creative avenue to display their abilities and interests in short, basic videos. This study investigates the potential of TikTok as an edutainment platform to enhance students understanding focusing on finance theory. Finance, often perceived as a challenging subject, requires pedagogical methods that suite with digital native learners. TikTok's short form videos, interactive features, and visually engaging content present a new opportunity to address these challenges. The purpose of this study is to evaluate TikTok's usefulness as an edutainment tool for boosting diploma students' understanding of finance theory. By exploring the platform's capacity to clarify finance theories and foster active learning, this study underscores the importance of leveraging emerging technologies to redefine traditional educational practices. This paper aims to provide a foundation understanding for future studies and offers insights for educators considering innovative, technology-driven approaches to teaching finance theory.

KEYWORDS: TikTok, Edutainment tool, Digital learning, Finance theory, Learning preferences.

1 INTRODUCTION

The integration of social media platforms into educational settings has been a growing area of interest, particularly as educators seek innovative ways to engage students in learning complex concepts (Anderson, 2020; Lee & Xie, 2021). Among these platforms, TikTok has emerged as a powerful tool for "edutainment", the blending of education and entertainment to facilitate learning in a more accessible and engaging manner (Mohamed et al., 2023; Zhang & Wang, 2022). This short-form video platform, known for its creative and interactive content, offers unique opportunities to enhance students' comprehension of abstract and theoretical subjects, including finance (Kaur & Sharma, 2023; Lin, 2022).

Finance theory is often perceived as challenging due to its reliance on abstract concepts, quantitative models, and complex jargon (Smith & Johnson, 2019). Traditional teaching methods, while effective for some, often fail to resonate with digital-native students who are accustomed to rapid, visually engaging content (Brown et al., 2020; Park, 2021). The adaptability of TikTok in creating short, visually appealing, and contextually relevant videos has the potential to bridge this gap (Chen et al., 2022; Rivera, 2021). By leveraging its algorithm to tailor content delivery and utilizing features such as duos, challenges, and gamification, TikTok can transform how finance is taught and understood (Nguyen et al., 2023; Lee, 2022).

Recent studies have highlighted the effectiveness of TikTok in promoting active learning and student engagement across diverse educational domains, including language acquisition, STEM, and humanities (Rahman et al., 2021; Walker et al., 2022). However, its application in finance education remains underexplored, despite evidence suggesting that interactive and bite-sized content significantly improves retention and comprehension of complex topics (Foster & Green, 2022; Carter et al., 2023). This study aims to fill this gap by investigating how TikTok can be utilized to enhance students' understanding of finance theory, focusing on its potential to clarify complex concepts and foster deeper cognitive engagement (Xiao et al., 2023; Turner & Adams, 2021). The objective of this study is to explore existing literature on the use of TikTok as an edutainment platform to enhance diploma students' understanding of finance theory. Specifically, the study aims to examine how TikTok's short-form, interactive, and visually engaging content can support active learning and simplify complex financial concepts for learners. Through this review, the study seeks to provide a theoretical foundation and practical insights for educators and researchers interested in integrating emerging digital tools into finance education.

2 LITERATURE REVIEW

2.1 Digital Learning and Edutainment

The term "edutainment" is a combination of "education" and "entertainment", it has gained popularity in both academic and practical educational contexts. The phrase typically refers to material, technologies, or experiences designed to educate and entertain learners, particularly in a digital or multimedia setting. In educational practice, edutainment is frequently linked to digital platforms, mobile applications, gamified learning settings, and social media material (Liu et al., 2020). The arrival of digital technologies has transformed education, fostering novel pedagogical methods that blend entertainment and learning, a concept known as edutainment (Johnson, 2023; Evans & Cook, 2023). Social media platforms, particularly TikTok, have garnered attention for their potential to engage students through short, creative, and interactive content. Studies have shown that TikTok, with its user-friendly interface and vast repository of user-generated content, serves as an effective platform for promoting learning (Brown et al., 2020; Chen et al., 2022).

Edutainment combines entertainment elements with educational objectives to foster an engaging and immersive learning experience (Nguyen et al., 2023). Rooted in active learning theories, this approach emphasizes participation and interaction, which are key to improving cognitive outcomes (Liu et al., 2022). TikTok aligns with these principles, offering tools such as duets, hashtags, and challenges that encourage collaborative learning (Rahman et al., 2021). Constructivist theories further support TikTok's potential, highlighting how learners construct knowledge through social interaction and contextual engagement (Lee, 2022; Mohamed et al., 2023).

Digital learning emphasizes interactive, self-paced education, often supported by multimedia tools. Edutainment, a blend of education and entertainment, has been shown to improve student motivation and engagement (Berk, 2009). Mayer's (2009) multimedia learning theory supports the use of visual and auditory elements to enhance comprehension and memory retention, making platforms like TikTok suitable for educational purposes. Moore et al. (2011) define digital learning as "learning facilitated by technology that gives students some element of control over time, place, path, or pace of learning." This learner-cantered approach stresses flexibility and personalization, setting digital learning apart from traditional classroom training.

In summary, edutainment is a pedagogical strategy that integrates educational goals with entertainment formats to enhance engagement, motivation, and learning, especially in digital and interactive environments.

2.2 TikTok in Education

TikTok has evolved beyond a platform for entertainment into a space for informal learning. With over a billion users globally (Statista, 2023), its accessibility and ease of content creation make it a viable educational tool. Research indicates that TikTok can enhance student engagement and knowledge sharing when used in educational contexts (Green & Clark, 2021). Interactive features like comments, duets, and hashtags enable collaborative learning and peer interaction (Chen & Chen, 2021).

Student engagement is a critical factor in academic success, and digital tools like TikTok have proven effective in fostering motivation and participation (Brown et al., 2020; Martinez et al., 2023). TikTok's interactive features, such as likes, comments, and sharing, promote a sense of community and collaborative learning (Rivera, 2021). Furthermore, gamification elements, such as challenges and rewards, align with motivational theories, enhancing students' intrinsic and extrinsic motivations to learn (Johnson, 2023; Lee, 2022).

Research indicates that short-form videos enhance attention, comprehension, and retention, especially for complex topics (Carter et al., 2023; Walker et al., 2022). TikTok's format, which limits videos to a few minutes, aligns with the attention spans of digital-native students (Park, 2021). Studies in STEM and humanities education demonstrate that TikTok effectively simplifies abstract concepts through visual aids, storytelling, and gamification (Foster & Green, 2022; Lin, 2022). However, its application in finance education, a field often perceived as daunting due to its reliance on technical jargon and mathematical models, remains underexplored (Smith & Johnson, 2019).

2.3 Finance Education Challenges

Finance is commonly viewed as abstract and difficult due to its reliance on numerical data and theoretical constructs. Traditional lecture-based methods may not effectively convey complex financial concepts to all learners (Hess & Franks, 2020). Innovative strategies, including short-form videos and real-life applications, are needed to simplify finance education.

A further common argument against deeper learning is the conventional pedagogical approaches taken in finance education. Finance is usually taught in a very theoretical way, according to Biktimirov and Klassen (2008), which can turn off students who need real-world application and visualization to understand difficult ideas. They recommend using technology-enhanced learning resources, case studies, and simulations to increase understanding.

2.4 TikTok for Teaching Finance Theory

Short, visual explanations of financial concepts on TikTok can demystify topics and increase accessibility. Kay et al. (2020) found that video-based content improved comprehension and retention of chemical concepts, suggesting similar outcomes may be achievable in finance. User-generated content also reinforces learning, as students engage actively by creating or responding to educational videos (Xie et al., 2021).

TikTok represents a transformative tool in the edutainment landscape, offering innovative ways to engage students and enhance learning outcomes. Its application in finance education, though nascent, holds promise for making complex theories accessible and relatable. By addressing existing challenges and leveraging its unique features, TikTok can redefine traditional pedagogical approaches, paving the way for a more interactive and inclusive learning environment (Nguyen et al., 2023; Walker et al., 2022).

Finance education**,** traditionally grounded in quantitative concepts and case-based analysis, has seen growing adaptation to social media formats**. (**Nwachukwu and Nwankwo, 2020) argue that integrating social media into financial literacy programs increases student engagement, especially when educators use relatable language, infographics, and current financial trends. This interactive learning format supports better retention and real-world application of financial principles.

2.5 Digital Natives and Learning Preferences

Today's learners, often referred to as digital natives, prefer fast, visual, and mobile-friendly content (Prensky, 2001). TikTok's design caters to these preferences, offering tailored learning experiences through its algorithm and user engagement features (Tang et al., 2022). This alignment with student behavior enhances its potential as a teaching aid.

3 DISCUSSION & CONCLUSION

TikTok represents a transformative tool in the edutainment landscape, offering innovative ways to engage students and enhance learning outcomes. Its application in finance education, though nascent, holds promise for making complex theories accessible and relatable. By addressing existing challenges and leveraging its unique features, TikTok can redefine traditional pedagogical approaches, paving the way for a more interactive and inclusive learning environment (Nguyen et al., 2023; Walker et al., 2022).

Despite its potential, TikTok's use in education faces challenges such as content quality control, data privacy concerns, and the risk of distraction (Evans & Cook, 2023; Mohamed et al., 2023). In finance education, ensuring the accuracy of content is paramount, given the technical nature of the subject (Smith & Johnson, 2019). Educators must navigate these challenges by curating reliable content and fostering a balance between entertainment and educational value (Rahman et al., 2021). Additionally, developing guidelines for educators on content creation and evaluation is crucial to maximize its educational potential while mitigating risks (Evans & Cook, 2023). Other than that, TikTok poses challenges such as content credibility, platform distractions, and limited depth in video duration (Bayne & Ross, 2014). Educators must guide content creation and curation to ensure accuracy and alignment with learning outcomes. Structured integration into formal learning environments remains essential.

Studies highlight TikTok's success in enhancing learning across disciplines. For instance, Rahman et al. (2021) demonstrated its effectiveness in STEM education, while Walker et al. (2022) found that short-form videos improved comprehension in language learning. Finance-specific studies, such as Nguyen et al. (2023), suggest that TikTok can simplify complex financial theories through creative visualizations and practical applications. However, further research is needed to establish best practices for integrating TikTok into finance curricula (Lin, 2022; Foster & Green, 2022) and assess its impact on academic performance across diverse disciplines.

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Substitute Blended Learning in English for Technical Communication: Students' Acceptance and Way Forward

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ABSTRACT

Substitute blended learning (SBL), which combines face-to-face instruction with online learning components, has gained increasing attention in the field of language education as a flexible and innovative approach. This study investigates the acceptance of SBL among students enrolled in an English for Technical Communication (ETC) course, focusing on their perceptions of its effectiveness and challenges. The integration of technology into language learning is vital for preparing students to navigate the demands of a digitally driven world while fostering essential technical communication skills. Despite its growing implementation, limited research has explored students' acceptance of SBL in the context of ETC courses and the factors influencing its long-term sustainability. This study addresses this gap by asking: How do students perceive the SBL approach in ETC, and what improvements are needed to ensure its effectiveness and sustainability? Using a mixed-methods approach, data were collected through surveys and interviews with ETC students, focusing on their engagement, experiences, and suggestions for improvement. The findings reveal that while most students value the flexibility and accessibility offered by SBL, challenges such as limited digital literacy, reduced motivation in online tasks, and a preference for face-to-face interaction were noted. To address these issues, this study recommends enhancing digital infrastructure, providing targeted training for both students and instructors, and incorporating more interactive online elements to maintain engagement. These findings contribute to the field by emphasizing the importance of balancing online and in-person learning elements, fostering inclusivity, and integrating emerging technologies to optimize SBL. By addressing these challenges, the study underscores the potential of SBL to become a sustainable and impactful approach for developing technical communication skills in the digital age.

KEYWORDS: Substitute blended learning, student acceptance, digital literacy, interactive education, educational sustainability.

1 INTRODUCTION

In an era increasingly defined by digital transformation and global connectivity, the educational landscape has evolved to incorporate various technology-mediated pedagogical models. Among these, Substitute Blended Learning (SBL) has emerged as a prominent instructional strategy that integrates face-to-face instruction with online learning elements. This pedagogical model is particularly relevant in the context of language education, where dynamic and multimodal instructional approaches are essential to foster communicative competence and digital literacy simultaneously. As higher education institutions strive to equip students with the competencies required in a technologically driven world, the adoption of SBL represents an effort to create flexible, accessible, and contextually relevant learning environments.

The integration of information and communication technologies (ICT) into education has transformed the way knowledge is delivered, received, and assessed. In language education, the incorporation of digital tools ranging from learning management systems (LMSs) to synchronous communication platforms has enabled instructors to enhance instructional delivery while fostering learner autonomy. Specifically, in English for Specific Purposes (ESP) courses such as English for Technical Communication (ETC), where language skills are interwoven with discipline-specific competencies, the need for instructional strategies that mirror real-world communication scenarios is paramount. SBL has shown potential in this area, offering both the structure of traditional classrooms and the flexibility of online platforms.

However, the effectiveness of SBL is contingent upon various factors, including students' acceptance, engagement, digital readiness, and the instructional design of the course. Despite its growing adoption, the empirical investigation into how students perceive SBL especially within the specialized context of ETC courses remains limited. Understanding these perceptions is critical to optimizing instructional practices and ensuring the long-term sustainability of SBL models in language education.

While the theoretical advantages of SBL are well documented, there remains a significant gap in understanding students' lived experiences and acceptance of SBL, particularly in courses that require both linguistic proficiency and technical competency. Existing studies often focus on general blended learning without disaggregating the unique challenges and opportunities presented in technical language courses like ETC. Moreover, variables such as students' digital literacy, motivation in asynchronous settings, and preference for face-to-face interactions are often overlooked. These issues raise pressing questions about the effectiveness and sustainability of SBL in such specialized contexts.

To address this research gap, the present study aims to achieve the following objectives:

1. Examine students' perceptions of Substitute Blended Learning in an English for Technical Communication course.
2. Identify the challenges and facilitators influencing students' acceptance and engagement with the SBL model.
3. Propose actionable recommendations for improving the instructional design and sustainability of SBL in ETC education.

This paper is organized into five major sections. Following the introduction, the Literature Review explores recent studies (2020–2025) on blended learning and its applications in language education, with a focus on technical communication. The Research Methodology section details the mixed-methods research design, including participant selection, data collection instruments, and analytical procedures. The Findings and Discussion section presents and interprets the results from both the quantitative and qualitative data. Finally, the Conclusion offer insights into the implications of the findings and suggestions for future practice and research.

2 LITERATURE REVIEW

2.1 Blended Learning in Language Education

Blended learning has been recognized as a transformative instructional approach that enhances engagement and learning outcomes by combining the benefits of traditional and digital modalities (Boelens et al., 2020). In language education, blended learning models enable more personalized learning experiences and support the development of digital literacy, both of which are essential in the modern communicative landscape (Alammary, 2021).

Several studies have affirmed the positive impact of blended learning on language acquisition. For instance, Wang and Zheng (2022) found that integrating asynchronous online tasks with classroom discussions improved students' retention of vocabulary and grammar in an ESP course. Similarly, Suri and Sharma (2021) observed increased student autonomy and motivation when learners were given the flexibility to control their learning pace in a blended English course.

2.3 The Emergence of Substitute Blended Learning (SBL)

The concept of Substitute Blended Learning (SBL) is a recent evolution of traditional blended models, emphasizing the replacement of certain in-person components with digital activities rather than merely supplementing them. This nuanced shift addresses the challenges of time constraints and logistical barriers in higher education settings while maintaining pedagogical rigor.

Research by Idris and Abas (2023) on engineering students demonstrated that SBL facilitated better time management and improved access to course content. However, their study also indicated that students experienced difficulties in engaging with asynchronous materials without real-time feedback, underscoring the importance of effective instructional design.

2.3 Challenges in SBL Implementation

While promising, SBL also introduces a set of challenges, particularly related to student motivation, digital literacy, and course interactivity. A study by Lee et al. (2022) reported that while students appreciated the flexibility of online modules, they often felt isolated and less accountable, leading to decreased participation in online activities. This is especially pertinent in courses like ETC, where active communication and collaboration are vital for skill development.

Moreover, technical barriers such as limited access to devices or unreliable internet connections have been cited as common issues (Rahman et al., 2020). Instructors, too, face a learning curve in transitioning to blended formats, necessitating ongoing professional development (Chang, 2021).

2.4 SBL in English for Technical Communication

Despite a growing body of literature on blended learning in general language education, few studies have focused specifically on ETC courses. One notable exception is the work by Kumari and Singh (2024), who examined the use of interactive simulations in an SBL model for technical writing. They found that students who engaged with discipline-specific digital tools showed improved application of technical writing principles.

However, more empirical data are needed to understand how students perceive the effectiveness, engagement, and sustainability of SBL in ETC courses. This study aims to fill that gap by offering a mixed-methods perspective grounded in learners' voices.

3 RESEARCH METHODOLOGY

3.1 Research Design

This study employs a convergent mixed-methods design to explore student acceptance of Substitute Blended Learning in an English for Technical Communication course. The design allows for the integration of both quantitative and qualitative data to provide a comprehensive understanding of students' experiences, challenges, and suggestions.

3.2 Participants

Participants included 100 undergraduate students enrolled in an ETC course at a Malaysian university. The participants were selected using stratified random sampling to ensure representation across different faculties and academic years. The demographic breakdown included students from engineering, computer science, and industrial design programs.

3.3 Data Collection Instruments

Two main instruments were employed:

- Survey Questionnaire: A structured questionnaire was developed based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The survey consisted of five sections: (1) demographic information, (2) digital literacy, (3) perceived usefulness of SBL, (4) student motivation, and (5) challenges and suggestions.
- Semi-Structured Interviews: Follow-up interviews were conducted with 15 volunteer participants from the survey group. The interviews explored students' detailed experiences with online and face-to-face components, their engagement levels, and their recommendations for improvement.

3.4 Procedure

The study was conducted over a 14-week semester. The ETC course was delivered using an SBL model, where 70% of sessions were conducted face-to-face and the remaining via the university's LMS. All online sessions included pre-recorded lectures, discussion forums, and interactive quizzes.

- Surveys were administered in Week 12.
- Interviews were conducted in Week 13 via video conferencing and lasted between 25–40 minutes.

3.5 Data Analysis

- Quantitative data from the surveys were analyzed using SPSS. Descriptive statistics, correlation analysis, and regression analysis were conducted to examine relationships between variables such as digital literacy and student acceptance.
- Qualitative data from interviews were analyzed thematically using NVivo software. Coding followed Braun and Clarke's six-phase approach: familiarization, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.

3.6 Ethical Considerations

Participants were assured of confidentiality, anonymity, and the voluntary nature of their participation. Informed consent was obtained digitally prior to data collection.

4 FINDINGS AND DISCUSSION

This section presents the detailed findings obtained from both quantitative survey responses and qualitative interview data regarding students' perceptions of substitute blended learning. The analysis is structured thematically, aligning with the key aspects of the learning experience, including comprehension, engagement, technological ease, challenges, and satisfaction. Statistical data is interpreted alongside open-ended responses to provide a comprehensive understanding of students' experiences.

4.1 Understanding of Course Content (Compared to Traditional Methods)

The survey responses indicate a generally positive perception of substitute blended learning in enhancing students' understanding of course content. The mean score of 3.92 (SD = 0.98) suggests that most students agree that this method is effective. The frequency distribution reveals that 80% of respondents either agreed (42%) or strongly agreed (38%) that blended learning improved their comprehension compared to traditional methods. Only 6% expressed disagreement, while 14% remained neutral.

Qualitative responses supported this finding, with students highlighting that pre-recorded lectures and digital notes allowed them to revisit complex topics at their own pace. One student noted:

"Having recorded lectures means I can pause and re-watch explanations until I fully grasp the material, which wasn’t possible in traditional lectures."

However, a small minority (6%) reported difficulties in adapting to the lack of face-to-face interaction, suggesting that blended learning may not be universally effective without additional instructor support.

4.2 Performance in Assignments and Examinations

Students also reported improved academic performance, with a mean score of 3.84 (SD = 0.95). A combined 76% agreed (44%) or strongly agreed (32%) that blended learning positively impacted their assignment and exam performance. The availability of digital resources, such as interactive quizzes and self-assessment tools, was frequently cited as beneficial.

Open-ended responses indicated that students particularly valued formative assessments (Kahoot, Quizizz) for reinforcing knowledge before summative evaluations. However, 18% remained neutral, and 6% disagreed, citing challenges in self-discipline and time management as barriers to optimal performance.

4.3 Ease of Using Digital Tools (LMS, Videos, Discussion Boards)

The usability of digital learning tools received high ratings, with a mean score of 4.31 (SD = 0.89). A significant majority found these tools accessible, with 78% describing them as "easy" (38%) or "very easy" (40%) to use. Only 6% reported difficulties, primarily due to technical issues such as slow internet or unfamiliarity with the platform.

Interview responses suggested that while most students adapted well, some recommended better onboarding tutorials for new users. One participant stated:

"The LMS is functional, but a short guide on navigating discussion boards and submitting assignments would help new students."

4.4 Confidence in Using Technology

Students exhibited strong confidence in using technology for learning, with a mean score of 4.12 (SD = 0.91). 76% reported being "confident" (42%) or "very confident" (34%), while 8% expressed a lack of confidence, often due to limited prior exposure to digital learning environments.

This finding aligns with the high ease-of-use ratings, suggesting that once students become familiar with digital tools, their confidence increases. However, institutions should consider basic digital literacy workshops for less tech-savvy learners.

4.5 Engagement in Online Activities (Simulations, Quizzes)

Engagement levels in online activities were moderately high, with a mean score of 3.88 (SD = 1.12). 68% found activities "engaging" (38%) or "very engaging" (30%), while 12% reported disengagement.

Thematic analysis revealed that gamified quizzes (40%) and group projects (30%) were the most engaging methods. Students appreciated competitive elements, such as leader boards in Kahoot, which increased motivation. Conversely, those who found activities less engaging cited repetitive formats and lack of instructor interaction as drawbacks.

4.6 Motivation to Participate in Discussions and Complete Tasks

Motivation levels were slightly lower than engagement, with a mean of 3.82 (SD = 1.14). While 68% felt motivated (40% agreed, 28% strongly agreed), 12% reported low motivation, attributing it to isolation and the absence of real-time peer interaction.

Suggestions to improve motivation included more live discussions (20%) and interactive case studies (10%), which could foster a sense of community.

4.7 Flexibility to Study at Own Pace

Flexibility was one of the most praised aspects, with a mean of 4.24 (SD = 0.96). 80% agreed (44%) or strongly agreed (36%) that blended learning allowed them to manage their study schedules effectively.

Students particularly valued asynchronous materials, such as recorded lectures, which accommodated different learning speeds. However, a few (6%) noted that excessive flexibility sometimes led to procrastination, suggesting a need for structured deadlines.

4.8 Challenges in Accessing Resources (Internet/Devices)

Despite overall positive perceptions, 20% of students faced access challenges, with a mean score of 1.98 (SD = 0.92). While 42% never experienced issues, 38% sometimes struggled, and 6% always faced difficulties, primarily due to unreliable internet or lack of devices.

This disparity highlights a digital divide, where some students are disadvantaged by infrastructural limitations. Recommendations included offline-accessible materials (30%) and optimized mobile content (25%) to mitigate these barriers.

4.9 Satisfaction with Substitute Blended Learning

Overall satisfaction was high (Mean = 4.02, SD = 0.94), with 78% being "satisfied" (44%) or "very satisfied" (34%). Only 6% expressed dissatisfaction, often due to technical or engagement issues.

4.10 Recommendation to Other Students

An overwhelming 68% would recommend blended learning to peers, while 24% were uncertain, and 8% would not. This strong endorsement suggests that, despite minor challenges, the model is perceived as beneficial.

4.11 Thematic Insights from Open-Ended Responses

A. Preferred Learning Materials
- Videos (32%) – Animated explainers, recorded lectures.
- Interactive simulations (28%) – Virtual labs, 3D models.
- Case studies (18%) – Real-world applications.

B. Engaging Teaching Methods
- Gamified quizzes (40%) – Competitive elements increased participation.
- Group projects (30%) – Collaborative learning was highly valued.

C. Technical Improvements Needed
- Better platform usability (35%) – Simplified navigation.
- Mobile-friendly content (30%) – Essential for students with limited computer access.

D. Adjustments to Workload and Scheduling
- Flexible deadlines (40%) – To accommodate different paces.
- Reduced workload (20%) – Overlapping assignments were stressful.

E. Support Systems for Success
- Q&A sessions (40%) – Immediate clarifications.
- Peer mentoring (30%) – Collaborative learning helped struggling students.

Key Takeaways

1. Blended learning enhances understanding and performance for most students.
2. Engagement is highest with interactive methods (gamification, group work).
3. Technical and accessibility barriers persist for some learners.
4. Flexibility is a major advantage, but some students need structured support.
5. Institutional improvements (better LMS design, offline materials) could further optimize the experience.

These findings provide actionable insights for educators and policymakers to refine blended learning strategies, ensuring inclusivity and effectiveness for all students.

In summary, the findings can be further understandable through these tables:

Quantitative Survey Results

Table 1: Student Perceptions of Substitute Blended Learning

Aspect Evaluated	Mean	Median	SD	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Understanding of Course Content	3.92	4	0.98	38%	42%	14%	4%	2%
Performance in Assignments/Exams	3.84	4	0.95	32%	44%	18%	4%	2%
Ease of Using Digital Tools	4.31	4	0.89	40% (Very Easy)	38% (Easy)	16%	4% (Difficult)	2% (Very Difficult)

Aspect Evaluated	Mean	Median	SD	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Confidence in Using Technology	4.12	4	0.91	34% (Very Confident)	42% (Confident)	16%	6% (Not Confident)	2% (Not at All)
Engagement in Online Activities	3.88	4	1.12	30% (Very Engaging)	38% (Engaging)	20%	8% (Not Engaging)	4% (Not at All)
Motivation to Participate	3.82	4	1.14	28%	40%	20%	8%	4%
Flexibility to Study at Own Pace	4.24	4	0.96	36%	44%	14%	4%	2%
Challenges in Accessing Resources	1.98	2	0.92	42% (Never)	38% (Sometimes)	14% (Most of the Time)	6% (Always)	-
Satisfaction with Blended Learning	4.02	4	0.94	34% (Very Satisfied)	44% (Satisfied)	16%	4% (Dissatisfied)	2% (Very Dissatisfied)
Recommendation to Other Students	1.56	1 (Yes)	0.72	68% (Yes)	24% (Maybe)	8		

Key Observations from Survey Data:

Highest-rated aspects: Ease of digital tools (Mean = 4.31), Flexibility (Mean = 4.24), and Confidence in technology (Mean = 4.12).

Areas needing improvement: Engagement (Mean = 3.88) and Motivation (Mean = 3.82) had slightly lower scores.

Accessibility issues: 20% of students faced challenges (sometimes or always) in accessing resources.

Thematic Analysis of Open-Ended Responses

Table 2: Student Suggestions for Improvement

Category	Top Suggestions	Frequency (%)
Preferred Learning Materials	Videos (pre-recorded lectures, animated explainers)	32%
	Interactive simulations (virtual labs, 3D models)	28%
	Case studies (real-world applications)	18%
Engaging Teaching Methods	Gamified quizzes (Kahoot, Quizizz)	40%
	Group projects (collaborative learning)	30%
	Live discussions (real-time Q&A)	20%
Technical Improvements	Better LMS usability (intuitive navigation)	35%

Category	Top Suggestions	Frequency (%)
	Mobile-friendly content (offline access)	30%
	Faster resource access (cloud storage, optimized loading)	25%
Workload Adjustments	Flexible deadlines (staggered submissions)	40%
	Self-paced learning (modular structure)	30%
	Reduced workload (fewer overlapping assignments)	20%
Support Systems Needed	Q&A sessions (live clarifications)	40%
	Peer mentoring (study groups)	30%
	Tutoring (one-on-one academic support)	20%

Key Takeaways from Qualitative Data:

Students prefer interactive and visual materials (videos, simulations, case studies).
Gamification and collaboration boost engagement (40% favored quizzes, 30% group work).
Technical barriers exist, especially for mobile users (30% requested better mobile support).
Flexibility in deadlines and workload is highly desired (40% requested staggered deadlines).

Summary of Key Findings:

Strengths of Substitute Blended Learning
High satisfaction (78%) Most students found it effective. Flexibility (Mean=4.24) Self-paced learning was a major advantage. Ease of digital tools (Mean = 4.31) LMS and video resources were user-friendly.

Areas for Improvement:

Engagement & motivation - Some students felt isolated (12% reported low motivation). Technical access issues - 20% struggled with internet/devices. Need for structured support - More Q&A sessions and peer mentoring were requested.

Recommendations for Educators:

Increase interactive content (gamified quizzes, group projects).
Improve accessibility (mobile-friendly LMS, offline materials).
Provide flexible deadlines to accommodate different learning paces.
Enhance student support (live Q&A, mentoring programs).
Final Thoughts

This structured presentation highlights both quantitative trends and qualitative insights, making it easier to identify strengths and areas needing refinement in blended learning models. The data suggests that while most students benefit from this approach, targeted improvements in engagement, accessibility, and support could further enhance the learning experience.

5 CONCLUSION

The findings of this study highlight the overall effectiveness of substitute blended learning in enhancing students' comprehension, performance, and flexibility, as evidenced by high satisfaction rates (78%) and positive perceptions of digital tools (Mean = 4.31). A majority of students reported improved understanding of course content (80% agreement) and appreciated the self-paced nature of blended learning (Mean = 4.24). However, the study also reveals critical challenges that must be addressed to optimize this learning model further.

One key issue is variable engagement and motivation, with some students (12%) feeling less engaged due to a lack of real-time interaction. To mitigate this, educators should integrate more interactive and collaborative elements, such as gamified quizzes (40% preference) and group projects (30% preference). Additionally, live Q&A sessions (20%) and peer mentoring (30%) could foster a stronger sense of community, reducing feelings of isolation.

Another challenge is unequal access to digital resources, with 20% of students facing technical barriers, such as unreliable internet or inadequate devices. Institutions should prioritize mobile-friendly content (30% request) and offline-accessible materials to ensure inclusivity. Improving LMS usability (35% suggestion) and optimizing platform navigation would also enhance accessibility for all learners.

Furthermore, while flexibility was a major advantage, some students struggled with self-discipline and workload management. Implementing structured yet adaptable deadlines (40% recommendation) and offering modular learning pathways (30%) could help students balance autonomy with accountability.

In conclusion, substitute blended learning is a promising educational approach, but its success depends on addressing engagement gaps, accessibility limitations, and support needs. By enhancing interactivity, ensuring equitable access, and providing structured flexibility, institutions can create a more inclusive and effective blended learning environment. Future research could explore long-term impacts of these interventions on student performance and retention.

Ultimately, the key takeaway is clear: blended learning works, but it must be continuously refined to meet diverse student needs and maximize its potential.

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Gamification in Blended Learning: Enhancing Student Engagement in the 4IR Era – A Conceptual Paper

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ABSTRACT

The Fourth Industrial Revolution (4IR) is transforming education through the integration of advanced technologies such as artificial intelligence (AI), virtual reality (VR), and gamification. Blended learning, which combines traditional face-to-face instruction with digital learning, has emerged as a flexible and accessible educational model. However, maintaining student engagement in blended learning environments remains a significant challenge. This paper explores the role of gamification as a pedagogical strategy to enhance student motivation and participation in blended learning settings. By incorporating game mechanics such as points, badges, leader boards, and interactive challenges, gamification creates immersive and dynamic learning experiences. Additionally, AI-driven adaptive learning systems and VR-enhanced environments personalize and enhance engagement. While gamification offers numerous benefits, including increased motivation, collaboration, and cognitive retention, its implementation presents challenges such as design complexity, technological limitations, and balancing intrinsic and extrinsic motivation. This conceptual paper synthesizes existing literature and proposes a framework for integrating gamification into blended learning environments. The framework emphasizes aligning game mechanics with educational objectives, leveraging AI for personalized learning, fostering collaborative experiences, and utilizing data analytics to track progress. Finally, the study identifies future research directions, including empirical validation, long-term impact assessments, and the ethical considerations of AI-driven gamification. This paper contributes to the ongoing discourse on innovative educational strategies in the 4IR era and provides a foundation for future empirical research on gamification in blended learning.

KEYWORDS: Gamification, Blended Learning, Fourth Industrial Revolution (4IR), Artificial Intelligence (AI), Virtual Reality (VR)

1 INTRODUCTION

The Fourth Industrial Revolution (4IR) is characterized by the convergence of advanced technologies such as artificial intelligence (AI), robotics, the Internet of Things (IoT), and digital connectivity, which are reshaping industries, including education. The Online Educa Berlin (OEB) conference underscores that the 4IR is fundamentally altering how we live, learn, and work, necessitating a paradigm shift in educational methodologies (OEB Global, n.d.).

As we navigate this transformative era, education systems must adapt to meet the evolving demands of learners and the workforce. Traditional pedagogical approaches are no longer sufficient to equip students with the skills required in a technology-driven world. The rapid digitalization of education calls for innovative strategies that blend traditional teaching methods with modern technological advancements to foster a more engaging and effective learning experience.

One such approach is blended learning, a model that integrates face-to-face instruction with digital learning components. This method has gained traction due to its ability to offer flexibility, accessibility, and personalized learning experiences. However, despite its benefits, blended learning presents significant challenges, particularly in maintaining student engagement and motivation. The self-paced nature of online learning components often leads to decreased interaction, procrastination, and a sense of isolation among learners, impacting learning outcomes negatively.

To address these challenges, educators are exploring innovative techniques to enhance student engagement in blended learning environments. One promising solution is gamification—the integration of game-like elements into educational settings to increase motivation and participation. By leveraging game mechanics such as points, badges, leader boards, and interactive challenges, gamification has the potential to make learning experiences more immersive, enjoyable, and effective (Zainuddin, 2018). Moreover, the integration of AI and virtual reality (VR) has expanded the scope of gamified learning, allowing for personalized and adaptive learning experiences that cater to individual student needs (Lee & Hammer, 2011).

This paper explores the role of gamification in enhancing student engagement in blended learning within the context of the 4IR era. It examines the potential benefits of gamification, the challenges associated with its implementation, and proposes a framework for effectively integrating gamification into blended learning environments to optimize student engagement and learning outcomes.

1.1 Gamification as an Engagement Tool

Gamification, defined as the application of game-design elements in non-game contexts, has gained significant attention in education to enhance student engagement, motivation, and participation. By integrating game mechanics—such as points, badges, leaderboards, levels, and challenges—into the learning environment, gamification introduces elements of competition, achievement, and rewards, creating a more dynamic and engaging experience for students (Zainuddin, 2018). Through these elements, students are incentivized to progress in their learning journey, interact with the course material in meaningful ways, and feel a sense of accomplishment upon achieving specific goals. In the context of blended learning, gamification addresses common challenges such as student disengagement, procrastination, and isolation by making learning more interactive and enjoyable.

1.2 Psychological Basis of Gamification

The effectiveness of gamification in educational settings is grounded in several psychological theories that emphasize motivation and engagement. Understanding these theories can help in the design and implementation of gamified experiences that foster deeper learning.

1.2.1 **Self-Determination Theory (SDT)**: Deci and Ryan's (1985) SDT posits that individuals are motivated by intrinsic factors, such as autonomy, competence, and relatedness. In a gamified learning environment, these elements can be nurtured through opportunities for self-directed learning (autonomy), progressively challenging tasks that encourage skill development (competence), and collaboration with peers (relatedness). Gamification inherently supports these needs, as it provides students with choices (such as selecting tasks or pathways) and facilitates cooperative activities that strengthen relationships.

1.2.2 **Flow Theory**: Csikszentmihalyi (1990) introduced the concept of "flow," describing an optimal psychological state where an individual is fully immersed in an activity that offers a perfect balance of challenge and skill. In gamified learning, this state is fostered by designing tasks that challenge students but are still within their capabilities. Well-structured gamified elements, such as levels, achievement systems, and feedback loops, help to maintain the balance that keeps students engaged, leading them to achieve the flow state.

1.2.3 **Behaviourism**: Gamification leverages behaviourist principles by providing clear rewards and instant feedback to reinforce desired behaviours. Skinner (1938) emphasized the role of reinforcement in shaping behaviours. By incorporating rewards like points, badges, and leader boards, gamification taps into these reinforcement principles, encouraging students to engage in tasks and complete challenges in pursuit of external rewards. While intrinsic motivation is essential, extrinsic motivators play a role in promoting initial engagement and perseverance, especially in online and blended environments.

1.3 Technological Integration in Gamified Learning

The role of technology in gamified learning has significantly evolved, with advancements such as AI, virtual reality (VR), and data analytics expanding the scope and effectiveness of gamification. These technologies enhance the personalization, immersion, and adaptability of gamified learning experiences.

1.3.1 **AI-Powered Adaptive Learning Systems**: One of the most promising applications of gamification in education is the integration of AI-driven adaptive learning systems. These systems can personalize the learning experience by adjusting the difficulty of tasks and challenges based on individual student performance. Lee and Hammer (2011) highlight how AI can track students' progress, assess their strengths and weaknesses, and provide targeted feedback, creating a tailored and engaging learning journey. For example, AI can recommend specific game-like challenges or modify existing tasks to suit the learner's pace, ensuring that they remain challenged but not overwhelmed.

1.3.2 **Virtual and Augmented Reality (VR and AR)**: Virtual and augmented reality technologies offer immersive and interactive experiences that can complement gamification. By creating simulated environments or overlaying digital information on the real world, VR and AR can make abstract or complex concepts more tangible and engaging. In a gamified learning environment, VR can transport students to virtual worlds where they can solve puzzles, complete quests, or explore new concepts through interactive simulations. AR, on the other hand, can enhance physical learning

spaces by adding interactive elements, such as gamified tasks, to the real-world environment. These technologies provide an unprecedented level of engagement, allowing students to learn by doing, experimenting, and exploring in ways that traditional learning methods cannot match.

1.3.3 Data Analytics for Tracking Engagement: Data analytics tools are essential in monitoring student progress and engagement in gamified learning environments. By collecting and analyzing data on student behaviour—such as participation rates, task completion times, and performance on challenges—educators can gain valuable insights into individual and group engagement levels. Real-time analytics can also help identify students who may be struggling, allowing for timely interventions to re-engage them. Moreover, data-driven insights can inform decisions on adjusting game mechanics, such as introducing new challenges, modifying rewards, or enhancing collaborative elements to optimize student learning outcomes (Hamari et al., 2014).

1.4 Impact on Student Engagement and Learning Outcomes

Research consistently demonstrates that gamification has a positive effect on student engagement, motivation, and overall learning outcomes. A meta-analysis by Hamari, Koivisto, and Sarsa (2014) found that gamification significantly enhances student engagement and learning performance when implemented effectively. The introduction of game-like elements such as competition, rewards, and progress tracking has been shown to increase cognitive engagement, improve retention rates, and foster a sense of achievement.

However, the effectiveness of gamification depends on its design. Poorly implemented gamification, such as the use of superficial rewards or poorly aligned game mechanics, can lead to disengagement and even undermine learning. For instance, if points or badges are awarded without clear connections to learning objectives, students may focus on accumulating rewards rather than mastering content, resulting in shallow engagement. Additionally, over-reliance on extrinsic motivators—such as badges and leaderboards—may diminish intrinsic motivation, where students engage primarily for external rewards rather than out of curiosity or a desire for mastery (Deci & Ryan, 1985). Therefore, the key to successful gamification lies in aligning game mechanics with educational goals and ensuring that the experience remains meaningful and challenging.

Moreover, gamification can help address common challenges in blended learning environments. In traditional blended learning models, students may struggle with feelings of isolation or lack of interaction with instructors and peers. Gamification addresses this issue by encouraging social interactions, competition, and collaboration. Collaborative elements of gamification, such as team-based challenges and peer feedback, promote peer-to-peer learning, reducing the sense of isolation that is often associated with online learning components.

2 RESEARCH PROBLEM

Despite the promise of gamification, its implementation in blended learning environments is fraught with challenges. One primary concern is aligning gamification elements with pedagogical objectives, ensuring they serve educational purposes rather than just entertaining students. Additionally, disparities in technological accessibility can create inequities in gamified learning, limiting its effectiveness for students with limited access to digital tools and stable internet connections.

Another challenge lies in balancing extrinsic and intrinsic motivation. While rewards such as points and badges can initially drive participation, their long-term impact on deep learning remains debatable.

Over-reliance on extrinsic motivators may lead to diminished intrinsic motivation, where students engage only for rewards rather than genuine curiosity and mastery of content.

Furthermore, there is a gap in empirical research evaluating the long-term effects of gamification on student engagement, cognitive retention, and overall learning outcomes within the context of 4IR-driven education. Many existing studies focus on short-term implementations, leaving questions about sustainability and adaptability in evolving educational landscapes unanswered.

3 RESEARCH OBJECTIVES

This study aims to investigate the role of gamification in enhancing student engagement within blended learning environments, with a specific focus on how the 4IR (Fourth Industrial Revolution) technologies are reshaping education. The research objectives are as follows:

- **3.4 Identify Effective Gamification Strategies**: This objective seeks to uncover and evaluate gamification strategies that align with specific educational goals, such as enhancing motivation, improving retention, and fostering critical thinking. By assessing the interplay between game mechanics and pedagogical outcomes, the study aims to highlight the most effective approaches to gamification in blended learning environments.
- **3.5 Examine the Challenges and Opportunities of Gamification Implementation**: This objective explores the barriers to implementing gamification, such as technological constraints, resistance from stakeholders, and challenges in designing content. It also seeks to investigate the opportunities that the 4IR presents, including the use of artificial intelligence (AI), virtual reality (VR), and real-time analytics to enhance learning experiences. Identifying these challenges and opportunities is crucial to understanding how gamification can be successfully integrated into diverse learning contexts.
- **3.6 Propose a Framework for Integrating Gamification**: The study will present a comprehensive framework that integrates gamification into blended learning environments. The proposed framework will outline best practices for game mechanics selection, the role of AI in personalization, strategies for fostering collaboration, and the use of data analytics to track progress. The goal is to offer a practical guide for educators to optimize student engagement and learning outcomes through gamified experiences.

4 LITERATURE REVIEW

4.1 Meta-Analyses on Gamification Effectiveness in Education

Recent studies have examined the effectiveness of gamification in enhancing student engagement, motivation, and learning outcomes. A systematic review by Hamari et al. (2024) highlights how immersive and interactive learning experiences in gamified virtual reality (VR) environments significantly enhance student motivation and retention. Another meta-analysis by Xu and Yang (2023) indicates that well-structured gamification leads to improved student participation, particularly when combined with real-time feedback and adaptive learning strategies.

4.2 AI-Driven Personalization in Gamified Learning

Artificial intelligence (AI) is playing an increasing role in gamified education, enabling personalized learning experiences that cater to individual student needs. AI-powered adaptive learning

platforms can analyze student progress in real-time and adjust difficulty levels accordingly. A study by Lee and Chen (2024) demonstrated that AI-driven gamification, when integrated with learning analytics, enhances cognitive engagement and fosters a higher level of intrinsic motivation. Similarly, research by Patel et al. (2023) discusses the application of AI-based recommendation systems that provide personalized challenges and content adaptations in gamified environments, ensuring that students remain engaged and motivated.

4.3 Empirical Studies on VR/AR Gamification and Student Engagement

The integration of augmented reality (AR) and virtual reality (VR) into gamified learning environments has demonstrated significant benefits in student engagement. Research by Alghamdi and Ibrahim (2022) explores how AR-enhanced gamification improves learning outcomes by allowing students to interact with digital objects in real-world scenarios, fostering experiential learning. Another empirical study by Rodríguez et al. (2024) highlights that VR-based gamification creates an immersive experience that increases participation, particularly in STEM education, where students engage in interactive simulations of complex concepts.

4.4 Gamification in Education

Gamification has gained significant traction as a method to improve student engagement and motivation in educational contexts. As Deterding et al. (2011) define, gamification is the use of game design elements in non-game settings, aiming to increase user interaction, motivation, and experience. Research consistently demonstrates that when gamification is properly implemented, it leads to greater cognitive engagement, higher retention rates, and improved academic performance (Hamari, Koivisto, & Sarsa, 2014). The integration of game elements, such as rewards, levels, and points, can create a sense of accomplishment and challenge, which are known to foster intrinsic motivation.

However, the design of gamified systems is not without its pitfalls. Poorly conceived gamification can lead to negative outcomes, such as superficial engagement or, in extreme cases, disengagement. A key challenge in gamification design is ensuring that the game mechanics are aligned with the learning objectives and do not overshadow the educational content. Moreover, an overemphasis on extrinsic rewards can diminish intrinsic motivation (Deci & Ryan, 1985). Thus, thoughtful alignment of game mechanics with educational goals is critical to achieving positive results.

Emerging technologies, such as AI, VR, and mixed reality, have the potential to greatly enhance the gamification experience. AI-driven adaptive learning systems, for instance, can tailor challenges and feedback to individual students, increasing the relevance and impact of gamified content. By providing real-time feedback and adjusting the difficulty of tasks based on student performance, these technologies have the potential to optimize learning outcomes (Lee & Hammer, 2011).

4.5 Blended Learning Models

Blended learning is an educational approach that combines face-to-face classroom teaching with online learning elements. The goal is to leverage the strengths of both traditional and digital learning to create a more flexible, personalized, and scalable educational experience (Graham, 2006). A well-designed blended learning environment allows students to engage with the material at their own pace and provides opportunities for personalized learning paths. However, student engagement remains a significant challenge in blended learning models. Factors such as lack of interaction with peers and instructors, procrastination, and the isolation of online learning can result in lower motivation and engagement (Bernard et al., 2014).

Research suggests that integrating gamification into blended learning can help overcome these challenges by adding an interactive and engaging layer to the learning process. Gamification elements, such as leaderboards, achievement badges, and progress tracking, can motivate students to stay on track and actively participate in both face-to-face and online components of the course (Alammary, Sheard, & Carbone, 2014). Moreover, gamified experiences create opportunities for social interaction and collaboration, which can mitigate feelings of isolation and increase peer engagement.

4.6 Theoretical Foundations of Engagement

Several key theories provide a foundation for understanding how gamification can foster student engagement:

4.6.1 Self-Determination Theory (SDT) (Deci & Ryan, 1985): This theory emphasizes the importance of intrinsic motivation in driving engagement. According to SDT, students are most engaged when they experience autonomy, competence, and relatedness. Gamification can foster these elements by providing students with choice (autonomy), offering progressively challenging tasks (competence), and encouraging collaboration (relatedness).

4.6.2 Flow Theory (Csikszentmihalyi, 1990): Flow theory posits that individuals achieve optimal engagement when they are fully absorbed in an activity that balances skill and challenge. Gamification can facilitate flow experiences by offering tasks that match the learner's current abilities while pushing them slightly beyond their comfort zone.

4.6.3 Behaviourism (Skinner, 1938): Behaviourist principles focus on reinforcement, where positive behaviours are encouraged through rewards and feedback. Gamification draws on this theory by providing rewards (points, badges, achievements) and feedback to reinforce desired learning behaviours and outcomes.

4.7 Challenges in Implementing Gamification

Although gamification offers many potential benefits, there are several challenges to its widespread adoption in blended learning environments:

4.7.1 Technological Limitations: The effectiveness of gamification can be hindered by technological challenges, such as inadequate access to digital devices, slow internet connections, or limited access to AI-powered adaptive platforms. Additionally, poorly designed gamification systems that rely heavily on technology may alienate students who are not technologically proficient (Alammary et al., 2014).

4.7.2 Resistance to Change: Both educators and students may resist the adoption of gamification. Teachers may be skeptical about the efficacy of gamification or may lack the skills necessary to design gamified experiences. Students may also view gamification as trivial or unnecessary if it does not align with their learning preferences or academic goals (Hamari et al., 2014).

4.7.3 Design Complexity: Developing gamified content that is engaging and pedagogically sound requires expertise and resources. Creating content that strikes the right balance between fun and educational value is a complex task, and gamification may not be a one-size-fits-all solution for every subject or learner type (Zainuddin, 2018).

4.7.4 Ethical Concerns: With the increasing use of AI and data analytics in gamified learning, issues related to data privacy and the ethical use of student information have become prominent. Ensuring

that student data is used responsibly and transparently is essential for maintaining trust and equity in gamified learning environments.

4.7 Opportunities in the 4IR Era

The Fourth Industrial Revolution (4IR) offers a transformative landscape for gamification in education, characterized by the infusion of advanced technologies such as artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and the Internet of Things (IoT). These technologies can elevate gamified learning by making it more personalized, interactive, and immersive.

4.7.1 AI-Driven Personalization in Gamified Learning

AI can significantly enhance the personalization of gamified content. Adaptive learning systems powered by AI can assess a student's strengths and weaknesses in real time, offering tailored challenges and real-time feedback. This personalization is crucial for addressing the diverse learning needs within a blended environment, ensuring that all students, regardless of their skill level, are appropriately challenged. For instance, AI algorithms can adjust game levels based on student performance, ensuring a balanced level of difficulty that maintains engagement and maximizes cognitive benefits.

Further research could explore how AI can create dynamic narratives or challenges that evolve based on the student's learning journey. For example, the game storyline could shift according to the learner's progress, offering a unique learning path for each student and fostering a deeper connection to the content.

4.7.2 Immersive Learning through VR and AR

The potential for VR and AR to enhance gamified learning experiences cannot be overstated. These technologies can create fully immersive environments where students engage with the material in a three-dimensional, interactive space. Gamified VR platforms can simulate real-world scenarios, allowing students to experiment with problem-solving in a safe, controlled environment. VR can also transport students to historical events, scientific phenomena, or other settings, making abstract concepts tangible and real.

Blended learning environments benefit from these immersive experiences by complementing the traditional classroom with interactive digital explorations. Research can investigate how VR and AR can be seamlessly integrated into gamified systems, ensuring that the immersion enhances, rather than distracts from, the learning objectives. A study could also analyze how different types of gamifications (competitive, cooperative, or exploratory) function in immersive VR or AR settings.

4.7.3 Data Analytics and Real-Time Progress Monitoring

The use of real-time data analytics in gamified systems offers educators valuable insights into student performance and engagement. By tracking how students interact with game mechanics, educators can adjust the learning experience dynamically, ensuring that it is responsive to students' needs. For example, the analytics could show when students are struggling with certain content or when they are excelling, allowing for immediate interventions or further challenges.

Research in this area could explore the development of tools for educators to analyze the vast amount of data generated in gamified learning environments. Such tools could provide predictive insights, allowing for proactive adjustments to instructional strategies, fostering a more adaptive and responsive learning environment.

4.8 Benefits and Challenges of Gamification in Blended Learning

Gamification offers numerous benefits to blended learning environments, enhancing engagement, motivation, and overall learning outcomes. However, like any pedagogical approach, it also presents certain challenges that need to be addressed to ensure its effective implementation. In this section, we will explore both the advantages and limitations of using gamification in the context of blended learning.

4.8.1 Enhanced Student Engagement: One of the most significant advantages of gamification in blended learning environments is the increased level of student engagement. According to research by Anderson (2012), gamification taps into students' natural love for competition, achievement, and progress tracking. By incorporating game mechanics such as points, levels, badges, and challenges, students are motivated to actively participate in the learning process. This approach transforms learning from a passive activity to an interactive experience, where students are driven to complete tasks and strive for mastery, not just for grades but also for the enjoyment of accomplishment.

Moreover, in blended learning models, students often have to balance both online and in-person components. Gamification can help bridge this gap by creating seamless transitions between physical and digital learning environments. For example, students could continue their progress or complete specific quests (tasks or challenges) in an online component after an in-class session, encouraging continuity and engagement across different platforms.

4.8.2 Increased Motivation and Persistence Gamification: Encourages intrinsic and extrinsic motivation by providing a system of rewards and recognition. The concept of "levelling up" or earning rewards such as badges and trophies can create a sense of accomplishment and progression. These rewards, when aligned with learning objectives, can foster a sense of competence and mastery (Ryan & Deci, 2000). Additionally, gamified experiences often include progress bars, milestones, and leaderboards, which allow students to visualize their achievements. This not only reinforces the desire to continue learning but also instils a sense of purpose and urgency in completing tasks.

In blended learning, where students may sometimes feel disconnected from their peers or instructors, the use of gamification can provide continuous motivation. By setting clear, achievable goals and offering immediate feedback, students remain motivated to engage with the material, even when learning in an online or asynchronous setting.

4.8.3 Improved Learning Outcomes and Skill Development: Studies have shown that gamification has a positive impact on learning outcomes, particularly in areas such as problem-solving, critical thinking, and creativity (Deterding et al., 2011). Game-based learning challenges students to think critically, collaborate with peers, and develop problem-solving skills—all of which are essential competencies for the 4IR.

In blended learning environments, gamification helps reinforce these skills by providing opportunities for hands-on experiences, simulations, and interactive content. For instance, VR and AR applications in gamified learning allow students to engage in realistic simulations, practice real-world scenarios, and experiment with different approaches to problem-solving. These experiences not only enhance cognitive skills but also develop soft skills, such as collaboration, communication, and adaptability, which are crucial for success in the modern workforce.

4.8.4 Personalized Learning Experiences: One of the key benefits of gamification is its ability to create personalized learning experiences for students. With the help of data analytics and AI-powered platforms, gamified systems can adjust the difficulty of tasks, offer individualized feedback, and suggest content that is tailored to each student's needs. This personalized approach ensures that students are always appropriately challenged, neither bored with tasks that are too easy nor overwhelmed by tasks that are too difficult.

For example, AI can track a student's performance in real-time and adjust the complexity of challenges to match their progress. In a blended learning environment, this personalization is especially valuable because it ensures that students who might be struggling with online components can receive additional support or alternative tasks to help them catch up. Meanwhile, high-achieving students can be given more advanced challenges to maintain their interest and push their learning further.

4.8.5 Fostering Collaboration and Social Interaction: Another major benefit of gamification is its potential to foster collaboration among students. While blended learning environments can sometimes result in feelings of isolation, gamified elements such as team-based challenges, leaderboards, and cooperative missions can create opportunities for students to interact and collaborate. The social aspect of gamification helps build a sense of community, even in online or hybrid settings, reducing isolation and promoting peer learning.

For example, students can form teams to complete group challenges, earn collective rewards, or compete against other groups in a friendly competition. This collaborative approach not only enhances learning outcomes but also develops essential teamwork and communication skills.

4.9 Challenges of Gamification in Blended Learning

4.9.1 Risk of Overemphasis on Extrinsic Motivation: While rewards and recognition can motivate students, there is a potential risk of over-relying on extrinsic motivators such as points, badges, and leaderboards. When students are primarily motivated by external rewards, they may fail to develop intrinsic motivation—the desire to engage in learning for the sake of personal growth and curiosity (Deci & Ryan, 1985). This can lead to shallow learning, where students focus on earning rewards rather than deeply understanding the content.

In blended learning environments, this challenge may be exacerbated if students engage with gamified components primarily for the rewards and not for the actual educational value of the experience. To mitigate this, educators must design gamification systems that balance extrinsic and intrinsic motivation, ensuring that the rewards are aligned with learning goals and do not overshadow the intrinsic satisfaction of mastering new concepts.

4.9.2 Potential for Over-Competition: Leaderboards and competitive elements can enhance motivation for many students; however, for others, they may create anxiety or discourage participation. Excessive focus on competition can lead to negative outcomes, such as stress, demotivation, or a sense of failure for students who fall behind. This issue is particularly prevalent in blended learning, where students may already feel disconnected or isolated from their peers.

To avoid these challenges, it is essential to incorporate elements that emphasize personal progress and self-improvement, rather than just comparing students to one another. For instance, offering rewards

for individual milestones or improvement rather than relative ranking can promote a healthy sense of competition without creating undue pressure.

4.9.3 Difficulty in Aligning Gamification with Learning Objectives: Another challenge lies in ensuring that the game mechanics and rewards align with educational objectives. When gamification is poorly designed, it can result in students focusing more on earning rewards than on mastering the content. For example, awarding points for completing arbitrary tasks or simple quizzes may encourage students to focus on task completion rather than deep learning. This misalignment can reduce the overall educational effectiveness of the gamified experience.

In blended learning environments, where both online and offline components need to be integrated cohesively, aligning gamified elements with learning objectives can be more complex. Educators must carefully plan gamified activities to ensure that each element, whether it's a challenge, reward, or level, directly supports the intended learning outcomes.

4.9.4 Technological Barriers: The integration of advanced technologies such as AI, VR, and data analytics can enhance the gamified experience but also presents technological challenges. Not all students may have access to high-performance devices or stable internet connections, which can limit their ability to fully participate in gamified activities. In addition, educators must be proficient in using these technologies to create and manage gamified systems effectively, which can be time-consuming and require specialized knowledge.

To address these challenges, institutions need to invest in accessible technologies and provide support for both students and educators. Ensuring that the gamified experience is inclusive and accessible is crucial for maximizing its benefits.

4.9.5 Teacher Training and Implementation: For gamification to be successful in blended learning environments, educators must be adequately trained in designing, implementing, and assessing gamified learning experiences. Many teachers may lack the skills or knowledge necessary to integrate game mechanics effectively into their teaching strategies. Additionally, creating and maintaining gamified systems requires significant time and effort, which may be a barrier for instructors already managing diverse teaching responsibilities.

Professional development programs and workshops focused on gamification can help educators develop the skills they need to create effective gamified learning environments. Moreover, schools and universities can provide technological support and tools that simplify the process of integrating gamification into existing curricula.

4.10 Proposed Framework for Gamified Blended Learning

This study proposes a comprehensive framework for integrating gamification into blended learning environments. The framework includes the following key components:

4.10.1 Game Mechanics Alignment

To ensure gamification enhances learning outcomes, it is essential to align game mechanics with specific learning objectives. This alignment serves to reinforce educational goals while maintaining student engagement. For example:

(a) Points and Leaderboards: These elements foster healthy competition and incentivize students to actively engage in learning. Points can be awarded for completing assignments or mastering concepts, while leaderboards create a sense of achievement (Deterding et al., 2011).

(b) Badges and Achievements: These serve as symbols of success and mastery, motivating students to track their progress and continue striving for excellence (Zainuddin, 2018).

(c) Levels and Unlockable Content: These mechanisms can be used to introduce progressive challenges, where students unlock new content, tasks, or rewards upon completing specific goals, enhancing their sense of progression and mastery (Anderson & Lawton, 2015).

4.10.2 Personalization through AI

AI-powered platforms enable educators to tailor gamified learning experiences to meet individual students' needs, enhancing engagement and effectiveness. AI can:

(a) Adapt Learning Pathways: AI can track students' progress and adjust challenges to suit their learning pace, ensuring that they are neither overwhelmed nor bored (Lee & Hammer, 2011).

(b) Provide Real-Time Feedback: Instant feedback ensures that students are aware of their progress and areas that need improvement (Anderson & Lawton, 2015).

(c) Recommend New Challenges: Based on a student's past performance, AI can propose new quests or activities, allowing the learning experience to remain dynamic and aligned with the student's interests and capabilities (Hamari et al., 2014).

4.10.3 Collaborative Gamification

Gamification in a blended learning environment should encourage collaboration as much as it does individual achievement. Collaborative gamification can be achieved through:

(a) Team-Based Challenges: These challenges encourage students to work together to complete tasks, solve problems, or create projects, fostering peer interaction and shared learning experiences (Alammary et al., 2014).

(b) Peer-to-Peer Feedback: Students can engage in mutual evaluation, offering constructive feedback on each other's work. This peer-driven process not only deepens their understanding but also enhances communication and social skills (Vygotsky, 1978).

(c) Cooperative Quests: Group quests, where students collaborate to reach a common goal, promote a sense of community and shared achievement. These experiences are particularly valuable in reducing the isolation often associated with online learning components of blended education (Graham, 2006).

4.10.4 Progress Analytics

Data analytics is a powerful tool in the 4IR era, offering insights into student performance and engagement. Real-time analytics allow instructors to monitor:

(a) Individual Progress: By tracking how students are performing on tasks and challenges, instructors can identify which students may need additional support or more advanced content (Hamari et al., 2014).

(b) Engagement Levels: Analytics can reveal whether students are actively participating or disengaging, allowing educators to adjust game mechanics or content to re-engage students who may be losing interest (Alammary et al., 2014).

(c) Learning Outcomes: By comparing analytics across multiple students or cohorts, educators can assess which game mechanics are most effective in achieving specific educational goals (Deterding et al., 2011).

4.10.5 Instructor Training

The successful implementation of gamification in blended learning environments requires educators to be equipped with the necessary knowledge and skills. This can be achieved through:

(a) Professional Development Programs: Training teachers to design and implement gamified learning experiences is crucial. These programs should focus on integrating game mechanics with educational objectives, managing technology effectively, and fostering a positive, engaging learning environment (Zainuddin, 2018).

(b) Ongoing Support: After initial training, ongoing professional development ensures that educators stay informed about the latest advancements in gamification, AI, and other relevant technologies (Lee & Hammer, 2011).

(c) Collaboration Among Educators: Encouraging teachers to share successful strategies and collaborate on the design of gamified content can lead to a more robust and diverse approach to gamification, benefiting both educators and students (Hamari et al., 2014).

5 METHODOLOGY AND DATA

This study will adopt a mixed-methods approach, combining both quantitative and qualitative data collection techniques to assess the effectiveness of gamification in enhancing student engagement in blended learning environments. A quasi-experimental design will be employed to compare two groups: one using gamified learning and one following a traditional blended model. Random sampling will be used for selecting students to ensure the results are generalizable, while purposeful sampling will be used for qualitative interviews to select participants with relevant experience in gamified learning.

5.1 Data Collection

Quantitative data will be collected through pre- and post-surveys that measure student motivation, engagement, and academic performance, along with analytics from gamified learning platforms. Qualitative data will be gathered through interviews and focus groups with students and instructors to explore their experiences with gamification, providing deeper insights into the reasons behind changes in engagement and performance.

5.2 Data Analysis

Descriptive statistics will summarize the quantitative data, followed by t-tests to compare pre- and post-survey results. Thematic analysis will be used for the qualitative data, with the aim of identifying key themes around motivation, collaboration, and perceived learning outcomes.

5.3 Ethical Considerations

The study will adhere to ethical guidelines, including obtaining informed consent from all participants and ensuring data confidentiality. Informed consent forms will outline the study's objectives and data usage, while participant anonymity will be maintained throughout the research process.

6 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

6.1 Limitations of the Conceptual Approach

While gamification presents substantial benefits for blended learning environments, certain limitations must be acknowledged:

6.1.1 Lack of Empirical Validation: The proposed conceptual framework has not yet been tested in a real-world setting, making it challenging to ascertain its effectiveness across different learning environments.

6.1.2 Contextual Constraints: The framework may be more applicable to certain educational disciplines and might not generalize across all subjects or student demographics.

6.1.3 Technological Barriers: Implementation challenges, such as limited access to high-speed internet and AR/VR tools, may restrict the scalability of gamified blended learning solutions.

6.2 Future Research Directions

To strengthen the understanding and application of gamification in blended learning, further research is recommended:

40.2.1 Empirical Validation: Future studies should conduct experimental or quasi-experimental research to test the proposed framework's impact on student engagement, motivation, and academic performance.

40.2.2 Longitudinal Studies: There is a need for long-term investigations to determine the sustained effects of gamification on student learning outcomes and retention.

40.2.3 Diverse Educational Contexts: Research should explore the effectiveness of gamification across different disciplines, age groups, and cultural backgrounds to determine its broader applicability.

40.2.4 Integration with Emerging Technologies: Future studies could examine the role of AI, blockchain-based credentialing, and learning analytics in optimizing gamification strategies for personalized learning.

6.3 Clarification of Methodology for a Conceptual Paper

This paper is conceptual and does not include empirical data collection or experimental validation. Instead, it synthesizes existing literature to propose a framework for integrating gamification into blended learning environments. Future empirical studies can be conducted to assess the framework’s applicability and effectiveness in diverse educational settings.

For future research that seeks to test this framework, the following methodology is suggested:

6.3.1 Research Questions:

(a) How does gamification impact student engagement in blended learning?

(b) What role do AI-driven adaptive learning tools play in gamified education?

(c) What challenges and benefits arise when integrating VR/AR-based gamification into blended learning?
(d) Data Collection Methods: Surveys, interviews, focus groups, and learning analytics data from gamified platforms can be used to evaluate student engagement and performance.
(e) Analytical Approaches: A mixed-methods approach using statistical analysis (e.g., ANOVA, regression analysis) and qualitative thematic analysis can provide comprehensive insights.

7 CONCLUSION

The integration of gamification into blended learning environments presents a transformative approach to enhancing student engagement, motivation, and learning outcomes in the 4IR era. By incorporating game mechanics, AI-driven personalization, and immersive technologies such as VR and AR, gamification creates dynamic and interactive educational experiences that align with contemporary digital advancements.

This paper has explored the theoretical foundations of gamification, its psychological impact on learning, and the various challenges and opportunities associated with its implementation. While gamification offers significant benefits, including increased motivation, personalized learning, and collaborative engagement, its effectiveness depends on thoughtful design, alignment with pedagogical objectives, and accessibility of technological resources.

Despite its potential, gamification in blended learning is not without limitations. The need for empirical validation, concerns regarding technological disparities, and the balance between intrinsic and extrinsic motivation remain key areas for future investigation. Longitudinal studies and experimental research are essential to understanding the long-term impact of gamification on learning retention and academic performance.

Moving forward, educational institutions and policymakers must invest in professional development, infrastructure, and research to optimize gamified learning strategies. By leveraging data analytics, AI-powered adaptation, and immersive technologies, educators can create more engaging, inclusive, and effective learning environments. Ultimately, gamification has the potential to redefine education in the digital age, fostering a generation of learners who are not only academically proficient but also equipped with the critical thinking, collaboration, and problem-solving skills necessary for success in the 4IR landscape.

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The Impact of Blended Learning on ESL Learners' Language Proficiency in a Selected Tertiary Institution in Kuala Lumpur

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ABSTRACT

This study investigates the impact of blended learning on the language proficiency of ESL learners at a selected tertiary institution, with particular attention to the challenges faced and the key factors influencing language development in this environment. Data were collected from 100 ESL learners via a Google Forms questionnaire, comprising eight questions on the challenges of blended learning and twelve questions on factors affecting language proficiency. The results reveal that learners encounter several obstacles, including technical issues and reduced face-to-face interaction. However, the findings also highlight that peer interaction and group work significantly enhance writing skills, while self-discipline and effective time management are critical to overall language proficiency. The study concludes that, while blended learning offers meaningful opportunities for ESL learners, addressing its inherent challenges is essential to optimize learning outcomes.

KEYWORDS: Blended Learning, Learning,ESL Learners,Language Proficiency,

1 INTRODUCTION

Blended learning, which integrates both online and face-to-face instruction, offers a dynamic approach to language learning by encouraging student engagement and improving outcomes. According to Alnajdi (2019), this hybrid model allows learners to interact directly with instructors and peers, fostering a richer educational experience than fully online environments. Research by Shahin (2019) shows that students exposed to blended learning perform better in language assessments compared to those in traditional settings. Despite its benefits, implementing blended learning effectively remains a challenge, especially in developing countries where resources and training may be limited (Kintu et al., 2019).

English as a Second Language (ESL) learners across various academic programs must navigate English-medium instruction, making language proficiency critical. However, adapting to blended learning can be difficult due to shifts in learner responsibilities and engagement challenges, particularly following the rapid changes brought about by the COVID-19 pandemic. Students need to adjust to less structured environments, which can impact their language acquisition. This study explores the challenges ESL learners

face and the factors influencing their proficiency in a blended learning environment at a selected tertiary institution, using a quantitative approach via Google Forms.

The study aims to: (1) explore the challenges ESL learners face in a blended learning setting, and (2) identify key factors affecting their language proficiency. The central research questions are: What challenges do ESL learners encounter? What influences their language proficiency in this environment? Two hypotheses are tested: (H1) ESL learners face significant challenges in blended learning that impact their proficiency, and (H2) motivation, learning preferences, and instructor support significantly influence their proficiency.

In this study, "ESL learners" refers to students at the selected tertiary institution who study English for academic purposes, regardless of their program of study. The "impact of blended learning" refers to how this instructional method affects language skills such as listening, speaking, reading, and writing. Prior studies (e.g., Mohamed, 2021) confirm that blended learning can enhance these skills by providing flexible, engaging, and interactive learning environments.

This study contributes to understanding how blended learning can be optimized for ESL learners, especially in institutions balancing traditional and digital teaching methods. Although findings are based on a limited sample, they may inform future teaching strategies and curriculum development. Ultimately, the study supports the potential of blended learning to improve ESL learners' academic performance, provided that instructors are equipped with the necessary training and digital tools to effectively implement this approach.

2 LITERATURE REVIEW

2.1 Blended Learning

Blended learning combines face-to-face instruction with technology, allowing students to access lessons in-person or online (Gonzalez, 2020). Oliver (2019) describes it as merging different instructional elements, while Driscoll (2019) notes it includes various teaching methods, technologies, and authentic tasks. MacDonald (2019) highlights its flexibility, enabling students to learn at their own pace, which benefits personalized instruction. However, low-achieving students may struggle to move beyond the set curriculum (Gülten, 2019). In higher education, blended learning encourages student feedback and independent learning (Hughes, 2021). Globally, institutions are embracing this model to remain competitive in the evolving digital age (Aljader, 2019).

2.2 Tertiary Education

Tertiary education refers to all forms of post-secondary learning such as universities and polytechnics, essential for training professionals in various fields (Asuzu, 2022). It plays a significant role in national development, as higher education quality directly influences technological advancement and economic growth (Hoai, 2023). By shaping human capital, tertiary education becomes a critical driver in redefining a country's economic structure and productivity.

2.3 Language Proficiency

Studies suggest blended learning significantly enhances students' language skills—listening, speaking, reading, and writing—by merging web-based and traditional instruction. Krashen & Brown (2019) observed that modern second and foreign language programs now emphasize academic language proficiency, aiming to prepare learners for real-world professional and social communication in English.

2.4 ESL Learners

ESL, or English as a Second Language, is taught in settings where English is widely spoken, such as the US or UK (Nordquist, 2019). Unlike EFL learners who only encounter English in the classroom, ESL learners are immersed in English daily (Si, 2019). With technological integration, learning has evolved,

offering ESL students greater opportunities to practice the language. In Malaysia, English is introduced from preschool and widely used, making most students highly proficient (University Malaya, 2022).

2.5 Review of the Past Studies

Al-Rimawi (2014) conducted a quasi-experimental study on first graders learning English and found that the experimental group using blended learning outperformed the control group. Similarly, Saleh & Khader (2016) showed that blended learning improved science achievement among third graders, offering benefits like flexibility, cost-effectiveness, and improved information exchange. Buao et al. (2022) explored blended learning among 52 high school teachers and confirmed that students' academic performance improved with this method. Farahidatul Akmar Awaludin et al. (2023) investigated university students' perceptions of hybrid learning in ESL settings post-COVID-19 and found positive attitudes, especially in areas of flexibility and access. Li (2022) also noted that EFL learners benefited academically from blended learning, affirming that integrating online and traditional teaching enhanced student outcomes.

Blended learning, which integrates traditional face-to-face instruction with digital tools, has emerged as a powerful educational approach, particularly in tertiary education and ESL learning contexts. It offers flexibility, promotes self-paced learning, and allows for greater student engagement through personalized instruction. Research has consistently shown that blended learning enhances academic performance, language proficiency, and overall learner satisfaction. As global education systems continue to evolve in response to technological advancements and post-pandemic challenges, blended learning remains a relevant and effective method for addressing diverse learner needs and improving educational outcomes.

2 METHODOLOGY

The research adopts a quantitative approach, as it allows for objective data analysis using statistics, thereby minimizing bias. Among the four basic types of quantitative methods—descriptive, correlational, experimental, and comparative—the study employs a descriptive design to examine the current state of ESL learners' experiences in a blended learning environment. This method does not involve manipulating variables but instead uses tools like questionnaires distributed via Google Forms to collect data from ESL learners at Universiti Poly-Tech Malaysia (UPTM). A cluster sampling technique is used to group participants naturally by their class sections, making the sampling process more efficient and suitable for the institutional setting.

The data collection relies on structured survey questionnaires incorporating a 4-point Likert scale (Strongly Disagree to Strongly Agree). This method effectively captures students' attitudes toward blended learning and its impact on language acquisition. The ethical foundation of the study is grounded in informed consent, ensuring all participants voluntarily participate with full awareness of the research purpose, consistent with ethical research practices advocated by institutions like the University of Oxford.

The research targets undergraduate ESL students at UPTM, with a pilot test involving 15 participants to validate the questionnaire. Purposive sampling was used to ensure relevance, and the instrument was tested for reliability using Cronbach's Alpha, yielding strong internal consistency values (0.80 and 0.85 for different sections). The final data collection involves 100 students, providing a robust dataset for meaningful statistical analysis.

The data analysis is conducted using Microsoft Excel 2019, utilizing descriptive statistics along with visual representations like charts and tables to facilitate understanding of trends and patterns. In summary, this chapter details a well-structured and ethically sound research process aimed at investigating how blended learning influences ESL learners, offering both validity and clarity in its methodological framework.

3 FINDINGS AND DISCUSSION

3.1 Challenges by ESL learners at UPTM in a blended learning environment.

Based on table 1, the question 6 'I miss the peer support I get in a traditional classroom' has the highest calculation of mean which is 2.78. This question indicates that the ESL learners agreed that missing their peer support is the biggest challenge for them. The lowest mean goes to question 1 'I often face technical issues (e.g., internet connectivity, software problems) during online classes' which is 2.56 which indicates that the ESL learners agreed on the statement given.

Table 1 Challenges in Blended Learning

No	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Mean
		F	%	F	%	F	%	F	%	
1	I often face technical issues (e.g., internet connectivity, software problems) during online classes.	11	11	37	37	37	37	15	15	2.56
2	I find it difficult to interact with my instructors in a blended learning environment.	9	9	37	37	41	41	13	13	2.58
3	I have trouble understanding course material when it is delivered online.	12	12	32	32	43	43	13	13	2.57
4	I struggle with time management in a blended environment.	10	10	32	32	38	38	20	20	2.68
5	I feel less motivated to learn English in a blended learning environment compared to traditional classroom settings.	15	15	30	30	34	34	21	21	2.61
6	I miss the peer support I get in a traditional classroom.	9	9	30	30	35	35	26	26	2.78
7	It is boring to learn English in a hybrid learning environment.	15	15	26	26	34	34	25	25	2.69
8	The structure of the environment in hybrid learning helps me focus on learning.	9	9	28	28	42	42	21	21	2.75

ESL learners at Universiti Poly-Tech Malaysia (UPTM) face several challenges in a blended learning environment, particularly in relation to technological and social aspects. One significant difficulty involves technical issues that arise during online classes. These include inconsistent internet connectivity and problems with educational software, both of which disrupt the learning process and negatively impact learners' engagement with digital content. Such challenges are not unique to UPTM; Alvarez (2020) noted

that technical difficulties—such as limited internet access and inadequate technological infrastructure—are common in developing countries. In these contexts, low computer availability, unstable internet connections, and underperforming learning management systems often hinder the smooth implementation of blended learning.

Beyond technical concerns, social interaction—or the lack thereof—is another key area of concern. In traditional classroom settings, learners benefit from peer support, which facilitates immediate clarification of doubts, spontaneous discussion, and overall motivation. However, blended learning environments tend to limit face-to-face communication, leading to reduced opportunities for peer engagement. Singh (2023) highlighted that student often feel the absence of interpersonal connections in blended formats, which can result in feelings of isolation and decreased motivation.

The reduction in peer collaboration not only affects emotional well-being but also has academic consequences. Conventional classroom settings encourage group work, dynamic interaction, and networking—components that contribute to holistic learning. In contrast, blended environments may limit these opportunities unless intentionally designed to support social learning. News (2024) emphasized that direct interaction in physical classrooms fosters networking and relationship-building, which are essential for both academic and professional development. Peer learning has been identified as a particularly important factor in sustaining learner engagement and promoting mutual support. According to Lu and Smiles (2022), peer interaction plays a significant role in enhancing collaboration, reinforcing understanding, and creating a sense of trust among learners. When students are given space to exchange ideas and support one another, their confidence and academic outcomes tend to improve.

These findings highlight that ESL learners at UPTM are particularly impacted by the dual challenges of limited technological access and reduced peer interaction in blended learning environments. To ensure the success of such educational approaches, it is crucial to address both the technical infrastructure and the social dimensions of learning by providing sufficient support systems and fostering interactive, community-based learning strategies.

3.2 Factors that affect the ESL learners' language proficiency at UPTM in a blended learning environment.

Based on Table 2, the highest mean score is for question 10: 'My self-discipline and time management skills are crucial for success in a blended learning environment,' which has a mean of 3.12. The majority of respondents agreed that the main factor affecting their language proficiency was their self-discipline and time management. Furthermore, the lowest mean score is for question 7: 'Peer interaction and group work in blended learning improve my English language writing skills,' which has a mean of 2.64.

Table 2 Factors Affecting Language Proficiency

No	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Mean
		F	%	F	%	F	%	F	%	
1	The blended learning environment has significantly impacted my English language proficiency.	5	5	23	23	58	58	14	14	2.81
2	The quality of online instructional materials affects my English language proficiency.	8	8	27	27	53	53	12	12	2.69

3	Frequent online interaction with instructions enhances my English language proficiency.	5	5	28	28	46	46	21	21	2.83
4	Frequent offline interaction with instructions enhances my English language proficiency.	6	6	27	27	41	41	26	26	2.87
5	Opportunities for practicing speaking and listening in a blended learning environment are sufficient.	4	4	25	25	52	52	19	19	2.86
6	Peer interaction and group work in blended learning improve my English language- speaking skills.	4	4	25	25	53	53	18	18	2.85
7	Peer interaction and group work in blended learning improve my English language- writing skills.	13	13	25	25	47	47	15	15	2.64
8	Peer interaction and group work in blended learning improve my English language- reading skills.	7	7	27	27	47	47	19	19	2.78
9	Peer interaction and group work in blended learning improve my English language- listening skills.	5	5	27	27	50	50	18	18	2.81
10	My self-discipline and time management skills are crucial for success in a blended learning environment.	2	2	14	14	54	54	30	30	3.12
11	Having access to additional learning resources (e.g., online libraries, language apps) helps to improve my language proficiency.	8	8	21	21	41	41	30	30	2.93
12	I feel more confident in my language proficiency after participating in blended learning compared to before.	7	7	25	25	47	47	21	21	2.82

This section discusses key factors influencing the language proficiency of ESL learners within the blended learning environment at UPTM, as reflected in the study findings.

One area examined was the role of peer interaction and group work in enhancing English writing skills. Although these are generally regarded as effective strategies for collaborative learning, responses in this study suggest that their impact on writing improvement was less significant. This contrasts with existing literature. For instance, Dhaarani (2024) emphasized that peer learning through group tasks is a highly effective method for engaging students and enhancing academic performance. Such activities encourage collaboration, problem-solving, and the application of diverse learning strategies, ultimately fostering a supportive environment that mirrors real-world communication and teamwork.

Similarly, Geta and Olango (2019) argued that blended learning promotes the development of self-directed learning habits. Students learn to synthesize information from multiple sources, restructure knowledge, and seek additional support—such as researching writing techniques via online platforms. However, in the context of this study, such benefits did not clearly translate to improvements in writing proficiency through peer collaboration. This deviation could be attributed to contextual factors specific to UPTM, such as the structure of group activities, learner engagement levels, or limitations in peer feedback practices. As such, while prior research supports the value of peer interaction in blended learning, its limited impact in this case highlights the importance of localised investigation.

In contrast, one of the most significant factors identified in this study was the role of self-discipline and time management. Learners consistently recognized the importance of these attributes in navigating the demands of a blended learning model. Nur et al. (2020) noted that as learners in blended environments are often expected to take greater responsibility for their own learning, strong self-management skills are crucial. Geng and Wei (2023) further described self-discipline as a self-regulatory mechanism that enables learners to maintain focus, resist distractions, and persist in achieving academic goals. Their research also linked self-discipline to higher academic performance, suggesting that students who manage their time well and remain consistent in their efforts tend to perform better.

Overall, these findings suggest that while peer interaction is widely recognized as a useful educational tool, its effectiveness in improving English writing skills within the UPTM blended learning context may be limited. On the other hand, the critical role of self-discipline and time management was strongly affirmed by the participants, reinforcing the idea that these internal qualities are key to succeeding in blended learning environments. These results emphasize the need to tailor learning strategies and support mechanisms based on students' specific learning contexts and challenges.

4 CONCLUSION

The findings revealed two primary themes: the limited impact of peer interaction and group work on writing skills, and the significant role of self-discipline and time management in academic success.

Despite the general assumption that peer interaction enhances language learning, this study found that group work in a blended learning context did not substantially contribute to the improvement of students' English writing skills. Although students agreed that peer collaboration was part of their learning experience, the effect on writing proficiency appeared minimal. This outcome diverges from prior studies, such as Dhaarani (2024), who argued that peer learning is one of the most effective strategies for increasing student engagement and fostering deeper learning. Group activities, according to her, offer students varied perspectives, stimulate critical thinking, and promote collaborative problem-solving, all of which can positively influence language acquisition.

Further supporting this view, Geta and Olango (2019) contended that blended learning environments encourage learners to adopt self-directed learning strategies. These include connecting different content formats, organizing information effectively, and engaging in independent research—skills particularly beneficial to writing development. However, in this study, such advantages did not clearly manifest in students' writing outcomes. This suggests that while peer collaboration may offer theoretical benefits, its actual implementation at UPTM may have lacked the structure or support necessary to translate into measurable writing improvement. Factors such as the quality of peer feedback, the level of student engagement, or limited opportunities for meaningful interaction may have contributed to this outcome. These contextual limitations must be considered when interpreting the results, especially since the study focused on a specific institutional setting.

In contrast, the data indicated strong agreement among students regarding the importance of self-discipline and time management in a blended learning context. This aligns with findings by Nur et al. (2020), who highlighted that success in blended learning is closely tied to a student's ability to manage their own learning processes. In such models, where learners often operate with greater autonomy, the development of time management skills and self-regulation becomes critical. Geng and Wei (2023) also emphasized that self-discipline involves the internal regulation of attention and behavior, enabling students to remain focused on academic tasks despite distractions. Their study found a positive correlation between

self-discipline and academic achievement, reinforcing the notion that students who possess higher levels of self-regulation tend to perform better academically.

These findings suggest that while external collaborative strategies like group work and peer interaction have potential, internal factors such as motivation, discipline, and time management are more influential in determining language proficiency outcomes in a blended learning environment. The limited effectiveness of peer collaboration in this context also underscores the importance of structured instructional design, which should include clear roles, effective group dynamics, and targeted peer feedback mechanisms to maximize learning benefits.

Overall, the results of this study contribute to a nuanced understanding of blended learning for ESL learners, highlighting that effective language development requires more than simply integrating technology and peer activities. It demands careful attention to learner autonomy, support structures, and the practical implementation of collaborative learning strategies.

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Striving for Educational Excellence in the 4IR Era: Experiential and Active Learning Approaches in Wastewater Engineering

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ABSTRACT

The Fourth Industrial Revolution (4IR) is reshaping how we prepare future engineers, calling for fresh, innovative teaching methods that go beyond lectures and textbooks. In light of this, our study explores an integrated approach to experiential and active learning in an environmental chemical engineering course, aimed at deepening students' understanding of secondary wastewater treatment. As part of the learning experience, students went on a guided field trip to a Regional Sewage Treatment Plant. This real-world exposure was followed by a dynamic in-class session using a bookend active learning strategy. The session opened with a reflective activity, moved into a Think-Pair-Share exercise focused on real operational challenges like high MLSS, low MLVSS, and sludge bulking, and ended with a simulation where students stepped into the shoes of plant managers solving process issues. Feedback from student reflections, surveys, and facilitator notes revealed significant gains in engagement, comprehension, and the ability to connect theory with practical applications. This blend of hands-on learning and structured classroom activity not only encouraged critical thinking and teamwork but also helped students apply their knowledge in meaningful ways especially skills essential for navigating the complexities of 4IR. This study highlights how integrating real-world learning into engineering education can better prepare students for the future and offers a replicable model for other educators aiming to do the same.

KEYWORDS: Teaching Innovation, Real world application, active learning, flipped classroom

1 INTRODUCTION

Engineering education is increasingly shifting toward student-centred, experiential learning approaches that aim to bridge the gap between theoretical concepts and real-world practice. In disciplines such as environmental chemical engineering, this transition is particularly important due to the complex, multidisciplinary nature of environmental systems and the critical need for students to develop both conceptual understanding and problem-solving skills relevant to real-world contexts (Cifrian et al., 2020).One essential area of environmental engineering education is wastewater treatment, a topic that requires students to comprehend biological, chemical, and physical processes, as well as operational and regulatory considerations (Henze et al., 2016; Ksenofontov, 2020).

Traditional lecture-based teaching methods, while effective in conveying foundational theory, often fall short in providing students with the contextual understanding needed to analyze, evaluate, and manage real treatment systems (Fernández-Gómez et al., 2024). As a result, students may struggle to apply classroom knowledge to complex and dynamic scenarios encountered in practice. To address this gap,

educators have turned to experiential learning methods, including field trips, active learning, and flipped classroom strategies, to promote deeper understanding and engagement (Jamison et al., 2022). Field visits to wastewater treatment plants offer students the opportunity to observe operational systems firsthand, visualize treatment processes, and connect theoretical principles to practical applications. However, without structured integration into the curriculum, the impact of field trips may be limited to surface-level observations (Krakowka, 2012). Similarly, active learning methods such as collaborative problem solving, scenario-based tasks, and guided reflection have been shown to improve student engagement and retention of knowledge. When these methods are combined with flipped learning, where students explore content before class and then use class sessions for application and discussion, the result is a more interactive and student centered learning environment.

This paper presents a case study that explores the integration of a Regional Sewage Treatment Plant field trip with a bookend active learning session as part of an undergraduate environmental chemical engineering course. The aim is to assess the effectiveness of this combined approach in enhancing students' understanding of secondary wastewater treatment processes. By engaging students as operational decision-makers in a simulated scenario, the activity seeks to foster higher-order thinking, promote systems-level understanding, and link classroom content with professional practice. The study also contributes to the broader conversation on teaching innovation in engineering education, highlighting how carefully designed experiential and active learning opportunities can improve student outcomes in complex technical subjects. Through survey data, reflections, and learning assessments, this paper evaluates the impact of the learning intervention and offers recommendations for educators aiming to implement similar strategies in their courses.

2 MATERIALS AND METHOD

A total of 28 students enrolled in a Environmental Chemical Engineering course participated in this study. The students were part of a cohort that engaged in a flipped classroom approach, combining a field trip to a Regional Sewage Treatment Plant (RSTP) with a subsequent lecture on wastewater treatment processes. This cohort also participated in a bookend active learning activity, where they solved problems as operational plant managers in secondary wastewater treatment. Figure 11 shows the flow of the learning activity.

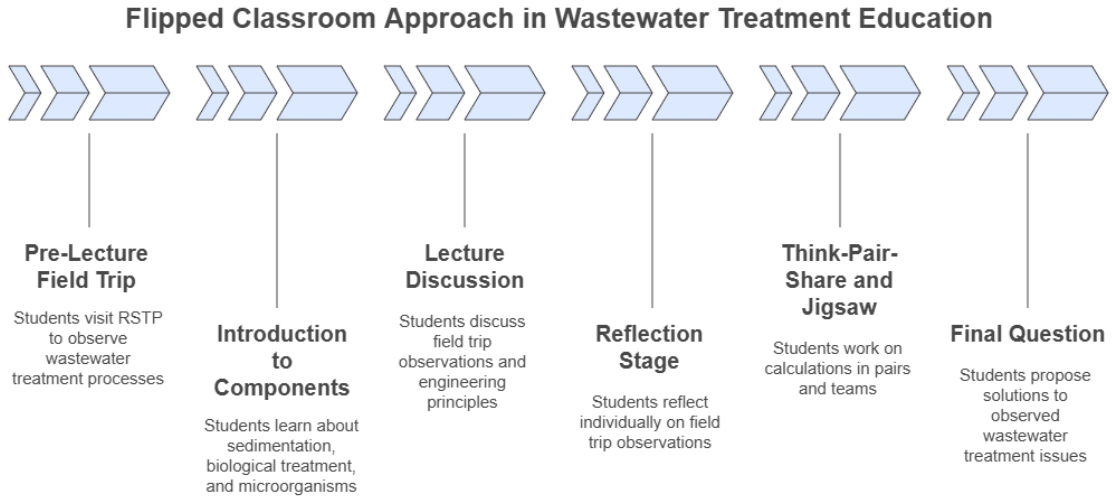


Figure 11 Learning activity of wastewater treatment

2.1 Survey Instrument

To evaluate the effectiveness of the flipped classroom approach and active learning activities, a survey was administered to all 28 students at the end of the lesson. The survey consisted of 12 Likert-scale questions, designed to assess the following dimensions:

i. Engagement and interest in the field trip and lecture
ii. Perceived relevance of the field trip to the lecture material
iii. Effectiveness of the bookend active learning activities in enhancing understanding
iv. Overall satisfaction with the flipped classroom approach
v. Confidence in applying knowledge to real-world scenarios

The Likert scale ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). Additionally, open-ended questions were included to capture qualitative feedback on student experiences and suggestions for improvement.

2.2 Principal Component Analysis (PCA)

To analyze the survey data, Principal Component Analysis (PCA) was employed. PCA was used to identify underlying patterns in the students' responses and to reduce the dimensionality of the survey data while retaining the most significant information. This approach allowed for the identification of key factors that contributed to the overall effectiveness of the flipped classroom and active learning activities. The Likert-scale responses were standardized to ensure that all variables had the same scale before performing PCA. PCA was conducted using a correlation matrix to determine the principal components that best explain the variance in the survey data. The PCA was executed using PCA calculator by Statistic Kingdom, and results were visualized using biplots to provide insights into the relationships between survey questions and student perceptions (*Principal Component Analysis Calculator*, 2017).

3 RESULTS AND DISCUSSION

This section presents and discusses the findings from the student survey conducted to evaluate the flipped classroom and active learning strategies implemented in the wastewater treatment module. The data were analysed using PCA to uncover underlying trends in student responses and to identify key dimensions that contributed to student engagement, perceived learning effectiveness, and satisfaction with the learning experience. The flipped classroom design which anchored by a field trip to the Regional Sewage Treatment Plant and reinforced through a bookend active learning session was intended to enhance student understanding of complex engineering processes by bridging theoretical concepts with practical applications (Cho et al., 2021). These pedagogical interventions reflect a commitment to educational excellence in the Fourth Industrial Revolution (4IR) era, which demands that graduates possess not only strong technical knowledge but also high-level cognitive skills, adaptability, and the ability to learn from real-world scenarios. The results of the survey provide insights into how students perceived the integration of experiential and problem-based learning methods, and their effectiveness in promoting critical thinking, collaboration, and real-world problem solving, all of which are essential competencies in the 4IR context. The survey results provide insight into how students perceived the integration of experiential and problem-based learning activities and their effectiveness in promoting critical thinking, collaboration, and real-world problem solving.

The PCA method allowed us to distil the multi-dimensional survey data into a few principal components that represent the most significant factors influencing student learning outcomes (Gewers et al., 2018). These components were then interpreted in the context of pedagogical strategies, providing a data-driven perspective on the impact of the flipped classroom model in an engineering education setting. In the following sections, we present the outcomes of the PCA, explore student response trends, and discuss how these findings align with or differ from existing literature on active learning in chemical engineering

education. We also reflect on student feedback, identifying both strengths and areas for improvement in the instructional design.

3.1 Conceptual understanding

A PCA was performed to investigate the dimensional structure of student responses to three survey items that aimed to evaluate conceptual understanding in a wastewater treatment course enhanced by flipped learning and a field trip. The items measured students' (1) understanding of concepts discussed in the lecture as supported by the field trip, (2) ability to connect real-world observations to theoretical content, and (3) perceptions of the flipped learning approach as more effective than traditional lectures. These measured items can be visualized in Figure 12.

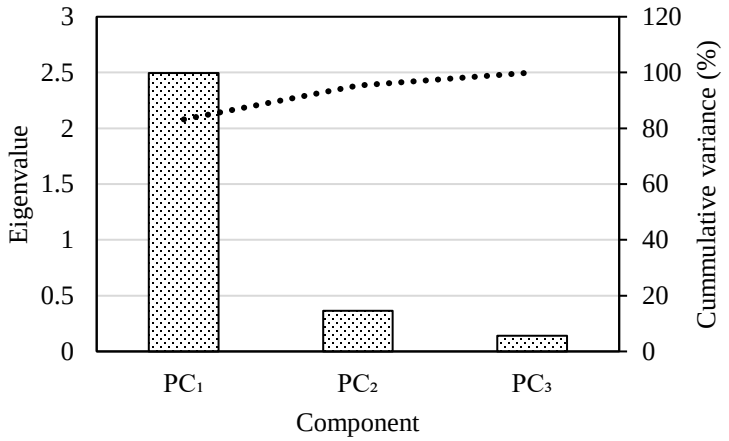


Figure 12 Conceptual understanding distribution and grouping

The PCA results indicated that the first principal component (PC_1) had an eigenvalue of 2.4957, explaining 83.19% of the total variance. The second and third components (PC_2 and PC_3) had eigenvalues of 0.3629 and 0.1413, explaining 12.10% and 4.71% of the variance, respectively. Cumulatively, the first two components accounted for 95.29% of the total variance, suggesting that while PC_1 captures the dominant underlying construct, there may be a secondary factor with a smaller, yet notable influence. The strong contribution of PC_1 suggests that the three items are closely linked and likely reflect a common construct: students' perceived improvement in conceptual understanding as a result of the course design. This finding supports the effectiveness of integrating field-based experiences with flipped classroom strategies in promoting meaningful learning of wastewater treatment concepts (Baytiyeh & Naja, 2017).

In the 4IR era, educational excellence is defined by the ability to foster deep conceptual understanding that transcends rote learning. The integrated use of flipped instruction and experiential fieldwork responds to this imperative by situating abstract engineering theories within authentic environmental and operational contexts. The presence of a moderate secondary component (PC_2) also highlights how diverse learning experiences resonate differently with students, further reinforcing the value of multimodal instructional strategies in cultivating holistic and adaptable engineers.

3.2 Application and analytical

Three survey items related to the effectiveness of an operational plant manager learning activity in a wastewater treatment context was conducted. The items assessed students' (1) confidence in applying wastewater treatment knowledge, (2) ability to analyze and interpret key plant data (such as MLSS, MLVSS, SVI, and F/M ratio), and (3) preparedness to apply wastewater treatment concepts in future

academic or professional settings. As shown in Figure 13, the PCA results revealed that only one principal component (PC_1) had an eigenvalue greater than 1, specifically an eigenvalue of 3. This component accounted for 100% of the total variance in the data, while the second and third components (PC_2 and PC_3) had eigenvalues of 0, contributing no additional variance. The cumulative variance explained by PC_1 was also 100%, indicating a highly unidimensional data structure.

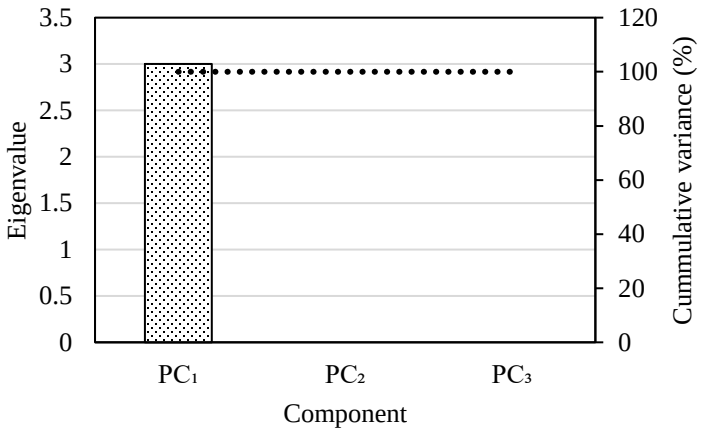


Figure 13 Application and analytical distribution and grouping

This result suggests that all three items are strongly correlated and represent a single latent construct. In this case, the dominant component likely reflects a shared perception of student self-efficacy in wastewater treatment application. The operational plant manager activity appears to have influenced students' confidence, analytical abilities, and sense of preparedness in a cohesive manner, rather than as isolated outcomes. From a pedagogical perspective, the emergence of a single dominant component reinforces the effectiveness of integrating real-world, experiential learning activities into environmental engineering education (Cheng et al., 2019; Wolf et al., 2023). The structured engagement with real plant data, role-play decision-making, and post-field trip reflection may have worked synergistically to enhance students' perceived competence. The unified nature of the responses indicates that students did not compartmentalize these learning outcomes, but rather experienced them as part of a comprehensive skill-building process.

These findings are particularly relevant to the 4IR era, where graduates must be capable of interpreting complex data, applying analytical tools, and making decisions in dynamic environments. By embedding role-based simulations and authentic data analysis into the curriculum, the module not only developed technical proficiency but also nurtured self-directed learning and decision-making under uncertainty, both of which are core to engineering practice in a data-driven world.

3.3 Critical thinking

To evaluate critical thinking development in the context of wastewater treatment education, student responses to two items was applied. The survey items focused on students' perceptions of (1) how the problem-solving activity improved their critical thinking skills and (2) how the learning activities offered practical insights applicable to real-world engineering scenarios. Figure 14 shows the PCA results that the first principal component (PC_1) had an eigenvalue of 1.8216, accounting for 91.08% of the total variance. The second component (PC_2) had a significantly lower eigenvalue of 0.1784, accounting for only 8.92% of the variance. The cumulative variance explained by the two components reached 100%.

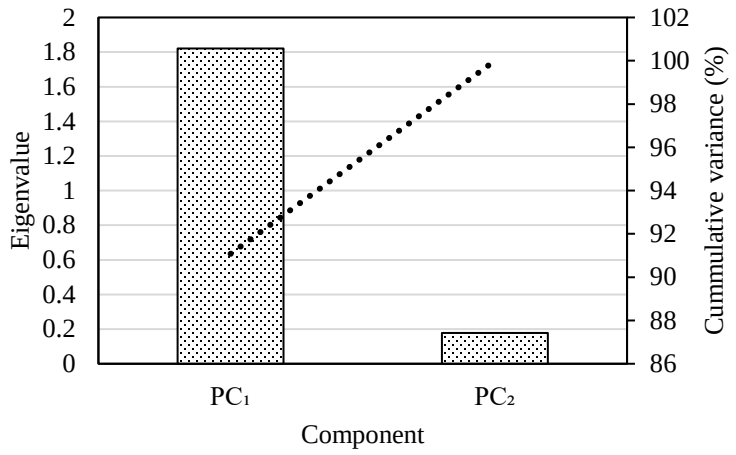


Figure 14 Critical thinking component distribution

These findings indicate a strong correlation between the two survey items, suggesting they primarily measure a single underlying factor that likely reflects students' perception of their critical thinking development and real-world applicability. The high proportion of variance explained by PC_1 indicates that students tended to perceive the problem-solving and practical elements of the learning activities as deeply interconnected. The findings highlight the importance of using authentic engineering scenarios within active learning settings to foster critical thinking, a vital skill in twenty-first century engineering education. The problem-solving activity likely enabled students to engage with complex wastewater treatment decisions while making relevant connections to professional contexts. This approach supports the development of analytical, reflective, and decision-making abilities essential for success in the rapidly evolving landscape of modern engineering practice. Such alignment between classroom tasks and industry-relevant challenges is crucial in preparing engineering students for real-world problem-solving.

In striving for educational excellence in the 4IR era, the development of critical thinking is a fundamental objective (Ahern et al., 2019). The problem-based learning elements in this module encouraged students to synthesize knowledge, assess competing options, and generate solutions that reflect real engineering challenges. The ability to think critically and reflectively is essential for engineers who must innovate and adapt in the face of technological disruption and environmental complexity.

3.4 Engagement and interest

Principal Component Analysis (PCA) was performed to evaluate student responses to two survey items under the theme of engagement and interest in environmental engineering. The items explored students' perceptions of (1) the overall engagement of the learning experience in combining field trip, lecture, and active learning activities and (2) how the field trip influenced their interest in environmental engineering topics. The PCA results revealed that the first principal component (PC_1) had an eigenvalue of 1.8216, accounting for 91.08% of the total variance. The second principal component (PC_2) accounted for the remaining 8.92%, with an eigenvalue of 0.1784. The cumulative variance explained by both components reached 100%, indicating that the two items share a strong underlying structure.

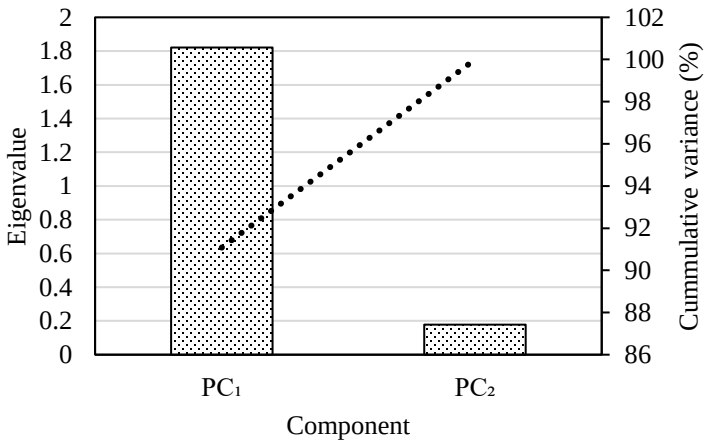


Figure 15 Engagement and interest distribution

The high percentage of variance explained by PC_1 suggests that both items are strongly correlated and tap into a single latent dimension, likely representing students' overall engagement and motivational response to the blended learning approach. This result implies that the combination of a field-based experience, theoretical instruction, and active learning not only deepened understanding, but also significantly enhanced student enthusiasm and interest in the subject. Educationally, this supports the assertion that engagement and motivation are heightened when learners are exposed to diverse, meaningful educational experiences. The field trip, serving as a tangible and immersive element, appears to have played a key role in sparking curiosity and fostering a stronger connection to environmental engineering. When paired with in-class activities and reflective learning, these experiences can form a compelling learning journey that sustains student interest.

In the context of the 4IR, educational excellence demands learning environments that are not only content-rich but also emotionally engaging and learner-centred. The PCA results in this section reinforce the importance of motivation and personal relevance in driving sustained learning (Cronin-Golomb & Bauer, 2022; Kember et al., 2008). The field trip, functioning as a tangible and immersive experience, appears to have been particularly effective in sparking curiosity and building a stronger emotional and intellectual connection to environmental engineering. When paired with in-class problem solving and reflective learning activities, these experiences foster intrinsic motivation, a vital component for nurturing lifelong learners who can thrive in fast-evolving, interdisciplinary fields.

By strategically designing instruction that promotes engagement through varied, meaningful experiences, this module aligns with 4IR educational priorities such as personalization, experiential learning, and student agency. The strong engagement responses underscore the value of educational strategies that go beyond knowledge delivery to actively cultivate student interest and professional identity in the engineering discipline.

3.5 General review

The PCA results strongly support the effectiveness of a blended instructional approach that integrates flipped learning with experiential, real-world exposure. The dominant principal components consistently reflect substantial gains in conceptual understanding, analytical capability, and critical thinking. Meanwhile, the presence of smaller secondary components suggests variation in how students internalized different aspects of the learning experience, pointing to the value of offering diverse pedagogical strategies to address varying learner needs.

Findings also confirm that the operational plant manager activity, as part of a broader flipped and field-based strategy, effectively cultivated a comprehensive sense of competence among students in

applying wastewater treatment knowledge. The clear alignment of responses around core constructs such as critical thinking and real-world relevance reinforces the strength of this instructional design in promoting deep, meaningful learning. Likewise, students reported high levels of engagement and sustained interest, underscoring the importance of curricular models that go beyond content delivery to actively motivate and immerse learners through applied and collaborative experiences.

One limitation of this study is the modest sample size (n = 28), which may affect the generalizability of the findings to broader student populations. Additionally, reliance on self-reported survey responses introduces the possibility of response bias, despite efforts to incorporate both quantitative and qualitative data for triangulation. Future research should aim to include a larger and more diverse student cohort and potentially complement self-reported outcomes with performance-based assessments or longitudinal tracking to evaluate long-term impacts of the instructional model.

4 CONCLUSIONS

These findings align with the broader goals of education in the 4IR, which emphasize the development of adaptable and future ready graduates equipped with critical thinking, problem solving, and collaboration skills. The blended learning model, grounded in experiential learning, real world relevance, and student centered engagement, reflects key educational principles of the 4IR. By exposing students to authentic engineering scenarios and encouraging active participation, this instructional approach supports the cultivation of both technical proficiencies, and the soft skills required in rapidly evolving and interdisciplinary work environments. Integrating such pedagogies into environmental engineering education ensures that learners are not only absorbing knowledge but also developing the mindset and capabilities needed for innovation and lifelong learning in a technology driven era.

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LMS in Substitute Blended Learning: The Effectiveness and Its Future Proof Mechanism

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ABSTRACT

The use of Learning Management Systems (LMS) in practicing substitute blended learning (SBL) has emerged as a transformative approach in language education, particularly for courses like English for Technical Communication (ETC). LMS platforms offer a structured environment for integrating face-to-face and online learning, enhancing accessibility, flexibility, and engagement. This study investigates the effectiveness of LMS-based SBL in ETC courses and explores mechanisms to ensure its long-term viability. The integration of technology in language learning is critical for equipping students with the technical communication skills required in a digitally evolving world. Despite the increasing adoption of LMS in education, research on its specific role in facilitating SBL for ETC courses remains limited. This study addresses this gap by asking: How effective is the use of LMS in SBL for ETC, and what strategies can ensure its sustainability and continuous improvement? A mixed-methods approach was employed, involving student surveys, interviews, and analysis of LMS usage data to evaluate effectiveness and identify areas for enhancement. The findings reveal that LMS-based SBL is effective in fostering independent learning and providing diverse resources, but challenges such as inconsistent usage, lack of interactive elements, and limited digital literacy hinder its potential. To future-proof this approach, the study recommends optimizing LMS features, incorporating interactive tools, ensuring robust technical support, and promoting ongoing feedback mechanisms. These insights contribute to the field by providing a framework for leveraging LMS in SBL while addressing challenges, ensuring inclusivity, and enhancing the learning experience. This study underscores the potential of LMS in sustaining a dynamic and impactful learning environment for ETC students.

KEYWORDS: Learning Management System, substitute blended learning, digital literacy, interactive education, educational sustainability, interactive learning tools.

1 INTRODUCTION

The increasing integration of technology into higher education has transformed how language courses are delivered, particularly in technical fields that demand precise communication skills (Terzioğlu & Kurt, 2022). Learning Management Systems (LMS) have become essential platforms for implementing substitute blended learning (SBL) models, which combine face-to-face and online instruction. In English for Technical Communication (ETC) specifically where accuracy, clarity, and context-specific conventions are paramount, LMS offer learners structured access to resources, assignments, and feedback, contributing to flexible and scalable pedagogy.

Despite the proven benefits of blended learning, relatively few studies have explored LMS-driven SBL specifically within ETC contexts. Research in English for Foreign Language (EFL) and general academic language courses shows increased satisfaction and engagement when LMS features are used thoughtfully (Ariawan et al., 2023; Abaricia & Delos Santos, 2023), yet its direct applicability to technical writing courses remains underexamined. This study addresses this gap by exploring both the practical outcomes and future-proof strategies needed to sustain LMS-supported SBL in ETC.

2 LITERATURE REVIEW

Learning Management Systems such as Moodle, Canvas, and Blackboard have become integral to blended learning, offering both asynchronous learning resources, for example discussion forums and resource repositories and synchronous materials like live quizzes and webinars tools that support student-centered learning (Carr Chellman et al., 2000). Research in EFL contexts demonstrates that LMS platforms enhance learner autonomy and motivation by providing structured, flexible learning environments (Ariawan et al., 2023). However, student engagement depends on several factors such as usability, interactivity, and technical readiness (Simelane-Mnisi & Mokgalaka-Fleischmann, 2023; Ariawan et al., 2023).

2.1 Effectiveness in Language and Technical Communication Courses

Empirical studies reveal that structured LMS environments lead to improved learning outcomes, particularly in listening and speaking proficiency (Terzioğlu & Kurt, 2022). However, evidence remains mixed in areas requiring specialized discourse, such as technical writing. A systematic review observed that LMS-driven blended learning often correlates with improved learner satisfaction, but its effectiveness depends on instructional design quality, including interactional features and feedback mechanisms (Abaricia & Delos Santos, 2023; Yıldız & Kurt, 2022).

2.2 Research Gaps

Most LMS research on language learning focuses on general academic or EFL settings, with fewer studies investigating specialized technical communication courses. Additionally, research often emphasizes either technology features or pedagogy rather than integrating both. Pre-2020 work (Kurata et al., 2018) suggested collaborative tools are essential for engineering education, but a holistic, integrated understanding of how LMS platforms support SBL in ETC remains limited.

3 METHODOLOGIES

3.1 Research Design

A convergent mixed-method design was chosen to triangulate quantitative and qualitative findings. Surveys provided broad data on frequency of LMS use, perceived usefulness, technical readiness, and satisfaction. Semi-structured interviews offered insight into experiences and improvement needs. Finally, LMS usage logs allowed analysis of actual engagement patterns across features.

3.2 Participants & Context

Participants were 80 undergraduate ETC students at a Malaysian technical university utilizing Moodle-based LMS during a 14-week semester. Participation was voluntary, with 72 completing the survey; 12 were interviewed.

3.3 Data Collection & Analysis

- **Surveys**: A 25-item questionnaire measured perceived usefulness, ease of use, digital literacy, self-regulation, and engagement. Items were adapted from TAM and blended learning scales with reliability ($\alpha > .80$).
- **Interviews**: 30-minute semi-structured interviews probed LMS feature experiences, technical challenges, and suggestions for improvement.
- **Usage Logs**: Moodle logs tracked login frequency, forum postings, quiz completions, and resource access.

Quantitative data were analysed using descriptive statistics and correlation analysis; qualitative data underwent thematic coding. Usage logs were analysed for feature utilization trends.

4 FINDINGS

4.1 Effectiveness of LMS-based SBL

A significant 85% of students reported that the LMS enhanced their ability to manage study schedules and learning pace. LMS usage logs corroborated this, showing frequent access to lecture materials, supplementary readings, and recorded sessions. These findings align with Ariawan et al. (2023), who observed that LMS-supported environments in speaking classes promoted learner autonomy and self-regulated learning. Similarly, Jiang and Peng (2023) found that learner autonomy, when supported by LMS tools, positively influenced engagement and academic performance in English language.

Student engagement with LMS interaction tools presented a mixed picture. While 60% of students posted at least once in discussion forums, 25% reported minimal or no participation. Moreover, interactive features such as quizzes, peer-reviewed assignments, and collaborative tools were underutilized, suggesting a gap in instructional design. This supports Simelane-Mnisi and Mokgalaka-Fleischmann's (2023) argument that effective engagement requires intentional integration of LMS tools aligned with pedagogical goals. Their study emphasized that LMS features must be embedded within authentic, real-world learning tasks to foster meaningful interaction.

Approximately 30% of students expressed low confidence in navigating LMS tools, while 20% encountered technical issues such as login failures or file upload errors. These challenges mirror those reported in EFL contexts during the pandemic, particularly in Vietnam and Saudi Arabia, where digital literacy gaps and infrastructure limitations hindered LMS adoption. The findings underscore the need for targeted digital skills training and robust technical support to ensure equitable access and effective LMS use.

4.2 Future Proof Mechanisms

Emerging from interviews, students suggested that the integration of Learning Management Systems (LMS) into classroom settings significantly influenced their learning experiences, particularly in terms of accessing course materials, tracking progress, and engaging in interactive activities. They emphasized that LMS tools facilitated better organization, timely feedback, and more flexible communication with instructors, ultimately enhancing the overall effectiveness of the classroom environment.

To foster deeper engagement and facilitate more effective learning, the LMS should incorporate a range of interactive features. These may include embedded quick quizzes that provide immediate formative feedback, peer review mechanisms to encourage collaboration and critical thinking, and integrated assignment rubrics that clearly communicate assessment criteria. By making these elements readily accessible within the LMS interface, both students and instructors benefit from greater transparency and ease of use, ultimately enhancing the overall learning experience.

Reliable technical support and comprehensive training are essential to ensure the effective use of LMS platforms. This can be achieved through the provision of weekly tutorial sessions either live or recorded, along with detailed how-to guides tailored to common user needs. Additionally, maintaining accessible help desks, whether through chat, email, or in-person support, allows students and faculty to resolve issues promptly. This ongoing support infrastructure not only boosts user confidence but also minimizes disruptions to the teaching and learning process.

Building a responsive and adaptive learning environment requires regular feedback loops. Implementing mid-semester polls or reflective tasks allows educators to gather insights into student experiences, challenges, and suggestions. This timely feedback enables instructional teams to make informed adjustments to content delivery, pacing, or support mechanisms before the course concludes. Such a feedback-oriented approach reinforces a culture of continuous improvement and responsiveness, which can significantly enhance learner satisfaction and outcomes.

To keep pace with evolving educational technologies, it is vital to integrate innovative tools that enrich the learning experience. The incorporation of microlearning modules short and focused segments of content can cater to varied learning styles and provide flexibility for learners with different schedules. Additionally, immersive tools such as augmented reality (AR) or virtual reality (VR) experiences can be introduced via Learning Tools Interoperability (LTI) standards to ensure seamless integration within the LMS. These emerging technologies not only enhance interactivity but also offer novel ways to present complex concepts more effectively.

5 DISCUSSION

The results affirm that LMS-based SBL supports student-centred learning by facilitating flexibility and access. Challenges remain, such as underused interactive tools, technical barriers, and digital skills gaps. These findings are consistent with broader LMS research showing that perceived interactivity and ease-of-use significantly influence adoption (Demir et al., 2024; Simelane-Mnisi & Mokgalaka-Fleischmann, 2023).

5.1 Implications

To ensure the sustained success of LMS-based SBL in ETC, several strategic actions must be considered:

One of the most impactful ways to enhance student engagement and learning outcomes is by embedding interactive and collaborative features within the LMS. Tools such as quizzes, in-line annotations, discussion boards, and peer-review systems not only promote active learning but also foster a sense of community among learners. These features should be intentionally aligned with course objectives and assessment strategies to ensure pedagogical coherence. Research has shown that when students are

given opportunities to interact meaningfully with content and peers, their motivation and retention significantly improve (Simelane-Mnisi & Mokgalaka-Fleischmann, 2023).

Digital literacy remains a critical barrier for many students, particularly in contexts where exposure to educational technologies is limited. To address this, institutions should implement structured scaffolding mechanisms, including orientation sessions, step-by-step tutorials, and ongoing digital skills workshops. These initiatives can empower students to navigate LMS platforms confidently and independently. Moreover, embedding digital literacy into the curriculum can normalize technology use and reduce anxiety associated with digital learning environments (Jiang & Peng, 2023).

Technical issues, such as login failures or file upload errors, can disrupt learning and discourage LMS use. To mitigate these challenges, institutions should establish robust technical support systems. This could include peer mentoring programs where digitally proficient students assist their peers, as well as dedicated IT helpdesks that provide timely troubleshooting. Ensuring that students have access to reliable support not only enhances their learning experience but also builds trust in the institution's digital infrastructure.

To future-proof LMS-based learning, institutions should explore the integration of emerging technologies such as microlearning modules, gamified content, and immersive tools like virtual or augmented reality. These tools can be embedded into LMS platforms using LTI standards, allowing seamless access and data tracking. Aligning these innovations with pedagogical goals as proposed in recent 2023 frameworks can enrich the learning experience and cater to diverse learner preferences and needs.

By implementing these strategies, educational institutions can ensure that their LMS-based SBL models remain relevant, resilient, and responsive to evolving educational demands. These systems not only support improved literacy outcomes in ETC programs but also contribute to a more inclusive and future-ready learning ecosystem.

6 CONCLUSIONS

This study has shown that LMS play a crucial role in implementing SBL effectively within ETC courses. The findings confirm that LMS platforms enhance flexibility, promote learner autonomy, and offer diverse learning resources that are well-aligned with the needs of today's digital-native students. However, the study also reveals significant areas that require attention namely, limited interactivity, inconsistent usage, and varying levels of digital literacy among students. These limitations hinder the full potential of LMS-based SBL and highlight the need for targeted interventions.

To ensure long-term success and sustainability, it is essential for educational institutions to adopt a proactive approach. This includes integrating interactive tools within LMS platforms, providing ongoing technical and digital literacy support, and incorporating continuous feedback mechanisms. Furthermore, future-proofing strategies such as the adoption of adaptive learning technologies, immersive content, and mobile-compatible platforms can strengthen student engagement and learning outcomes.

Ultimately, this research contributes to the growing body of knowledge on technology-enhanced language education by offering actionable insights into optimizing LMS use in ETC. By addressing existing gaps and strategically enhancing LMS functionalities, educators and institutions can foster a more inclusive, engaging, and future-ready learning environment for students in technical communication and beyond.

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The Impact Of Flipped Classroom Method In Teaching The Simple Present Tense: A Case Study At Kolej Poly-Tech MARA Ipoh

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ABSTRACT

This research investigates the effectiveness of the flipped classroom approach in enhancing the teaching and learning of the Simple Present Tense among English language learners. The study was conducted by comparing the performance of two groups of students: a control group, which received instruction through traditional teacher-centred methods, and an experimental group, which experienced a flipped classroom model. In the flipped approach, students were given access to instructional materials such as video lessons and guided notes prior to class, allowing them to familiarize themselves with the content at their own pace. Classroom time was then used for interactive activities, such as discussions, grammar exercises, and peer collaboration, to reinforce what they had learned independently. To evaluate the impact of the teaching methods, both groups were administered a pre-test to assess their initial understanding of the Simple Present Tense, followed by a post-test to measure any improvement after the intervention. The results demonstrated a significant increase in the post-test scores of the experimental group compared to the control group, suggesting that the flipped classroom strategy had a more positive effect on students' grasp of grammatical rules and usage. These findings indicate that the flipped classroom not only enhances students' comprehension of specific grammar topics but also promotes greater engagement, autonomy, and active learning. By shifting the focus from passive reception to active participation, this approach encourages students to take more responsibility for their learning and supports continuous learning beyond the confines of the classroom environment.

KEYWORDS: Flipped Classroom, Grammar instruction, Simple Present Tense, reinforcement,

1.0 INTRODUCTION

1.1 Background of Study

Technology now plays a vital role in education, significantly shaping teaching and learning practices. The integration of modern technology has transformed classroom instruction, primarily aiming to support students in attaining the best possible learning outcomes. Innovations in educational technology

have shifted conventional teaching methods into more engaging and flexible approaches. These technological improvements not only raise the quality of instruction but also provide customized learning opportunities that cater to individual student needs (EDUCASE Learning Initiative, 2012; Abdelouahed, 2019).

With the expansion of technology-enhanced learning, we are seeing a surge in digital learning management systems (LMS), immersive simulations, and educational platforms like Google Classroom, Moodle, and Khan Academy. These tools deliver accessible, interactive content that gives students real-world learning opportunities while also making lessons more captivating. They foster student engagement and encourage both critical and creative thinking (Anghelo Josué et al., 2023). For instance, the use of Augmented Reality (AR) and Virtual Reality (VR) in language classes enables students to experience real-life scenarios in virtual spaces, helping them practice communication without fear of peer judgment (Zhao, Ren & Cheah, 2023). Students can engage in virtual activities such as ordering at a restaurant or asking for directions, allowing them to use vocabulary and expressions in relevant and meaningful contexts.

Moreover, digital collaboration platforms like Google Docs and Padlet offer spaces for students to share their ideas, give feedback, and develop their language skills remotely. These tools support collaborative learning and help students enhance their communication skills while engaging in group-based language projects. They can, for example, co-author narratives or prepare presentations in the target language, facilitating the exchange of ideas and feedback. These collaborative tools not only increase active student involvement but also support effective language acquisition through engaging and meaningful interaction.

In tandem with these technological tools, the Flipped Classroom (FC) model is gaining recognition as an innovative teaching strategy (Zheng et al.). Traditionally, teaching happens in-class with the teacher presenting content while students listen passively, followed by independent homework. The FC model reverses this process—students first learn new material at home via pre-recorded videos and digital resources, allowing for self-paced learning. In-class time is then used for practical application, discussions, and group tasks that enhance understanding. This model not only makes better use of classroom time but also increases student accountability and fosters a more participatory and student-centred atmosphere. When merged with tech-based instruction, the flipped classroom approach boosts learner motivation and involvement, creating a learning experience that suits the demands of modern education. Class periods are spent on applying knowledge through activities and collaboration, making learning more personalized and effective for 21st-century learners.

1.2 Research Problem

Grammar serves as a tool for understanding how language functions (Saaristo, 2015). In English, grammar especially the simple present tense forms a critical base for clear communication. As it is usually the first tense taught to learners, mastering the simple present enables them to express daily routines, habitual actions, general truths, and facts. It is the most frequently used tense to convey universal truths, whether in spoken or written form, making it more demanding to master than other tenses. Nevertheless, a solid understanding of this tense supports the acquisition of other tenses, while weak mastery can hinder overall grammatical development. Thus, fluency in the simple present tense enhances learners' ability to engage in fluid, natural conversations and boosts their confidence in speaking.

In traditional grammar teaching, however, the classroom is largely teacher-centered, with teachers delivering content while students remain passive listeners (Nazmi Dinçer & Mustafa Polat, 2022). To consolidate their knowledge, students are usually tasked with practicing on their own at home, which limits active engagement and meaningful application of grammar concepts. This teacher-dominated approach often results in passive learning. Research suggests that such passive learning, common in traditional

grammar instruction, can reduce students' ability to retain grammar rules and apply them in real-life situations (Nazari & Xodabande, 2020). These limitations have prompted educators to seek more engaging instructional methods. A notable alternative is the flipped classroom approach, in which students study the material in advance using pre-recorded lessons and online tools, then apply what they've learned through interactive, practical activities during class. Studies have shown that this approach not only increases student involvement but also deepens their understanding of complex grammar structures through collaborative and hands-on learning (Lo & Hew, 2020).

1.3 Research Objective and Research Question

This study is therefore designed to investigate whether the flipped classroom model can be effectively utilized for teaching English as a second language (ESL), with particular attention to the simple present tense. While the flipped classroom has shown success in other academic fields, its application in language education especially in grammar instruction remains relatively underexplored. Recent studies indicate that this approach can support active language engagement and improve grammar learning by offering students more time in class for practice and feedback (Jensen et al., 2022). Moving the instructional content outside of class allows students to study grammar rules at their own pace, while in-class sessions can be used for communicative tasks involving the simple present tense in meaningful situations.

In this research, the aim is to assess whether the flipped classroom can increase learners' motivation and participation in grammar learning, as well as enhance their understanding and use of the simple present tense in authentic communication. Targeting future Diploma in TESL students at Kolej Poly-Tech Mara Ipoh, the study will examine how this instructional model can be tailored to suit ESL learners who frequently struggle with grammar. Thus, the research will be guided by the following two questions:

RQ1: Is there a significant difference in the mastery of the simple present tense between students taught using the Flipped Classroom Approach and those taught through traditional methods?

RQ2: How do students perceive learning the simple present tense through the flipped classroom method?

The results of this study are expected to offer practical recommendations for educators interested in innovative teaching techniques in ESL settings and to support further research into effective grammar instruction approaches.

2.0 LITERATURE REVIEW

The flipped classroom is a modern and creative instructional method in which lessons are delivered outside the traditional classroom using online video lectures that the teacher prepares ahead of the scheduled class session. These recordings are thoughtfully created to align with the lesson goals and may help enhance students' understanding and performance in the subject. It is worth noting that the content isn't restricted to videos; audio lectures can also be employed as a main or additional material (Bergmann & Sams, 2012). In this model, class time, which is normally dedicated to direct teaching, is repurposed into hands-on learning sessions where students participate in group tasks aimed at strengthening their grasp of the material they studied earlier. This method promotes active participation and meaningful learning, as students are encouraged to connect prior knowledge to real-life situations. Hence, the teacher transitions from being the primary source of knowledge to a guide or mentor, supporting learners in becoming more independent. This transformation enhances not only content mastery but also nurtures essential 21st-century skills such as critical thinking and problem-solving (Bye, 2017).

The simple present tense plays a fundamental role in English grammar, representing routines, habits, and factual statements. However, many studies show that traditional approaches often rely on

teacher-led instruction, where classroom time is used to explain grammar rules, leaving students to practice alone at home. This practice often results in passive learning, with learners facing difficulty in applying grammar knowledge to real communication (Nazari & Xodabande, 2020). On the other hand, the flipped classroom aims to cultivate more active learning by having students explore the material before class and apply it through active engagement during the lesson. This shift can improve learners' ability to use grammar more effectively in actual conversations.

Among the many benefits of using the flipped classroom for grammar instruction is the flexibility it provides. Students are able to access complex grammar content anytime and revisit it at their own pace. Lo and Hew (2020) highlighted that such access to videos and lessons outside the classroom helps learners review difficult concepts multiple times, enabling them to come to class with foundational knowledge, ready to apply what they've learned. With regard to the simple present tense, learners can first learn the rules via online content, and then engage in classroom activities like role-playing, peer discussions, and constructing sentences. This hands-on strategy improves their retention and understanding of grammar as it is used in meaningful interactions.

Mehring (2017) found that flipped classroom strategies are highly effective in grammar teaching. Students involved in this method showed greater participation and comprehension than those taught through conventional techniques. His study noted that learners felt better equipped for class discussions and demonstrated increased confidence in using the simple present tense correctly in both spoken and written formats. Furthermore, the real-time practice and feedback available in flipped classes helped students improve their grammar accuracy significantly.

Still, while the flipped classroom shows promise, it comes with its own set of difficulties. Learners must be accountable for studying materials before class, which can be a challenge for students accustomed to teacher-led environments. A study by Chen Hsieh, Wu, and Marek (2017) found that although flipped instruction boosted learner motivation and independence, some students had trouble adjusting to self-paced study, especially if they lacked personal discipline. However, once learners became familiar with this approach, they gained from increased active learning and opportunities to engage with peers.

In a recent study, Akçayır and Akçayır (2018) analyzed how flipped classrooms benefit students learning English and observed improvements not only in their grammar knowledge but also in their speaking and writing skills. The study underlined that the flipped model promotes peer collaboration, which is essential in acquiring a new language. For instance, when students collaborated on simple present tense exercises like sentence-building, they helped correct one another's mistakes, enhancing understanding through group learning. This cooperative setting allowed learners to deepen their grammatical knowledge by applying it in practical contexts.

Another important strength of the flipped classroom is its incorporation of technology, which further boosts student interest in grammar instruction. Recent research by Jensen et al. (2022) indicates that digital resources such as grammar games, interactive quizzes, and videos make learning more enjoyable and engaging. These digital tools support students' understanding of the simple present tense by offering simulations and structured exercises to reinforce learning. Technology, therefore, plays a vital role in enhancing the flipped classroom experience by providing a variety of tools to support grammar learning inside and outside the class.

To sum up, the flipped classroom has proven to be an effective method for improving students' grasp of the simple present tense. It allows learners to access instructional materials at their convenience and transform classroom time into active, collaborative practice sessions. This method not only increases engagement and fosters deeper understanding but also enhances accuracy in grammar use. However, the model's success relies on students' commitment to pre-class preparation and the thoughtful integration of technology in the learning process. As more studies investigate its outcomes, the flipped classroom continues to offer promising avenues for enhancing grammar instruction in language learning contexts.

3. METHODOLOGY

3.1 Research Design

This study employs a mixed-methods approach, combining quantitative and qualitative research designs to evaluate the effectiveness of the flipped classroom in teaching the simple present tense at Kolej Poly-Tech MARA Ipoh. The integration of both methods allows for a comprehensive understanding of how the flipped model influences student outcomes, engagement, and learning experiences. The quantitative portion focuses on assessing student achievement through tests and surveys, while the qualitative part explores students' perspectives on how the flipped classroom assists them in comprehending the simple present tense. Using both methods provides a holistic evaluation of the flipped classroom's impact on grammar instruction.

3.2 Quantitative Design

The quantitative phase of the research aims to determine how effective the flipped classroom approach is in improving students' mastery of the simple present tense. A quasi-experimental design was implemented, involving two separate groups of participants: one control group that received traditional grammar instruction, and one experimental group that learned through the flipped classroom approach. Each group consisted of 36 prospective Diploma in TESL students from Kolej Poly-Tech MARA Ipoh. The six-week intervention allowed students enough time to adjust to the teaching methods and provided sufficient data for analysis.

By comparing the results between the control and experimental groups, this study aims to assess whether the flipped classroom method is more effective than traditional methods in helping students master the simple present tense. The findings are expected to provide valuable insights into how different instructional strategies influence grammar learning and can inform future teaching practices and curriculum planning.

Both groups took a pre-test at the start of the study to assess their initial knowledge of the simple present tense. The experimental group was given instructional content such as video lectures to study outside class, while class sessions were used for interactive and practical grammar activities. In contrast, the control group followed a conventional format where grammar rules were explained in class and homework was assigned for reinforcement. A post-test was administered to both groups after the six-week period to assess learning gains. The scores from both the pre- and post-tests will be statistically analysed to determine if a significant difference exists between the two teaching approaches.

3.3 Qualitative Design

The qualitative component of this study investigates the perceptions of students who experienced the flipped classroom method. A case study design will be applied to gain in-depth feedback from those in the experimental group.

To answer the study's second research question, a set of questionnaires adapted from Bell (2015) and Johnson (2013) was distributed to 10 students from the flipped classroom group. These questionnaires aimed to collect detailed feedback regarding the students' learning experience with the simple present tense under the flipped model. The frameworks from Bell and Johnson helped guide the questionnaire to assess both cognitive and affective factors, including how the flipped method influenced student understanding, motivation, and engagement.

The questions focused on prior knowledge, interest levels, engagement during lessons, and student views on how the flipped classroom compared to traditional instruction. It also aimed to find out how the method affected students' ability to apply grammar knowledge in real-life scenarios. Feedback from these

responses offered a deeper look at how the flipped approach supported language development and grammar comprehension.

Additionally, semi-structured interviews were conducted with selected students from the experimental group using purposive sampling. These interviews explored the students' reflections on the flipped classroom, including perceived advantages and limitations, and how the approach impacted their grasp of the simple present tense. All interviews were recorded, transcribed, and analysed thematically to uncover insights related to student engagement, interaction, and learning processes.

3.4 Data Analysis

3.4.1 Quantitative Data Analysis

The pre-test and post-test scores will be analysed using paired sample t-tests to compare the mean scores between the two groups (control and experimental) and to determine if there is a statistically significant improvement in the experimental group. Additionally, descriptive statistics (mean, median, and standard deviation) will be used to summarize the test scores.

3.4.2 Qualitative Data Analysis

For the qualitative data, thematic analysis will be applied to the interview transcripts. Thematic analysis involves identifying recurring themes and patterns that emerge from the data. The transcripts will be coded using both inductive and deductive coding methods, allowing for the discovery of both predetermined and emerging themes. These themes will then be organized into categories related to student perceptions with regard to the effectiveness of the flipped classroom model, and any challenges encountered during the learning process.

By integrating both quantitative and qualitative data, this study will provide a holistic understanding of the effectiveness of the flipped classroom in teaching the simple present tense. The quantitative data will offer measurable insights into students' learning outcomes, while the qualitative data will provide deeper insight into the experiences and perceptions that may influence these outcomes.

4 FINDINGS AND DISCUSSION

4.1 Quantitative Analysis

This section interprets the quantitative data gathered from the study on the effectiveness of the flipped classroom model in teaching the simple present tense.

4.1.1 Pre-Test Versus Post-Test

The first quantitative analysis focused on comparing the pre-test and post-test scores of two groups of students before and after the implementation of the flipped classroom technique. The results of the pre-test and post-test of the control group are summarised in Figure 4.1.

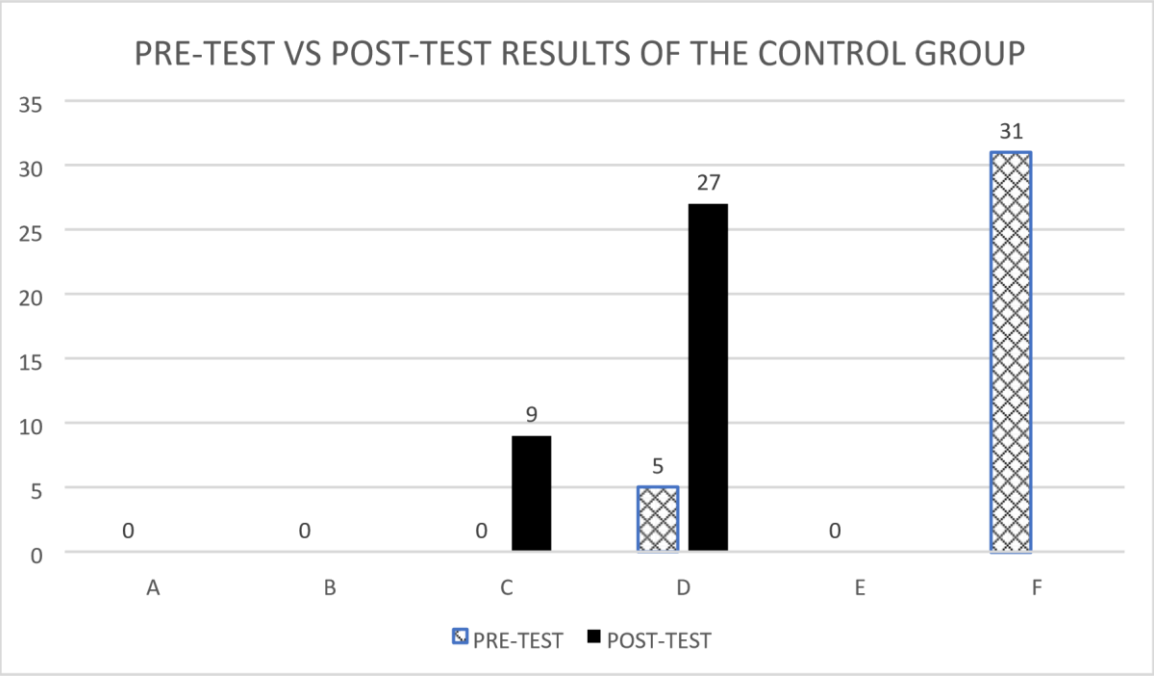


Figure 4.1. The results of the pre- and post-test of the control group.

Prior to the intervention using the flipped classroom method, the control group exhibited notable difficulties with the simple present tense, as evident in the pre-test outcomes. Among the 36 students, none secured a grade A or B. Only 5 students attained a grade C, and another 5 received a grade D. A significant majority 31 students were placed in the lowest category, scoring a grade F.

Following the intervention, the control group's post-test results revealed some improvement. Although no students reached grade A or B, a shift in achievement levels was observed. The number of students who obtained a grade C rose from 5 to 9, while those earning a grade D increased substantially from 5 to 27. Notably, no students remained at grade F, reflecting a modest yet positive effect of the teaching strategy, despite the continued concentration in the lower grade spectrum.

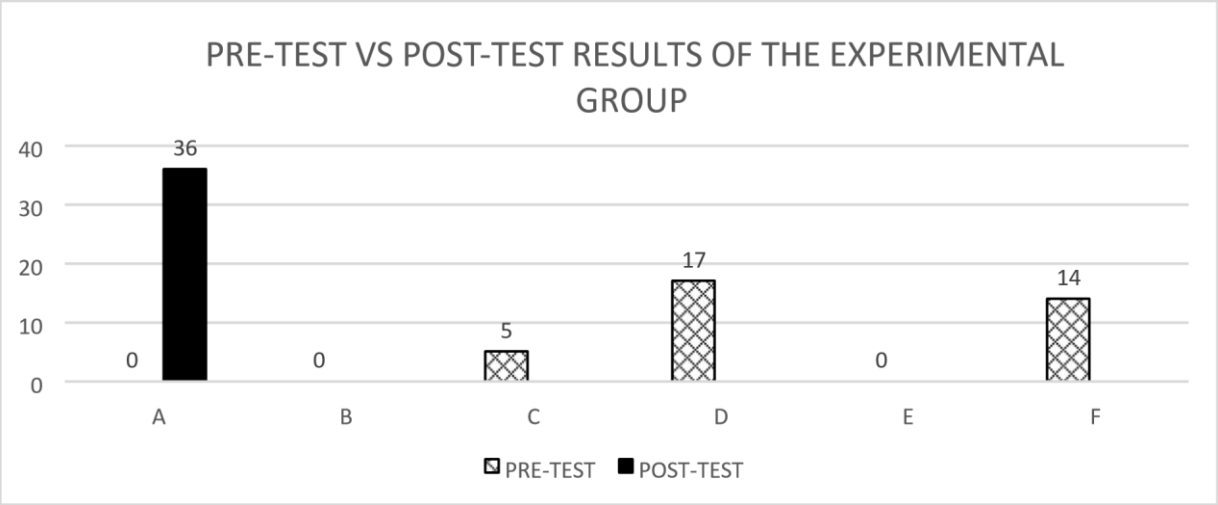


Figure 4.2. The results of the pre- and post-test of the experimental group.

The experimental group's pre-test results, taken before implementing the flipped classroom method, showed that no students obtained a Grade A or B. Only five students earned a Grade C, reflecting a minimal and partial understanding of the simple present tense. Most students 17 in total received a Grade D, suggesting a weak understanding of the topic. Additionally, 14 students failed with a Grade F, indicating serious gaps or misconceptions in their knowledge of the simple present tense.

Following the flipped classroom intervention, however, the post-test outcomes showed a significant improvement. A total of 36 students scored a Grade A, indicating strong proficiency in the simple present tense.

4.1.2 Normality Test Results

Table 4.1. The result of the Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Score on Test Before Class	1	.242	36	.000	.886	36	.001
	2	.229	38	.000	.896	38	.002
Score on Test After Class	1	.438	36	.000	.580	36	.000
	2	.410	38	.000	.648	38	.000

To assess data normality, the Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted. All groups recorded p-values below 0.05, indicating a deviation from normal distribution. As a result of this violation, non-parametric alternatives were applied: the Wilcoxon Signed-Rank Test for paired pre- and post-test comparisons, and the Mann-Whitney U Test for independent group comparisons.

Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test yielded a p-value under 0.05 (p=0.000), prompting the rejection of the null hypothesis. This result confirms a significant difference between pre-test and post-test scores, indicating that the flipped classroom approach positively influenced student outcomes.

Mann-Whitney U Test

The p-value from comparing the pre-test scores of both groups was 0.453, suggesting no significant difference in their initial performance levels. This shows that both groups had comparable understanding before implementing the flipped classroom strategy.

The p-value for the post-test results was 0.000, indicating a significant difference in performance between the groups after the intervention. This provides strong support that the flipped classroom approach led to substantial gains for the experimental group over the control group.**4.1.3 Descriptive Statistics**

Table 4.2. Descriptive Analysis

Statistics

		Score on Test Before Class	Score on Test After Class
N	Valid	74	74
	Missing	0	0
Mean		4.65	9.91
Median		5.00	12.00
Mode		5	7[a]
Std. Deviation		1.026	2.597

a. Multiple modes exist. The smallest value is shown

The descriptive statistics presented in Table 4.2 further reinforce the findings. The mean score rose from 4.65 before using the flipped classroom to 9.91 afterward, indicating a notable improvement in student achievement. Similarly, the median increased from 5.00 to 12.00, showing that the majority of students performed better following the use of the flipped classroom strategy. The mode shifted from 5 to 7, implying that more students scored around 7 after the intervention compared to lower scores previously. The standard deviation grew from 1.026 to 2.597, indicating greater variation in student outcomes post-implementation. This wider range of scores suggests that while many students progressed, the level of improvement varied, with some excelling while others struggled.

To conclude, the numerical data confirms the flipped classroom model's success in improving students' understanding of the simple present tense. The marked increases in mean and median scores,

along with supporting statistical evidence, demonstrate that this teaching approach had a positive impact. Yet, the higher spread of results points to the need for extra help for certain students to maximize their gains from the method. Overall, the results underscore the flipped classroom's promise in enhancing language learning achievements.

4.3 Qualitative Analysis

4.3.1 Results from Questionnaire

A set of questionnaires adapted from Bell (2015) and Johnson (2013) were given to 36 pupils in the experimental group to answer the second research question of this study and the results are shown in Table 4.3 below.

Table 4.3. Analysis of students' perceptions towards Flipped Classroom Approach

No.	Item	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
1	Flipped Classroom Approach is more engaging than the lessons I had before.	0.00% 0	0.00% 0	0.00% 0	33.00% 12	67.00% 24
2	Flipped Classroom Approach has improved my mastery of simple present tense.	0.00% 0	0.00% 0	0.00% 0	50.00% 18	50.00% 18
3	I am interested to acquire simple present tense in Flipped Classroom Approach.	0.00% 0	0.00% 0	0.00% 0	55.00% 20	45.00% 16
4	I like to learn at home and do the "homework" in the classroom.	00.00% 0	0.00% 0	0.00% 0	44.00% 16	56.00% 20
5	I could study at my own pace in Flipped Classroom Approach.	0.00% 0	0.00% 0	0.00% 0	33.00% 12	67.00% 24
6	Flipped Classroom Approach encourages me to work with my classmates actively.	0.00% 0	0.00% 0	42.00% 0.00% 0	15	68.00% 21
7	I communicated with my teacher more often in Flipped Classroom Approach.	0.00% 0	0.00% 2	0.00% 0	55.00% 20	45.00% 16
8	I was able to apply what I have learnt in the Flipped Classroom Approach into real life settings.	0.00% 0	6.00% 2	0.00% 0	56.00% 20	38.00% 14
9	I needed academic and technical assistance in Flipped Classroom Approach.	31.00% 11	19.00% 7	0.00% 0	25.00% 9	25.00% 9

10	Overall, I prefer learning simple present tense via Flipped Classroom Approach compared to traditional approach.	0.00% 0	0.00% 0	0.00% 0	42.00% 15	58.00% 21

Table 3 presents the analysis of the survey results for the flipped classroom approach in teaching the simple present tense reveals several key insights:

Mastery Improvement: An equal number of students (50%) strongly agreed and 50% agreed that the flipped classroom helped them improve their understanding of the simple present tense. No students disagreed or were unsure, indicating a shared perception of the method's positive influence on learning.

Interest in Learning: Regarding their interest in learning the simple present tense using the flipped model, 55% of students agreed and 45% strongly agreed. This demonstrates a generally high level of enthusiasm towards this teaching method among the students.

Learning Preferences: A majority (56%) strongly agreed that they enjoyed learning at home and doing activities in class, while 44% agreed. This suggests that students appreciated the flipped model, where they prepare lessons at home and apply knowledge during classroom sessions.

Self-Paced Learning: A total of 67% strongly agreed that the flipped approach allowed them to learn at their own pace, while 33% agreed. This reflects how the method provided students with autonomy and adaptability in their learning journey.

Collaboration with Classmates: Around 68% of students strongly agreed and 42% agreed that the flipped classroom promoted collaboration with peers. This indicates that the model successfully encouraged cooperative learning.

Communication with Teacher: When asked about interactions with their teacher, 45% strongly agreed and 55% agreed that they communicated more often in the flipped classroom, showing an increase in teacher-student engagement.

Real-Life Application: About 38% of students strongly agreed and 56% agreed that they could relate their learning to real-life contexts. However, 6% disagreed, showing a small gap in how well the knowledge translated to practical usage.

Need for Assistance: Interestingly, 31% of students strongly disagreed and 19% disagreed that they needed academic or technical help in the flipped setting, indicating many felt capable of learning independently. Still, 25% agreed and another 25% strongly agreed that they required assistance, highlighting differing levels of support needed.

Overall Preference: Lastly, 58% of students strongly agreed and 42% agreed that they preferred learning the simple present tense through the flipped model over conventional lessons. This shows a dominant preference for the flipped approach over traditional methods.

In summary, the findings reveal high engagement, stronger grasp of grammar, and a clear preference for the flipped model when learning the simple present tense. Although some students did need support, most found the approach to be flexible, interactive, and effective.

4.3.2 Results from the Semi-structured Interview

To explore students' personal insights and experiences learning the simple present tense through the flipped classroom, ten students were selected for individual semi-structured interviews. The aim was to gather deeper perspectives on how this model influenced their grammatical understanding, comfort in learning, and overall process. The interviews were transcribed verbatim and examined using thematic analysis. Several main themes surfaced, revealing students' deeper connection to the material, improved learning outcomes, and better mastery of the topic.

(i) Deeper Understanding of the Simple Present Tense

One clear theme that emerged was the students' belief that they had achieved a better grasp of the simple present tense. All five interviewees shared that watching lesson videos before class allowed them to understand the rules at a pace that suited them. This self-paced stage gave them the chance to absorb the material, making in-class tasks more beneficial. Students came to class prepared with prior knowledge, ready to strengthen their skills through hands-on learning. One student commented, "I could really focus on the rules at my own pace, and when I came to class, I was ready to practice, which made me understand the simple present tense much better."

(ii) Comfortable Learning in Their Own Space

Another key finding was the comfort students felt learning at their own pace and in a familiar environment. The flipped method gave them flexibility to learn in a relaxed way, which boosted their overall comfort. Several students said they valued the option to pause, rewind, and rewatch the videos as needed—something not possible during live teaching. This made them feel more in charge of their own learning. One student shared, "I liked being able to learn at home. I could watch the video more than once and pause it when I didn't understand, which made learning grammar less stressful."

(iii) Interactive and Fun Reinforcement Activities

The students also frequently highlighted how fun and interactive the in-class tasks were. After reviewing materials at home, class time was used for applying knowledge in enjoyable and collaborative activities. Many students felt this made learning more effective and exciting. Games, group tasks, and creative role plays were mentioned as ways they practiced using the simple present tense. One student reflected, "The class activities were fun and interactive. I felt like I was really learning, not just listening. It made using the simple present tense more natural."

(iv) Strengthened Mastery of the Simple Present Tense

Finally, all five students confirmed that their confidence and mastery in using the simple present tense had increased thanks to the flipped approach. They highlighted that applying rules during class, instead of only memorizing them, helped strengthen their knowledge. The practical tasks and immediate feedback in class gave them a clearer understanding. One student stated, "I feel much more confident using the simple present tense now because I practiced it so much during class. The flipped classroom helped me really get it."

5 CONCLUSION

This study examined the effectiveness of the flipped classroom model in teaching the simple present tense to ESL students. The quantitative analysis revealed a significant improvement in student performance, as indicated by increases in mean, median, and mode scores, and a greater mastery of the simple present tense post-intervention. The qualitative data further highlighted students' positive perceptions, including a deeper understanding of the grammar concept, comfort in learning at their own pace, and increased engagement through interactive activities. Together, these findings demonstrate that the flipped classroom is a valuable instructional approach that enhances both comprehension and practical application of grammatical rules in language learning.

5.1 Limitations

Despite the positive outcomes, the study encountered several limitations. First, the sample size for the qualitative interviews was limited to five students, which may not fully represent the broader student population. Additionally, the variability in student performance, as indicated by the increase in standard deviation, suggests that while some students excelled with the flipped classroom approach, others may have required additional support. Finally, the study focused only on the simple present tense, limiting its findings to a specific grammar point, which might not be fully generalizable to other aspects of language learning.

5.2 Implications for Further Research

Future research should consider expanding the sample size to include a more diverse range of students, which may provide more comprehensive insights into the flipped classroom's effectiveness across different learner profiles. Investigating how to provide additional support for students who may struggle with selfdirected learning in the flipped model would also be valuable. Furthermore, exploring the flipped classroom's impact on other grammatical concepts or language skills, such as writing or speaking, could offer a broader understanding of its effectiveness in ESL instruction. Additionally, incorporating longitudinal studies could assess the long-term retention and practical use of grammar rules learned through this method.

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Kesan Penggunaan Kaedah Wow-PEP Flipped Classroom (WPFC) terhadap Pencapaian Pembelajaran Kursus Mata Pelajaran Umum (MPU) Dalam Kalangan Pelajar Diploma

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ABSTRAK

Kajian ini bertujuan untuk mengkaji kesan penggunaan kaedah *Wow-PEP Flipped Classroom* (WPFC) terhadap pencapaian pembelajaran kursus Mata Pelajaran Umum (MPU) dalam kalangan pelajar diploma. Reka bentuk kajian adalah secara kuasi-eksperimen dengan melibatkan ujian pra dan pasca. Seramai 99 pelajar diploma telah dipilih sebagai sampel kajian untuk membandingkan prestasi antara kumpulan eksperimen dan kumpulan kawalan. Kumpulan eksperimen menerima intervensi WPFC, manakala tiga kumpulan kawalan menerima intervensi masing-masing melalui kaedah *Traditional Classroom* (TC), *Flipped Classroom* (FC), dan *Wow-PEP Classroom* (WPC). Data dikumpulkan melalui ujian pra dan pasca bagi kursus MPU2183 Penghayatan Etika dan Peradaban (PEP). Oleh kerana bilangan sampel bagi setiap kumpulan adalah kurang daripada 30, data dianalisis menggunakan ujian bukan parametrik, iaitu *Wilcoxon Signed Ranks Test*, untuk mengenal pasti perbezaan skor pencapaian yang signifikan secara statistik. Hasil analisis menunjukkan peningkatan skor yang signifikan dalam semua kumpulan selepas intervensi, dengan WPFC mencatatkan nilai median tertinggi yang melebihi purata, menandakan taburan data condong ke kiri dan menunjukkan lebih ramai pelajar memperoleh markah yang tinggi. Dapatan ini membuktikan bahawa penggunaan kaedah pengajaran berasaskan teknologi seperti flipped classroom dan platform kolaboratif Wow-PEP mampu meningkatkan pencapaian pelajar secara signifikan. Teknologi bukan sahaja meningkatkan penglibatan pelajar dalam pembelajaran, malah menyokong persekitaran pembelajaran yang lebih fleksibel, interaktif dan berpusatkan pelajar. Oleh itu, integrasi teknologi dalam bilik darjah wajar diteruskan sebagai pendekatan pedagogi masa hadapan yang efektif.

KATA KUNCI: Wow-PEP Flipped Classroom, Teknologi Pendidikan, Pencapaian Pelajar, Pengajaran Inovatif, Mata Pelajaran Umum

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1 PENGENALAN

Dalam era Revolusi Industri 4.0, institusi pendidikan tinggi di Malaysia, termasuk Kolej Poly-Tech MARA (KPTM) Ipoh, berhadapan dengan cabaran untuk memastikan keberkesanan pengajaran subjek Penghayatan Etika dan Peradaban (MPU). Subjek ini bertujuan untuk membentuk pelajar yang beretika dan berperadaban tinggi, selaras dengan aspirasi Falsafah Pendidikan Kebangsaan. Namun, pendekatan konvensional sering kali gagal menarik minat pelajar, menyebabkan penglibatan yang rendah dan pencapaian yang tidak memuaskan. Oleh itu, terdapat keperluan untuk meneroka pendekatan pedagogi inovatif yang dapat meningkatkan keberkesanan pengajaran dan pembelajaran subjek ini (Bahador, et al., 2018).

Salah satu pendekatan yang semakin mendapat perhatian ialah gamifikasi, iaitu penggunaan elemen permainan dalam konteks bukan permainan untuk meningkatkan motivasi dan penglibatan pelajar. Kajian oleh Nur Zaakirah Abd Hamid et al. (2024) mendapati bahawa gamifikasi dapat memotivasikan pelajar dan meningkatkan minat mereka dalam pembelajaran bahasa Arab, yang boleh diaplikasikan dalam subjek lain seperti MPU. Aplikasi seperti Kahoot! dan Quizizz membolehkan tenaga pengajar mencipta kuiz interaktif yang menjadikan pembelajaran lebih menyeronokkan dan berkesan . Selain itu, pendekatan flipped classroom, di mana pelajar mempelajari kandungan secara kendiri sebelum sesi kelas, membolehkan masa kelas digunakan untuk aktiviti yang lebih interaktif dan kolaboratif. Kajian oleh Bahador et al. (2018) menunjukkan bahawa flipped classroom meningkatkan penglibatan dan pencapaian pelajar dalam subjek Matematik Tingkatan 4 .

Integrasi teknologi dalam pengajaran dan pembelajaran memainkan peranan penting dalam merealisasikan pendekatan gamifikasi dan flipped classroom. Penggunaan platform seperti Google Classroom, Microsoft Teams, dan aplikasi interaktif lain membolehkan pengajaran yang lebih fleksibel dan berpusatkan pelajar. Menurut artikel di Sinar Bestari (2024), teknologi digital menyokong pelbagai pedagogi moden yang menggalakkan penglibatan aktif dan kolaboratif pelajar . Di KPTM Ipoh, penerapan teknologi dalam pengajaran subjek MPU dapat meningkatkan keberkesanan pembelajaran dan membantu pelajar menghayati nilai-nilai etika dan peradaban dengan lebih mendalam

1.1 Pernyataan Masalah

Kursus Mata Pelajaran Umum (MPU) merupakan satu komponen wajib dalam kurikulum pengajian tinggi di Malaysia yang bertujuan untuk membentuk pelajar yang seimbang dari segi intelek, sahsiah dan nilai kemanusiaan. Namun begitu, pengajaran kursus ini – terutamanya kursus seperti *Penghayatan Etika dan Peradaban (PEP)* – sering dilihat sebagai satu kursus yang bersifat teoritikal, pasif dan kurang menarik minat pelajar. Hal ini kerana, kaedah tradisional yang berpusatkan pensyarah dan berorientasikan kuliah menyebabkan pelajar tidak melibatkan diri secara aktif dalam proses pembelajaran dan seterusnya menjejaskan pencapaian dan penghayatan terhadap kandungan nilai dan etika yang cuba disampaikan (Hashim, Sharifuddin & Ibrahim, 2023).

Pendekatan yang lebih fleksibel, interaktif dan berasaskan teknologi yang boleh menyokong pembelajaran kendiri dan kolaboratif sangat diperlukan oleh para pelajar, terutamanya di dalam konteks Pendidikan era Revolusi Industri 4.0. Oleh itu, untuk meningkatkan penglibatan pelajar, kaedah *Flipped Classroom (FC)* telah muncul sebagai satu pendekatan pedagogi yang dapat membantu untuk meningkatkan prestasi akademik dan pemahaman konsep melalui pembelajaran aktif di dalam kelas serta akses kendiri kepada bahan pembelajaran di luar kelas. Walau bagaimanapun, kekurangan motivasi kendiri di dalam kalangan pelajar, interaksi yang terbatas dan penggunaan teknologi yang tidak menyeluruh menjadikan pelaksanaan kaedah ini sering berhadapan dengan cabaran. Selain itu, kepelbagaian faktor seperti latar belakang para pelajar yang berbeza, kekangan masa dan juga tahap kefahaman juga boleh mempengaruhi hasil pembelajaran (Wahidah et al., 2025).

Sebagai respons kepada cabaran ini, pendekatan inovatif seperti ***Wow-PEP Flipped Classroom (WPFC)*** diperkenalkan dengan menggabungkan model *flipped classroom* dan elemen kolaboratif dan

kreatif **Wow-PEP** – iaitu sebuah platform berasaskan teknologi yang menyokong pembelajaran kendiri, kolaboratif dan nilai murni. WPFC dirangka untuk memperkukuhkan penglibatan para pelajar dengan menyediakan persekitaran pembelajaran yang lebih bermakna, menyeronokkan dan berkesan. Namun begitu, keberkesanan kaedah ini dalam konteks pengajaran kursus MPU masih belum dikaji secara menyeluruh, khususnya dalam kalangan pelajar diploma.

Sehubungan itu, kajian ini dijalankan untuk menilai secara sistematik kesan penggunaan kaedah WPFC terhadap pencapaian pembelajaran kursus MPU, dengan menumpukan kepada komponen kognitif pelajar dalam mata pelajaran *Penghayatan Etika dan Peradaban*. Kajian ini penting bagi mengenal pasti sama ada pendekatan WPFC mampu mengatasi kelemahan kaedah tradisional dan meningkatkan pencapaian serta penglibatan pelajar dalam pembelajaran nilai, etika dan peradaban yang merupakan asas penting dalam membentuk jati diri generasi muda masa kini.

1.2 Objektif Kajian

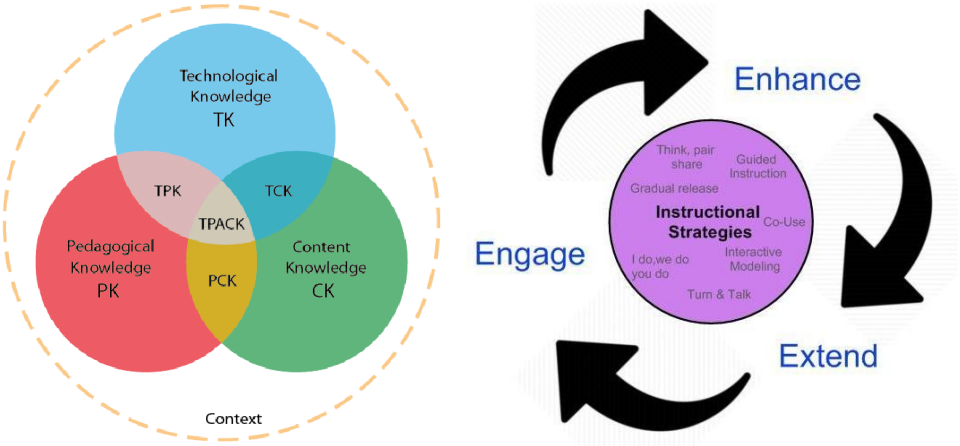
Berdasarkan isu-isu yang telah dibangkitkan dalam perbincangan sebelum ini, tujuan utama kajian ini adalah untuk dalam kalangan pelajar diploma. Objektif kajian ini adalah:

1. Mengkaji kesan penggunaan kaedah *Wow-PEP Flipped Classroom* (WPFC) terhadap pencapaian pembelajaran kursus Mata Pelajaran Umum (MPU) dengan membandingkan min pencapaian sebelum dan selepas rawatan bagi WPFC
2. Membandingkan prestasi antara kumpulan eksperimen *Wow-PEP Flipped Classroom* (WPFC) dan kumpulan kawalan *Traditional Classroom* (TC), *Flipped Classroom* (FC), dan *Wow-PEP Classroom* (WPC).

Objektif kajian ini akan memandu kajian dalam menjawab persoalan kajian dan mencapai matlamat keseluruhan kajian.

2 KAJIAN LITERATUR

2.1 Kerangka Teori



Gambarajah 1: Kerangka Teori

Komponen utama dalam WPFC terdiri daripada integrasi teknologi, pedagogi dan pengajaran efektif (TPACK) dan hubungan teknologi dengan pengalaman pelajar (Triple E Framework). TPACK adalah singkatan dari *Technological Pedagogical Content Knowledge*. Ini adalah sebuah kerangka kerja

(framework) yang menggambarkan pengetahuan yang diperlukan oleh guru untuk mengajar secara efektif dengan menggunakan teknologi. TPACK terdiri dari tiga komponen utama: Content Knowledge (CK) iaitu pengetahuan tentang penguasaan pelajaran itu sendiri. Pedagogical Knowledge (PK) iaitu pengetahuan tentang kaedah dan proses mengajar dan Technological Knowledge (TK) iaitu pengetahuan tentang cara menggunakan berbagai teknologi pengajaran. Hasil gabungan adalah TPACK itu sendiri, iaitu pemahaman yang kompleks tentang bagaimana mengintegrasikan teknologi dengan pedagogi dan pelajaran secara harmoni dalam proses pembelajaran. Secara ringkasnya, TPACK membantu guru berfikir tentang bagaimana memilih dan menggunakan teknologi dengan cara yang sesuai dengan bahan dan strategi mengajar mereka.

Triple E Framework adalah kerangka kerja yang digunakan untuk menilai keberkesanan penggunaan teknologi dalam pembelajaran. Triple E dikembangkan oleh Dr. Liz Kolb dan fokus pada tiga aspek penting yang harus dipertimbangkan saat menggunakan teknologi dalam pendidikan, iaitu Engage (Melibatkan), Enhance (Meningkatkan) dan Extend (Memperluas). Gabungan TPACK dan Triple E Framework di sebalik pelaksanaan WPFC menghasilkan kaedah pengajaran yang berfokus pada pengetahuan guru dan kesan penggunaan teknologi terhadap pencapaian pembelajaran.

2.2 Kerangka Konsep



Gambarajah 2: Kerangka Konsep

Gambarajah 2 menunjukkan pemboleh ubah bebas iaitu WPFC adalah intervensi atau pendekatan yang digunakan dalam pengajaran. Wow-PEP merujuk kepada kaedah pengajaran semasa kelas dalam bentuk *flipped classroom*, iaitu pembelajaran di mana pelajar mengakses kandungan sebelum kelas dan kelas digunakan untuk aktiviti aplikasi gamifikasi. Pemboleh Ubah Pengantara iaitu Motivasi Pelajar. Penggunaan Wow-PEP Flipped Classroom dijangka mempengaruhi motivasi pelajar merangkumi tahap dorongan dalaman dan minat pelajar terhadap pembelajaran. Motivasi ini menjadi pengantara (perantara) yang menghubungkan antara intervensi (Wow-PEP) dengan hasil pembelajaran. Pemboleh Ubah Bersandar, akhirnya pencapaian pelajar menjadi kesan yang diukur. Pencapaian ini diharapkan meningkat melalui perubahan pada motivasi pelajar yang didorong oleh penggunaan Wow-PEP Flipped Classroom. Ini bermaksud intervensi teknologi, WPFC tidak terus mempengaruhi pencapaian pelajar. Sebaliknya, ia mempengaruhi motivasi pelajar, dan seterusnya motivasi inilah yang mempengaruhi pencapaian.

2.2 Gamifikasi dalam Pengajaran dan Pembelajaran

Pengajaran dan pembelajaran (PdP) berasaskan gamifikasi menerapkan elemen permainan seperti ganjaran, persaingan, dan cabaran ke dalam konteks bukan permainan, termasuk dalam pendidikan. Penggunaan gamifikasi bertujuan adalah untuk meningkatkan motivasi, penglibatan, dan pencapaian pelajar dalam sesuatu kursus. Dalam tempoh lima tahun kebelakangan ini, terdapat peningkatan minat terhadap penggunaan gamifikasi dalam pengajaran dan pembelajaran di pelbagai peringkat pendidikan.

Kajian oleh Nur Zaakirah Abd Hamid et al. (2024) meninjau keberkesanan penggunaan gamifikasi dalam pengajaran dan pembelajaran bahasa Arab. Hasil kajian mendapati bahawa penggunaan aplikasi seperti *Wordwall, Quizziz, Kahoot,* dan *Quizlet* dapat memotivasikan pelajar dan meningkatkan minat mereka terhadap pembelajaran bahasa Arab. Namun, penggunaan gamifikasi masih belum dioptimumkan secara menyeluruh kerana masih ramai pendidik yang menggunakan kaedah konvensional dalam penyampaian pengajaran mereka.

Abu Bakar (2024) pula meneliti keberkesanan pembelajaran gamifikasi dalam kursus perakaunan. Kajian ini menunjukkan bahawa pendekatan gamifikasi dapat meningkatkan prestasi akademik dan sikap positif pelajar terhadap subjek perakaunan. Pelajar lebih bermotivasi dan menunjukkan minat yang lebih tinggi apabila elemen permainan diterapkan dalam pembelajaran.

Kajian oleh Nurfatin Hayati Azmi & Zarima Mohd Zakaria (2024) melibatkan guru pelatih di Universiti Pendidikan Sultan Idris (UPSI) semasa menjalani latihan mengajar di sekolah. Kajian mendapati bahawa pengetahuan guru pelatih mengenai gamifikasi adalah tinggi dan mereka berpendapat bahawa kaedah gamifikasi memberi kesan positif dalam melaksanakan penilaian terhadap pelajar serta memudahkan penyampaian pengajaran di dalam bilik darjah. Guru pelatih juga berpendapat bahawa penggunaan gamifikasi menarik minat pelajar dan selari dengan aspirasi Pelan Pembangunan Pendidikan Malaysia (PPPM). Hal ini disokong oleh hasil dapatan kajian Fathi dan Khadijah (2021) yang menunjukkan tahap minat dan penerimaan pelajar terhadap penggunakaan kaedah gamifikasi semasa PdPc berada pada tahap tinggi.

Kajian oleh Nur Safina Azim et al. (2024) di Universiti Kebangsaan Malaysia meneliti pandangan pelajar terhadap pelaksanaan gamifikasi di kampus. Hasil kajian menunjukkan bahawa pelajar menganggap gamifikasi sebagai medium penyampaian yang efektif, meningkatkan minat mereka terhadap pembelajaran, dan memperkukuh pengetahuan teknologi mereka. Gamifikasi juga dianggap selari dengan ciri pelajar masa kini yang terdedah kepada kemajuan teknologi maklumat.

Berdasarkan kajian-kajian yang telah dibincangkan, jelaslah bahawa gamifikasi dalam PdP mempunyai potensi besar dalam meningkatkan motivasi, penglibatan, dan pencapaian pelajar dalam pelbagai bidang pendidikan. Namun, untuk memastikan keberkesanan dan kelestarian penggunaan gamifikasi, pendidik perlu merancang dengan teliti, mengambil kira pandangan pelajar, serta mempertimbangkan aspek etika dan cabaran yang mungkin timbul.

2.3 Kaedah Flipped Classroom dan WOW

Penglibatan pelajar merujuk kepada tahap keterlibatan dalam pelbagai dimensi seperti penglibatan tingkah laku, emosi, dan kognitif. Menurut kajian oleh Alebrahim & Ku (2020), pendekatan flipped classroom diterima dengan baik oleh pelajar, yang mendapati bahawa kaedah ini secara efektif meningkatkan penglibatan mereka, pemahaman terhadap pelajaran, dan akhirnya membawa kepada prestasi dan gred yang lebih baik. Wong (2024) mendapati bahawa pelaksanaan model flipped classroom menghasilkan peningkatan yang ketara dalam kemahiran kalkulus selepas intervensi, dengan keberkesanan yang berterusan yang diperhatikan sepanjang masa. Oleh itu, penemuan ini menunjukkan bahawa model flipped classroom lebih sesuai untuk membangunkan kemahiran kognitif. Oleh itu, disarankan untuk mengintegrasikan model flipped classroom ke dalam institusi pengajian tinggi untuk meningkatkan persediaan pelajar menghadapi cabaran yang akan datang dalam bidang sains dan teknologi.

Penglibatan emosi merangkumi sikap, minat, dan respons emosi pelajar terhadap pembelajaran. Kajian oleh Lee dan Wallace (2018) mendapati bahawa pelajar dalam flipped classroom melaporkan tahap

minat dan motivasi yang lebih tinggi kerana aktiviti dalam kelas lebih interaktif dan menarik berbanding kuliah tradisional. Namun, kajian ini juga mencatatkan bahawa kejayaan flipped classroom dalam meningkatkan penglibatan emosi bergantung sepenuhnya pada kualiti bahan pre-kelas dan reka bentuk aktiviti dalam kelas. Analisis respons pelajar memberikan bukti tentang semangat yang ditunjukkan oleh pelajar terhadap aktiviti pembelajaran yang dijalankan dalam flipped classroom. Ini dikaitkan dengan pengetahuan yang sudah ada yang diperoleh sebelum sesi kelas. Akibatnya, pelajar menunjukkan kesiapsiagaan yang lebih tinggi untuk terlibat dalam perbincangan kelas, menyertai tugas pembelajaran dengan penuh semangat, dan menunjukkan kebolehan untuk mengkaji secara bebas (Sunway, Arapah & Muth'im, 2024).

Penglibatan kognitif merujuk kepada pelaburan dalam pembelajaran dan kesediaan untuk memberi usaha yang diperlukan untuk memahami idea-idea yang kompleks. Kajian oleh Say dan Yildirim (2020) menunjukkan bahawa flipped classroom menggalakkan penglibatan kognitif yang lebih mendalam, kerana pelajar diminta untuk secara aktif memproses dan menerapkan pengetahuan yang mereka peroleh daripada bahan pre-kelas. Hao, Tian, Mohd, Hai, Ge & Cheng (2024) mendapati bahawa kajian mereka menunjukkan bahawa pembelajaran berasaskan projek dan flipped classroom mempunyai pengaruh yang besar dalam meningkatkan pemikiran kritis dan merangsang kreativiti dalam kalangan pelajar. Selain itu, gabungan pembelajaran berasaskan projek dan flipped classroom menunjukkan kesan yang lebih ketara dalam mempromosikan kemahiran berfikir kritis dan memupuk kreativiti, menunjukkan potensinya sebagai kaedah pengajaran yang sangat berkesan untuk mengubah kurikulum dan amalan pengajaran semasa. Kajian komprehensif ini dengan bijaksana menggabungkan pelbagai aktiviti bilik darjah yang menarik dan interaktif, yang direka untuk meningkatkan pemikiran kritis, penyelesaian masalah, dan kebolehan membuat keputusan dalam kalangan pelajar dalam konteks pendidikan vokasional tinggi. Selain itu, ia menawarkan panduan yang komprehensif dan praktikal kepada pendidik dan pemimpin pengajaran, menerangkan strategi berkesan untuk mengenal pasti, memupuk, dan membangunkan pelbagai bakat dan kebolehan yang terdapat dalam bidang pendidikan ini.

Model flipped classroom bertujuan untuk meningkatkan penglibatan pelajar dan hasil pembelajaran dengan memindahkan fokus masa kelas daripada pembelajaran pasif kepada pembelajaran aktif. Walau bagaimanapun, meskipun terdapat kelebihan-kelebihan yang berpotensi, pelaksanaan flipped classroom menghadapi beberapa cabaran dan halangan yang boleh mempengaruhi keberkesanannya. Kajian menunjukkan bahawa motivasi dan kesiapsiagaan pelajar adalah faktor penting yang mempengaruhi kejayaan flipped classroom (Zhong, 2024). Selain itu, penilaian dan evaluasi terhadap model flipped classroom boleh menjadi kompleks. Kaedah penilaian tradisional mungkin tidak dapat mengukur sepenuhnya faedah pendekatan ini, seperti kemahiran menyelesaikan masalah yang dipertingkatkan atau pemahaman yang lebih mendalam terhadap kandungan. Oleh itu, pembangunan alat dan kaedah penilaian yang sesuai adalah penting untuk mengukur impak flipped classroom terhadap hasil pembelajaran pelajar (Zhu, Zhu & Hua, 2024). Terdapat beberapa isu utama berkaitan dengan pelaksanaan model flipped classroom, yang menekankan keperluan untuk penyelidikan dan pembangunan lanjut bagi memaksimumkan keberkesanannya.

3 METODOLOGI KAJIAN

3.1 Sampel Kajian

Kajian ini menggunakan teknik pensampelan mudah di mana penyelidik menjalankan tinjauan ke atas pelajar di dalam kelas mereka kerana mereka mudah diakses dan sedia ada (Doebel & Frank, 2024). Selain itu, ia mudah dilaksanakan kerana penyelidik juga merupakan pensyarah kelas, maka akses kepada responden adalah cepat, mudah dan menjimatkan kos. Seramai 99 orang pelajar diploma semester 4 dari Kolej Poly-Tech MARA Ipoh telah dipilih untuk kajian ini. Mereka mengambil kursus MPU2183 Penghayatan Etika dan Peradaban bagi sesi November 2024. Pelajar dibahagikan secara rawak kepada empat kumpulan berdasarkan pendekatan pengajaran yang berbeza: WPFC (n=26), FC (n=25), WPC

(n=23) dan TC (n=25). Kesetaraan antara kumpulan telah disahkan berdasarkan skor ujian pra. Pada akhir kajian, semua peserta melengkapkan ujian pasca yang sama.

3.2 Pengumpulan Data

Tujuan utama kajian ini adalah untuk mengkaji kesan penggunaan kaedah *Wow-PEP Flipped Classroom* (WPFC) terhadap pencapaian pembelajaran kursus Mata Pelajaran Umum (MPU) dalam kalangan pelajar diploma. Reka bentuk penyelidikan kuasi-eksperimen telah digunakan, yang melibatkan pelaksanaan strategi bilik darjah terbalik serta pengumpulan dan analisis data kuantitatif bagi menilai kesannya terhadap penguasaan teori pengetahuan dalam pendidikan tinggi.

3.3 Prosedur Kajian

Jadual 1 merumuskan prosedur pengajaran bagi setiap kumpulan.

Jadual 1: Prosedur Kajian

Kaedah	Sebelum kelas	Semasa kelas	Selepas kelas
WPFC	Menonton video pembelajaran dalam talian dan merujuk modul pembelajaran.	Melengkapkan tugasan di platform Wow-PEP dan dipantau oleh pensyarah.	Slaid penyelesaian dikongsikan untuk perbincangan kelas.
WP		Mengikuti kuliah dan mencatat nota.	Melengkapkan tugasan di platform Wow-PEP dan dipantau oleh pensyarah.
FC	Menonton video pembelajaran dalam talian dan merujuk modul pembelajaran.	Melengkapkan tugasan dan dipantau oleh pensyarah.	Slaid penyelesaian dikongsikan untuk perbincangan kelas.
TC		Mengikuti kuliah dan mencatat nota.	Melengkapkan tugasan sebagai kerja rumah.

4 DAPATAN DAN PERBINCANGAN

Statistik Deskriptif – membandingkan skor pencapaian antara TC, FC, WPC dan WPFC

Jadual 2: Perbandingan skor pencapaian

Report						
Achievement						
Method	Mean	N	Std. Deviation	Median	Z	Asymp. Sig. (2-tailed)
FC	5.2200	25	2.46255	4.5000	4.554[b]	.000
TC	4.2200	25	1.12805	4.0000	4.290[b]	.000
WPC	4.6957	23	2.61438	4.5000	4.200[b]	.000

WPFC	4.9615	26	2.39968	5.2500	4.462[b]	.000
Total	4.7778	99	2.22259	4.5000	a. Wilcoxon Signed Ranks Test	

Dari Jadual 2, didapati Kelas Terbalik (FC) mempunyai purata skor tertinggi (5.22), ini menunjukkan pencapaian terbaik keseluruhan 25 sampel manakala Kelas Tradisional (TC) dengan purata skor terendah (4.22) dengan sisihan piawai yang rendah (1.13) menunjukkan skor berkelompok rapat dan konsisten. Kelas Wow-PEP (WPC) mempunyai sisihan piawai tertinggi (2.61) dan ini mencadangkan ketidakstabilan dalam pencapaian 23 sampel manakala TC sisihan piawai terendah menunjukkan lebih keseragaman dalam pencapaian.

Kelas Wow-PEP Terbalik (WPFC) mempunyai median tertinggi (5.25) yang lebih tinggi daripada purata skor menunjukkan taburan pencong kiri di mana markah tinggi lebih banyak. Berdasarkan statistik deskriptif, FC dan WPFC menunjukkan pencapaian lebih baik secara keseluruhan. Namun WPFC memerlukan kajian lebih mendalam kerana nilai kebolehubahan yang tinggi berkemungkinan atas faktor perbezaan dalam konteks, pengajaran atau penilaian.

Wilcoxon Signed Rank – menentukan keberkesanan kaedah pengajaran dan pembelajaran kursus MPU

Jadual 3: Skor Z

METHOD	Z	Asymp. Sig. (2-tailed)
TC	4.554[b]	.000
FC	4.290[b]	.000
WPC	4.200[b]	.000
WPFC	4.462[b]	.000
a. Wilcoxon Signed Ranks Test		
b. Based on positive ranks.		

Nilai p bagi setiap kaedah adalah 0.000 (<0.001) menunjukkan menunjukkan bahawa keputusan tersebut adalah signifikan secara statistik, yang bermaksud terdapat kemungkinan besar bahawa perbezaan yang diperhatikan bukan disebabkan oleh kebetulan.

Keempat-empat kaedah (TC, FC, WPC dan WPFC) menunjukkan perbezaan yang signifikan secara statistik antara sampel berpasangan. Jika ini adalah daripada ujian pra dan pasca atau dua keadaan yang dibandingkan, anda boleh dengan yakin menyatakan bahawa intervensi atau perubahan tersebut mempunyai kesan yang signifikan ke atas setiap pemboleh ubah. Namun, hasil kajian menunjukkan bahawa pemilihan kaedah pengajaran (FC, TC, WPC, WPF) tidak memberi kesan yang signifikan terhadap tahap pencapaian pelajar.

Secara keseluruhan hasil kajian menunjukkan bahawa kelas Wow-PEP Terbalik (WPFC) paling dominan berbanding kaedah pembelajaran yang lain berdasarkan analisis deskriptif. Hasil analisis menunjukkan peningkatan skor yang signifikan dalam semua kumpulan selepas intervensi, dengan WPFC mencatatkan nilai median tertinggi yang melebihi purata, menandakan taburan data condong ke kiri dan menunjukkan lebih ramai pelajar memperoleh markah yang tinggi. Seterusnya, kaedah pengajaran FC dan WPFC menunjukkan pencapaian yang lebih baik daripada keseluruhan kaedah pembelajaran. Namun, hasil kajian untuk menentukan keberkesanan kaedah pengajaran dan pembelajaran menunjukkan bahawa pemilihan keadah pengajaran (FC, TC, WPC, WPF) tidak memberi kesan yang signifikan terhadap tahap pencapaian pelajar. Interpretasi kepada hasil kajian tersebut menunjukkan bahawa penggunaan kaedah pengajaran berasaskan teknologi seperti flipped classroom dan platform kolaboratif Wow-PEP mampu

meningkatkan pencapaian pelajar secara signifikan. Hal ini menunjukkan bahawa para pelajar lebih berminat untuk melaksanakan pembelajaran dengan menggunakan teknologi terkini. Hal ini dapat dibuktikan dengan hasil kajian Hadibah et al. (2022) juga menunjukkan murid mempunyai tahap minat yang tinggi dalam pembelajaran subjek Bahasa Melayu apabila guru menggunakan kaedah gamifikasi. Hal ini disokong oleh kajian Shaza Sahira et al. (2023) yang menunjukkan bahawa penggunaan gamifikasi di dalam pembelajaran membawa kepada persepsi yang positif dalam kalangan mahasiswa. Hal ini meningkatkan motivasi intrinsik, semangat kerjasama, persaingan yang sihat serta dapat meningkatkan ilmu pengetahuan pelajar. Mahasiswa kini menyambut positif terhadap penggunaan gamifikasi di dalam pembelajaran. Pembelajaran yang penuh interaktif ini dapat menyuntik semangat para pelajar untuk mempelajari sesuatu subjek. Pendekatan *flipped classroom* pula memberi ruang kepada para pelajar untuk bersedia terlebih dahulu sebelum hadir ke kelas. Pengajaran dan pembelajaran di kelas akan berjalan dengan lancar dan mencapai objektif pembelajaran dengan penglibatan pelajar yang aktif di dalam kelas.

5 KESIMPULAN DAN CADANGAN

Kajian ini menekankan potensi besar penggunaan gamifikasi dalam meningkatkan keberkesanan pengajaran dan pembelajaran subjek Penghayatan Etika dan Peradaban (MPU) di KPTM Ipoh. Pendekatan gamifikasi didapati mampu meningkatkan motivasi, penglibatan, dan pemahaman pelajar terhadap nilai-nilai etika dan peradaban. Namun, dapatan kajian menunjukkan bahawa penggunaan gamifikasi masih belum dioptimumkan secara menyeluruh, dengan ramai pendidik masih mengamalkan kaedah pengajaran konvensional. Hal ini mungkin disebabkan oleh kekangan masa, kurangnya latihan, dan keterbatasan sumber teknologi. Oleh itu, terdapat keperluan mendesak untuk memperkasakan pendidik dengan pengetahuan dan kemahiran dalam mengintegrasikan gamifikasi secara efektif dalam pengajaran mereka.

5.1 Cadangan

Bagi mengoptimumkan penggunaan gamifikasi dalam pengajaran dan pembelajaran, institusi pendidikan perlu menyediakan latihan berstruktur dan berterusan kepada para pensyarah. Latihan ini penting untuk memperkukuh kemahiran pedagogi digital serta memberi pendedahan kepada strategi gamifikasi yang berkesan dan relevan dengan kehendak pelajar masa kini. Selain itu, elemen gamifikasi wajar dirancang dan diintegrasikan secara sistematik dalam kurikulum dan modul pengajaran, bukan sekadar dijadikan aktiviti sampingan. Perancangan ini membolehkan pengajaran yang lebih interaktif dan bermakna, selaras dengan prinsip pembelajaran aktif. Di samping itu, pihak kolej atau kementerian juga digalakkan untuk membangunkan modul serta platform gamifikasi yang sesuai dengan konteks tempatan, khususnya berkaitan dengan hasil pembelajaran subjek MPU. Langkah ini mampu menyokong keberkesanan PdP serta menjamin kesesuaian kandungan dengan latar belakang pelajar tempatan. Tambahan pula, kolaborasi dalam kalangan pensyarah melalui komuniti pembelajaran profesional (PLC) dan bengkel dalaman perlu digiatkan bagi membolehkan perkongsian amalan terbaik, saling menyokong antara satu sama lain, dan meningkatkan keberkesanan pelaksanaan gamifikasi dalam bilik darjah.

5.2 Limitasi Kajian

Kajian ini menggunakan sampel yang terhad, iaitu hanya melibatkan pelajar BE 101 dan pensyarah dari Kolej Poly-Tech MARA (KPTM) Ipoh yang mengajar subjek MPU. Kekangan ini menjadikan dapatan kajian tidak boleh digeneralisasikan secara menyeluruh kepada semua institusi pengajian tinggi di Malaysia. Persekitaran pembelajaran, tahap pendedahan terhadap teknologi, serta amalan pedagogi yang berbeza di institusi lain mungkin mempengaruhi keberkesanan pelaksanaan gamifikasi. Oleh itu, kajian lanjutan yang melibatkan sampel lebih luas merangkumi pelbagai institusi di pelbagai lokasi geografi adalah disarankan bagi mendapatkan gambaran yang lebih holistik dan representatif terhadap penggunaan gamifikasi dalam pengajaran dan pembelajaran.

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A Case Of B40 Family: Family Roles In Supporting Children's English Language

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ABSTRACT

Finance is said to be an aspect that will affect the teaching and learning of children. In Malaysia, we are divided into three household income groups and the lowest class is B40 which is a low-income family. The results of a local survey found that this income factor resulted in difficulties for students in getting the right access in the scope of learning English. Some factors that have made it difficult for families to provide English language proficiency. so this study wants to see how families in the low-income group that is B40 play a role in supporting their children's English language development. Through interviews with six respondents representing diverse socio-economic backgrounds, the research explores the approaches, challenges, and perspectives surrounding English language learning within the family context. Findings reveal that while parents recognize the importance of English proficiency, they face limitations such as financial constraints, lack of time, and their own proficiency in the language. Nevertheless, parents utilize various methods including exposure to English media, encouragement of English communication, and enrollment in English classes to facilitate their children's language learning.

Keywords: B40 households, English language, socio economics, parental support.

1 INTRODUCTION

The purpose of this research is to determine the roles of the family in the B40 group in providing support for their children in the English language. This B40 family, as we all know, is low-income, and the majority of them have to work harder to get their children to school. The purpose of this study is to examine how far the B40 family home environment affects the English language development of their children. By examining the correlation between the household setting of B40 families and the English language development of their children, this study aims to uncover critical factors shaping language acquisition in socioeconomically disadvantaged communities. As Malay is the primary language spoken at home in most of Malaysia. Thus, this study focuses on challenges faced by b40 families. The research is dedicated to understanding the obstacles that confront B40 households, offering insights into the complexities of their daily lives. By concentrating on the experiences of B40 families, this study attempts to identify the socioeconomic barriers they encounter and explore potential avenues for support. With a focus on B40

households, the study seeks to analyze the multifaceted challenges they face, ranging from financial constraints to limited access to essential resources.

As we are aware, everyone in Malaysia would be able to communicate in Malay, which is our native tongue. However, learning English also plays a stronger role for everyone. English is not only a global language but also crucial for various aspects of life, including education, business, and communication with the international community. Therefore, Malaysians prioritize mastering both languages to thrive in a multicultural and interconnected world. In Malaysia, we can see the difference in family income affecting the development of children's English. Without adequate support for learning English, children from B40 backgrounds may face challenges in academic and professional settings where English proficiency is essential. Almost 40% of the Malaysian population consists of households with a monthly income below the poverty line income (Department of Statistics, 2017).

Most of these B40 groups are from families with less education and they work hard to meet their daily needs, causing them to neglect their children's education. A study attended by Nazri in 2014 and Hamizah in 2016 determined that the B40 family's low socio-economic factors caused the B40 family not to afford essential facilities for their children such as life insurance education and high-quality teaching. We can see that B40 families have difficulty supporting their children's English at home. When considering it from the standpoint of most groups, aside from B40, we find that they prioritize English, with some even making it their primary language at home. They are prepared to take further steps, including sending their children to extra classes and hiring tutors from home, to help their children become fluent in the language. In contrast, lower-income families, including those in the B40 group, may struggle to afford such resources, leading to potential gaps in English language development.

Thus, the aims of this research are to examine the impact of home environment on children's achievement in English language and to identify the challenges faced by b40 families.

2 LITERATURE REVIEW

2.1 Parental Role in Shaping Children's English Proficiency

Some research indicates that parental involvement has the greatest impact on younger children's academic achievement, while the majority of studies support the idea that children of any age with parental supervision tend to have better attendance, proficiency levels, and more positive school attitudes compared to those whose parents are less involved (Hill and Tyson, 2009). Families play an important role in providing support for children's English to make children interested in speaking and mastering this language more deeply. This language is very subjective and it is in the hands of parents how to shape and reinforce it. In today's circulation, there are many multicultural and diverse families who use bilingualism at home and they raise their children with that bilingualism. So the average family now wants their children to be proficient and able to use the English language which is highly emphasized in today's circulation. According to Bingham, Jeon, Kwon, & Lim (2017), improving children's language skills requires balancing the application of two dimensions: the cognitive, home literacy environment, and the affective, parenting style. Children can be taught a second language by their parents, giving them exposure to the language and accuracy. They can drive language development by fostering parent-child contact and creating an enjoyable learning environment.

Parents' resources for helping their children can also differ. According to Ghahdarijani and Rahimi (2021), parents in Iran gave their elementary school children help learning the English language by using tools like flash cards, CDs, and making sure the children completed the homework by a certain time. Resources play a crucial role in supporting children's English language development, serving as sources of inspiration and providing opportunities for immersive learning experiences. From books and language apps, these resources foster an environment conducive to language acquisition and encourage children to engage actively in their learning journey alongside their families.

2.2 Challenges in Supporting English Language Development

According to Madima and Makananise (2021), parents' confidence and fluency in the English language was a major factor in how much they contributed to their child's English education because parents who felt more fluent in the language believed they could make a bigger contribution. Parents who lack fluency in English may feel less confident in their ability to support their child's language development and may rely solely on the school to provide assistance in fostering English proficiency. This reliance underscores the importance of providing resources and support to empower parents in actively participating in their child's English language learning journey. In Malaysia, there are various dialects of speech that lead to language barriers that distinguish between states. "Learning another language enables a child to have two different world perspectives and cultural experiences," claims Colin Baker (1995). The state of Kelantan is one of the states with a concentration of dialects. So at home they seem to be divided by the Malay way of speaking with dialect and this has become a language limitation for the natives of Kelantan to process the English language. The results of the study found that the people of Kelantan are labeled as a group that is somewhat left behind in the use of the English language.

2.3 The Importance of English language among children

English proficiency among primary school students is crucial as it not only serves as a source of inspiration but also lays the foundation for future academic and professional opportunities. Supriyanti (2012:4) stated that the fact that economic globalization has pushed the demand of English in the form of the workforce who speak English to meet the need of the international economic forces. Mastery of the English language opens doors to a wealth of knowledge and information, enabling students to access a broader range of educational resources and pursue higher levels of learning. Furthermore, learning English also makes children smarter. It is due to the fact that, especially in the case of children, learning a language other than our mother tongue increases their mental capacity. In its prime, this is a fantastic way to encourage children to acquire English as a foreign language (Hakim & Chiani, 2019). Furthermore, being fluent in English improves one's communication abilities, which are critical for success in today's globalized society as English is widely utilized as a communication language in a variety of fields, including commerce, diplomacy, technology, and science.

3 METHODOLOGY

3.1 Research Design

This research paper elaborates on the roles of parents in the b40 group in supporting the development of their children's English language. This study uses a qualitative method in finding some respondents to be interviewed. This Qualitative research design is a methodology used to explore and understand complex phenomena in-depth. uses a qualitative method in finding some respondents to be interviewed. This emphasizes various techniques like open-ended interviews, focus groups, participant observation, and document analysis to gather data.

3.2 Sample of the study

To ensure the validity of this study, several interviews were conducted among families in the B40 group including variations in income levels. The sample selection for this study followed a purposive sampling approach, aiming to ensure the representation of families from the B40 were specifically chosen based on their inclusion in the B40 income bracket, as determined by the Department of Statistics (DOSM) in the 2019 Household Income report. Additionally, families with children aged between 7 and 12 were

targeted to capture the critical period of language development during early to middle childhood. This research also focuses on different state of families and have the following characteristics:

a. The total family income belongs to the B40 group listed by the Department of Statistics (DOSM) in the 2019 Household Income.
b. Have children that are in the 7–12 age range.

Table 2: Biography of the respondents

Respondent	State	Total number of children	Child's Age	Household B40 Group Income
Parents A	Selangor	2	9 years old	B1
Parents B	Johor	4	7,9 & 11 years old	B3
Parents C	Kelantan	5	9 years old	B2
Parents D	Pahang	3	8 years old	B2
Parents E	Pulau Pinang	3	9 & 11 years old	B3
Parents F	Melaka	2	11 years old	B1

3.3 Instruments

This interview session uses phone call interviews, recording by whatsapp voice conversation and face-to-face interviews. Interviews are conducted in Malay or English based on the family's choice and comfort to answer the questions. To demonstrate the validity and supporting documentation of the interview done for this study, the interview session is being recorded and transcribed. The interview will consist of the identical set of questions for each respondent to answer.

3.4 Themes of findings

The interviews that have been conducted have provided several themes of findings as follows:

a. Theme 1: The limited English Language Use
b. Theme 2: The effect of low income on economics nowadays
c. Theme 3: Time constraints in providing support
d. Theme 4: Parents lack confidence or proficiency in English
e. Theme 5: Parents' engagement in supporting children's English language activities.

4 RESULTS

4.1 The limited English Language Use

All six respondents say they have limited use of the English Language at their home.

Respondent A:
"We mostly speak in Malay. So, we also use English, but the basics are like "sit down" if you want to tell your child to sit down, "quiet", "please" or if you want to go anywhere, say "let's go". That's how simple it is."

Respondent B:
"So, what is always common is the use of English in school. But in this house, the use of English is a bit less, but it's like if we use English, we just use it like a market English, not really like we speak in full."

Respondent C:
"The use of English in the family is usually a basic word so that the children understand. For example, "pickup". "Throw the rubbish". If they want to speak correctly, we prefer Malay."

Respondent D:
"We just use the words, not the sentences. The rest is not a long or continuous conversation. I'm at home with my family and only use Malay and it's really hard for us to chat in English."

Respondent E:
"In my family, the use of English is not the main thing. Sometimes they are the ones who talk a lot. When they speak, we listen to them. We will correct what they said wrong. It is what we always talk about. We are also mixed with the Malay language. Often just Malay language only."

Respondent F:
"So, the use of English in the family is not applied much because he speaks Malay. So, if he wants to study, most of them will apply at schools or tuition places."

We can see that the average b40 family does not practice speaking English at home. They only speak using words mixed with the Malay language. Students' social environment is one among those aspects. In addition to the fact that parents of children in remote areas are unlikely to have had a good education, English is not spoken in their homes (Nazuha, 2018). It appears that the use of English in Malaysian households is limited and often relegated to basic words or phrases, with Malay being the primary language of communication. The conversation they go through should be easy to understand and the use of English is only used if they want to chat informally or when helping their children do school work only.

4.2 The Effect of Low-Income Family on Economics Nowadays

All six respondents have a problem in terms of providing good learning resources for their children in terms of low income and economic problems.

Respondent A:
"…the limitation may be from a financial point of view, it may also be because of today's economy, which is not very stable."

Respondent B:
"The limit for resources may be limited from an economic point of view. From a financial point of view. I went to Lotus that day, and someone offered me a resource for learning English. So, I'm interested. But when we look at the price, we really can't afford it. It's because we have to pay monthly for several months. His price is about a hundred and more, just pay within a year. So, it seems like there has to be a commitment to provide this resource. If we want to buy expensive types, it's quite difficult."

Respondent C:
"I also think that when it comes to providing this resource, it will affect our finances, like having to buy books to prepare other things and books on other subjects. So for us to focusing on this one is really hard."

Respondent D:
"But we are a financially tied family with many children and need a lot of money. So for me we only give out what is necessary like resources from the school and try our best to get resources like story books at a reasonable price."

Respondent E:
"Most of all,they are very expensive. I want to send them to the tuition center for the English language. It's very limited for me because of the economy, so we just study at home."

Respondent F:
"Now the economy is not encouraging, everything is expensive, if the book is cheap we I can buy it."

According to the Financial Education Network (FEN), Malaysian B40 households confront five main issues. The first is that these households have low trust in their financial expertise. We can see that finance has a great impact in the b40 family. If we talk about learning resources, for them it is important but they have other responsibilities and they can only support this English language resource to the extent they can. They have other costs that need to be made. As we know it is not the only source of learning English they need to support, they also focus on other subjects such as science and mathematics. 40% of Malaysian households make less than MYR 4830 per month on average, which suggests that their socioeconomic standing is still low. (Kusairi, S.; Sanusi, N.A.; Muhamad, S.; Shukri, M.; Zamri, N.2019)

4.3 The time constraints in providing support

Four out of six respondents stated that they lack time in providing support to their children.

Respondent A:
"In terms of obstacles and difficulties, maybe it's because I work. So, the children don't have a lot of time with us to communicate in English."

Respondent B:
"I think in terms of my time. Lack of time because we work. Back to work there is work at home that we need to do."

Respondent C:
"Maybe the obstacles faced. When I work away from my family. And I have less time to spend it with my children."

Respondent E:
"Our time with them is also an obstacle because we are not with them all the time, so it is difficult for us to apply that."

Career management is a challenge for parents who have to balance their time between their children's and their jobs, according to Abd Raof et al (2020). Since work and family are the two most important aspects of people's lives, handling different obligations takes a lot of time and effort (Hassan et al., 2022). Time is one thing that we are chasing nowadays. So, these growing children really need the support of their parents to be by their side especially when doing school work or reviewing lessons. In

today's fast-paced world, parents often find themselves balancing numerous responsibilities, making it essential for them to carve out dedicated time to support their children academically. Parents will feel guilty and unsatisfied if they can't balance the responsibilities at home and at work (Sitimin et al., 2017). Due to time constraints, parents are becoming less aware of their responsibilities and more willing to let their kids learn at home without supervision.

4.4 Parents lack confidence or proficiency in English

Four out of six parents admitted that they have a lack of proficiency in English that makes them unable to contribute to their children's English Language learning process.

Respondent A:
"*My husband and I are not very good at English."*

Respondent D:
"Circle who is not proficient in English."
Respondent E:
"My other obstacle as a mother is also lacking in eloquence itself. Sometimes My husband is smart. I'm not good at English."

Respondent F:
"We are also from a circle that is not skilled and not fluent enough to communicate if there is just a little bit. So, like us, none of us are very good at English."

According to Jones (2013), children may be more likely to interact with the English language if their parents are able to speak in it. The majority of these B40 parents and households simply have a secondary education. Their everyday lives are so busy earning a living that some of them overlook the educational advancement of their children. B40 parents bring their children to school and rely on the instructors to teach them. Three typical reasons are listed by Forey, Besser, and Sampson (2016) for why parents may find it difficult to support their children in their studies: a lack of time, a lack of skills, or a lack of English language proficiency. Additionally, parents with lower English proficiency may struggle to assist their children with English-language assignments or homework, further widening the educational gap.

4.5 Parents' engagement in supporting children's English language activities.

All six of the respondents outlined various strategies they employ to facilitate their children's acquisition of English language skills.

Respondent A:
"The way to encourage that may be in terms of buying English story books or watching children's favorite cartoon stories on television in English. specific approach may be that. My husband and I will have to practice or say the English sentence every day. That is one of the ways to improve children's English proficiency."

Respondent B:
"Usually that encourages watching English learning videos. usually if like him has school work, we will help him."

Respondent C:
"…use simple languages to talk to my children. Sometimes I also turn on English TV

channels for my children. I also spend time. Just 30 minutes a day. Sometimes just with my son to chat. Talking idly, sometimes I help my son in running the exercise book he bought from the bookstore."

Respondent D:
"…use by speaking, dare to speak and that is what we encourage. Using ideas from YouTube. Memorizing songs makes it easy and interesting for children to learn."

Respondent E;
"I encourage them to just open a story on YouTube, or sometimes I buy English books to read. we will teach. We will communicate in English. Helping to revise and supporting him to always be brave to speak in English."

Respondent F:
" We have already sent him tuition and talked about the importance of English."

Castro et al. (2015) recommended several forms of parental participation, including activity supervision, high expectations, keeping lines of communication open, and regular reading encouragement for kids. Tan et al. (2020) outlined six elements that they discovered improved student performance. Madima and Makananise (2021) identified two additional strategies for enhancing children's English language proficiency such as reading English books to them and letting them watch educational television.

4.6 Discussion

Families need to take proactive steps to guarantee the development of children's English. Family is the main pillar in showing personality and example in educating children. As parents, it is necessary to plan from the beginning how to educate children so that they can be given enough knowledge for them to grow up. In the meantime, in terms of income, there is no denying that the economic factor is the cause of the current disruption. However, in order to dignify the English language, parents can spend time and try as much as possible to provide exposure and motivation for them to be enthusiastic about learning at school and always do exercises that will hone their talents. Families play a pivotal role in fostering children's English language development by providing a supportive environment and setting positive examples. While economic challenges may exist, parents can still prioritize language learning by incorporating English into daily activities and utilizing free or low-cost resources. By instilling enthusiasm for learning and emphasizing the importance of English proficiency, parents can empower their children to succeed academically and beyond. Parents also can take initiative in various ways. First, to encourage daily practice in allocating a certain period of time every day for practicing your English, whether it is through reading, speaking, or engaging in language-learning exercises. Second, lead by example such as set a good example for your children by being enthusiastic about learning and utilizing the language. Third, set achievable goals by setting realistic goals for language development and monitor your progress over time, acknowledging your accomplishments as you go. Fourth, support and encouragement to help children stay motivated in their language learning endeavors, give them words of praise and encouragement. You can also offer help when needed

5 CONCLUSION

In conclusion, the research highlights the vital role that families in the B40 income range play in fostering their children's English language development. Six respondents from a range of socioeconomic backgrounds were interviewed for the study, which examined different methods, difficulties, and viewpoints related to English language instruction in the home. The results showed that B40 families faced a number of significant challenges, such as limited use of the English language at home, time constraints,

financial barriers that prevented them from accessing learning resources, parents' lack of confidence or English proficiency, and their efforts to support their children's English language activities. This study basically emphasizes how critical it is to identify and tackle the particular difficulties B40 families encounter when assisting the children's English language development. Teachers, legislators, and communities may collaborate to close the language gap and guarantee equal chances for all students, regardless of their socioeconomic status, by being aware of these obstacles and offering tailored help.

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The Homeschooling Decision: Insights from Minority Parents in Thailand's Elementary Education

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ABSTRACT
This research provides its finding from the collected information from the interviewed parents specifically to the pupil's mother regarding the reason behind choosing homeschooling as their children's education for the minority group household in Thailand. In this study, the main objective is to present the positivity side of conducting homeschool from the parents perspective and to clarify the doubted questioning problem in the society regarding the homeschooler socialization and the high expenditures in the homeschooling process. The method used in the study mainly refers to the experienced family and supported by doing the literature review from other researchers. The study also points out the achievement of the homeschooler children in order to show the best image why homeschooling is the best choice for some certain children and parents.

1 INTRODUCTION

1.1 Background of study

In Thailand, the percentage of homeschoolers is only 0.1% or counted in no. as 1000 of homeschooled kids, it has been raised after the pandemic of covid-19 with uncertain numbers which have yet published in any sources. The study aims to identify the reason behind the parents choosing homeschooling for their children's education instead of sending the pupils to traditional school or other alternative education. The low percentage numbers of homeschooling is present in Thailand even though it has been legally recognized since 25 years ago, in the year of 1999. By doing so, the research is focusing on the advantages that are touched by the parents on their homeschoolers and how the parents have vision toward education in Thailand whether it involves one of the reasons that they are applying to homeschool or other factors related. Some parents intended to homeschool their children but have stopped due to the factors of expenses perception, socialization, discipline and other predicted challenges given among society without fully completely understanding. Therefore, this study aims to find out on the certain chosen family on how this labeling somehow brought them to homeschooling, and how they turned all the drawbacks mentioned to something else which might inspire the other children's caretaker to confidently take decision if it answered their questions.

1.2 Problem statement

This research was conducted when it was seen that many students in Thailand do not enjoy going to school because of many factors such as rules and regulations, subject matter, bullying and other factors that make the school played as an unpleasant place for them. To some children, not enjoying school doesn't mean that they protest learning but rather the procedures of the system sometimes do not fulfill their need, not to mention or specific to Thailand education system, but the typical school it is. As said in published research in the National Library Medicine website, it mentions that Although most children and young people will dislike some aspects of school, some students who dislike school, dislike it completely. This *pervasive* form of dislike can result from academic difficulties, which can induce a self-perception of academic failure/incompetence (Murray and Mitchell, 2013 One of the solving issues is doing homeschool to foster the learning of children into positivity but while looking at the rage of homeschooling in Thailand, it still at the low range. Parents might be afraid of doing so due to many aspects of socialization, financial, managing and more. Therefore, this study will identify the advantages within homeschooling and illustrate the issues that are being worried among parents in the creative way of the interviewed parents in bringing their children the best education as they expected.

1.3 Research objective

The aim of finding the insight details of homeschooling among parents in Thailand. This study can be successfully completed when reached the following objectives which are to identify the evidence regarding the advantages of conducting homeschool, and to explore the views of parents in terms of public concern and why homeschooling remains their choice.

2 LITERATURE REVIEW

2.1. Homeschooled Kids and Their Social Skills

Research examining the social skills of homeschooled children indicates a complex picture. While some studies suggest that homeschooled children may exhibit social skills equally with or even superior to their traditionally schooled counterparts, other research highlights potential challenges in socialization. Some studies find that homeschooled children have diverse opportunities for social interaction through community activities, sports teams, and extracurricular programs, leading to the development of strong interpersonal skills and friendships. (Green Dr all, 2017) However, Ray (2019) mentioned that its concerns have been raised about the limited exposure to peer groups and diverse social settings that homeschooling may entail, potentially impacting children's ability to navigate complex social dynamics. Further exploration is needed to understand the range of social experiences and outcomes for homeschooled children, as well as the factors that contribute to their social development.

2.2 The Stage of Physical and Mental Health of Homeschool Kids

Studies investigating the physical and mental health of homeschooled children suggest overall positive outcomes, studies from Smith and Johnson (2018) Research indicates that homeschooled children often enjoy better physical health due to opportunities for regular exercise, nutritious meals, and reduced exposure to germs and illnesses in traditional school settings. Furthermore, homeschooling is associated with lower levels of stress, anxiety, and behavioral problems compared to traditional schooling, potentially contributing to better mental health outcomes. (Brown et al, 2020) However, challenges such as social isolation, lack of access to mental health resources, and parental stress can impact the well-being of homeschooled children. More comprehensive research is needed to assess the long-term physical and mental health outcomes of homeschooled children across different demographic groups and educational approaches.

2.3 Level of Satisfaction of Parents Toward Homeschooling

According to a study of Jones and Lee (2016) Literature exploring that parental satisfaction with homeschooling consistently indicates high levels of overall satisfaction. Parents cite various factors contributing to their satisfaction, including the ability to tailor education to their children's individual needs, flexibility in scheduling and curriculum, and the opportunity to instill values and beliefs in a home environment. Additionally, parents appreciate the close bond and quality time spent with their children through homeschooling. However, challenges such as balancing multiple responsibilities, navigating legal requirements, and accessing resources and support can impact parental satisfaction. Further research is warranted to explore the factors influencing parental satisfaction with homeschooling, as well as strategies to address challenges and enhance the homeschooling experience for both parents and children.

3 METHODOLOGY

The research's design is direct to qualitative research with all the information extracted from the interview session conducted to homeschooler's mom who came from different cities in Thailand and have various backgrounds in homeschooling. To complete the research with reliability and accuracy, the information was collected from different individuals in the same category which is homeschooling their children in elementary level. All the interviewees were confirmed on the condition that they owned these above characteristics in order to achieve the research objective.

The characteristics of the respondents are as follows:

a) The children are holding Thai nationality
b) Residence in Thailand
c) A mother who homeschooling an elementary kids

3.1 Biography of the respondents

Respondents	National - mixed	Age	Province	children	Carrier
A	Bangladesh	43	Bangkok	3	English tutor
B	-	44	Khonken	3	life skill teacher
C	Chilli	40	Pangga	2	English teacher/ freelancer
D	-	44	Krabi	1	Business woman (WFH)
E	Dutch	40	Bangkok	1	Personal business
F	Malaysia	34	Pattani	4	English teacher (Oxford)

The interview was held through voice call of Facebook Messenger and Google meet for some respondents. The use of language is mostly in English, only one respondent who prefers using Thai language in communication which can be translated and transcribed into English for the evidence. The respondents are being asked the same questions to measure the finding later.

3.2 Themes of finding

Theme 1 The most pleasant moment of parents in homeschooling is seeing the children enjoy their learning.

Theme 2 Students in homeschool is physically literates, good value and good wellbeing
Theme 3: English speaking is one of the biggest factors parents choose homeschooling.
Theme 4: Homeschooled children brave to express their feeling

4 FINDING

4.1 The pleasant moment in homeschooling is seeing the children learning what they love.

All of the interviewees mentioned the impressive moments at the same conclusion, which is, they are delighted and happy with homeschooling, seeing the children learning what they are interested in. Some students can earn money what they have practiced specifically to that particular area

Respondent A
My son is doing Science and Math, he looks ahead to learn medicine and join medical school or engineering school. The homeschooling we are doing now will be in his portfolio that he will show the judges where he will stand for admission. Therefore if the manager knows the direction of himself where they will go, it will be much better and we did it. They can study what they love and can directly specialize in the field they are interested in.

Respondent B
The most impressive moment is when I realized that my kids are able to learn what they're interested in and she is happy with what she learned from primary school until she entered university. She has many skills and abilities like cooking, baking, languages including Chinese and English, online marketing, health and physical education. My first kid as a case, now she is selected as a full scholarship student, studying in Bachelor of Arts program, majoring in English at one of the universities in Thailand.

Respondent C
When they said to learn things like "I would like playing guitar" so I bought the guitar for her and practiced. Another child is interested in something and she makes her own database and the way she talks to other people sharing to people is very impressive.

Respondent D
There are so many, I have homeschooled him for 6 years now, I met those moments a lot. Since we are using the system of unschooling mainly, he does not learn everything just the thing he desired to learn, for example coding, he learns by himself for 7 years old and now he is able to teach the other children as well, he has 500 students in his class now. I always tell everyone, not because he is smart, but because he has ample time to spend all his time focusing on this thing. I promote his class on my Facebook and he can make money from that. I transferred money to my account for 100,000 THB from the creation game of one of the big companies in Thailand which is CP. I was impressed not because of money but because he can do more things than I expected.

Respondent E *Yes, we feel that we are on the right track because it answers all questions that we have. Our child has more time to spend and play. We don't focus much on academics and get stressed every single day but enjoy learning instead. He is responsible for his study with correspondent times and now he has ample time to explore what he is interested in.*

Respondent F

All I know, after me and my husband talking to each other, is the goal of why we homeschool them and see the ultimate goal. Then we agree that we are in the right tract. The most beautiful moment was when my 5 year old son, when we brought them to travel, kept saying, "Mom, I think we are the luckiest people. Allah is so kind to us right mom? Thank you for working very hard and bringing us travel, spending time with us" I was feeling so Wow at that time. I was crying and got emotional with his touching words which mean a lot to me. One day, they will remember all the things we do together. I think all of these which we put an effort into can be remembered when we, parents, are not here any more especially to the value that we taught them.

Review:

One thing that can cause students to be opposed to learning because they don't like going to school. They overcome something which makes all the process of learning displeased. High percentages of students who refuse school and make their learning burdened. As said in the study, once they don't love some aspects of school, they will not love anything. As a parent, being able to observe the particular thing in children is the biggest blessing and can change their learning in a more comforting way. Focusing on particular interest of them, let them learn deeply is one of the best way of an effective learning, as said (Pi, 2023) Learning a little bit about a wide range of topics can make you a more well-rounded and knowledgeable person, and it can help you to make connections between different fields of study. However, it's also important to have a deeper understanding of certain subjects that really interest you. So, the ideal approach would be to follow Huxley's advice and have a wide knowledge base, while also having a few areas of expertise that you've studied in depth.

4.2 Students in homeschool are physically healthy, good value, stable and wellbeing.

5 respondents have mentioned about their child's health and well being, stability and being able to be happy most of the time due to the management of nutritions of their parents, the safety of the environment, positivity surrounded, sleep control and more that lead the children physically fit and mentally in a good stage. Homeschool pupils tend to have less stress and enjoy most of the learning progress.

Respondent A

The good part of homeschool is I find that my kids are stable in their mentality in dealing with their emotions. Whenever I want to approach them, they are ready to talk to me, they are ready to look me in the eyes and start a sensible conversation because when I compare them while they were in school their emotion isn't there, it's just having a normal talk like how's your day? How's your food? They were moody most of the time. My kids started homeschooling. They became easy going and lived simple. In terms of academic progress, when my kids struggle with their academic performance for a couple years, it never gets better. Later on, when she started homeschooling, I found a significant change in her, like she was willing to take.

Respondent B

It might not conclude easily but personally I guess it is on happiness and the feeling of freedom in expressing. The school teaches specifically to the qualifications or set the good image like this and like that which limits them to maximize their ability in performing things. Homeschooling can get a healthy mind and healthy physical health more than going to school.

Respondent C

When they have flexibility and freedom, they have more inner growth, self-esteem, self-control, they have more responsibility to control themselves by themselves. Healthy mind because no bullying from the classes. In personalities might be subjective, I observed from my online class students whether they are homeschooling or not in personalities nothing to compare. Our kids are less sick because when we go to school, they get sick a lot. I am saying what I see, homeschooling is healthy, they are with their parents

always, they have to know what to eat, managing sleep, we can control our food, a lot of school is overweight. Homeschool Kids have English speaking at the best level, they do not spend much time on speaking Thai, learning materials.

Respondent E

Even though they have little flu or cough they still have to go school otherwise, they cant get enough with learning time and attendance record. I am not really sure but seeing my relatives when they send their children even though they are sick.

Review: Students are easily stressed in school due to many factors. Referring to the InnerDrive website, it is being said that the cause of stress in school students is due to homework, workload, social life and the pressure of parents. When it comes to homeschooling, all those thing were get rid of from the system, no pressure from parents since they are the one who manage the school, they can follow the progression by themselves, homework can be assigned only particular days up to the suitable of the teacher, and no toxic social with them, only family and the hired teachers which they can limit the surrounding of them. Students become less stressed which supports physically in a good stage and mentally fine since they will not have any pressure. Most homeschooled parents love to let the children think by themselves more than set everything. The nutrition and all food were covered at home, no random interaction between people who have some sickness or flu which rarely have those kinds of fever.

4.3 English speaking is one of the biggest factors parents choose homeschooling.

Question that were asked parent whether Thailand education is not fulfill their need as parents, most of them not fully agreed and they expressed that is not the reason of their homeschooling rather, 5 of family's respondents are using English in communication and they wanted to have their kids improved in English Language which will be challenge in typical school that use Thai as main language, while the international school is not everywhere and other factors like financial which will be discussed in the next two of finding. These are 3 respondents who have mentioned that the kids are using English.

Respondent A

Not really, I think it is just who we are because my kids were raised in Bangladesh. When I looked at the other school kids, they were doing fine. Our kids need more adaptation which is a challenge for them to be in a Thai school. The way they enjoy it is not the way they enjoy and that's why homeschooling is a better choice for them.

Respondent C

Not really, if my kids speak Thai, maybe I can find a school that fits our philosophy. It is not fair to say that Thai education does not fulfill our education needs but yeah it is just because my children speak English. So far, I can say that maybe in Phang Nga (province) there is no Thai education curriculum that fits our needs. I think if I find a good school, I also want to send them to school. My husband said it is too late for kids in this generation while the curriculum is still the same. For us, homeschool we always change the curriculum up to the preference of the child at the time.

Respondent F

Not really, maybe if we stay in Bangkok there will be more choices for me to decide. Since Pattani does not have an international school or the place that using fully English since all my kid speak English mainly

Review:

Traditional schools in Thailand use Thai as a main language and when it comes to English class, they use only little such language in daily life which does not suit the children who aim to improve in the term of communication, only theory was mostly conducted. Some parents need to hire an English teacher

to teach their children after class, and they will have many additional classes which can cause the children to feel bored and not enjoy learning, they will not have ample time to sleep and do what they desire. Moreover, as a multiracial pupil, they cannot experience their level enough due to language barrier, while the international school is expensive. Therefore, homeschooling can reduce their stress in using language and that makes English play a big or main factor in parents deciding homeschool. As referred to in K12 Academic, it has been evident that the Thai education system in terms of English needs improvement. In the government schools the standards are similar and many elementary teachers freely admit that although they have little or no knowledge of the language, they are forced to teach English. Teaching English badly during the most influential years is better than not teaching it at elementary level, the debate circle was discussed regarding this matter.

4.4 Homeschooled children brave to express their feeling

2 respondents highlighted that their children are able to express what they feel and are ready to talk with their parents whatever happens. They have their own thoughts and are able to have critical thinking, solve their own problems and be independent.

Respondent B

I feel that I can reach the goal that I have set and the second one is that we successfully achieved the education system desired. They learn less and create more impact, focusing specifically on the field wanted by the children not to study all the things unnecessary because the nature of human being they can't cope with everything. For example, there are many parents that just let the kids study and identify later what the children wanted and they are able to extend and express their feelings. More importantly, they don't need to have long transportation.

Respondent D

The children in homeschool face the real world, and they need to solve the problem in real life. Those things make students outside school look like more adults and grow up more than the school children because they learn how to obey, and just follow the instructions, everything is scripted already, they do not meet many problems by the means of life. They follow the system provided, the limitations are there, they cannot manage to think outside the box. Moreover, students in school have the same friends and community, and do not have many chances to meet with different people, other places. Some students have bad friends accompanying them, and they have no choice but to avoid it because of all the problems like bullying, discrimination.

Review:

Homeschooled children are brave to express what they feel because there is a family for them listening to what they have been told. In school, the students might get ignorant from peers or teachers which can cause less confidence to speak some truth or even express what he/she feels. If pupils were bullied, teased, or made fun of from what they expressed emotion, they will be afraid of being rejected, or the adult said something that asks them to stop what they are showing can cause them to be afraid to later show their feelings. (foundcare, 2020) If pupils are not with their family all the time, these characteristics may not be observed. Therefore, this is counted as one of the advantages of homeschooling that children always have their people to stand by side and ready to hear their story. As also said, deep conversation can be made with homeschooled children, they will be ready to tell things to their parents but this doesn't mean that schooled kids are all not showing their emotion, there also is.

5 CONCLUSION

The finding has identified all the advantages of homeschooling and stated the reason why parents in minority groups in Thailand are opting homeschooling as their choice in educating their children especially in the elementary stage. As stated in finding, it can be seen that most parents are satisfied with their homeschooling even though there are challenges that have not been mentioned in this research. It can be concluded that most parents wanted an education and curriculum that was designed by their own and gave full support to their children in choosing what to learn which avoided from dislike of school and fostering learning in the children. The evidence can be seen from the enjoyed child who have physically healthy and mentally stable. Various achievements have been mentioned for homeschooled children that were managed by the 6 families with the highest levels of the effort of the parents and their families. The doubted point of society regarding the drawbacks of homeschooling has been clarified and turned to positivity to these groups of parents, socialization of the kids and financial management that turned to flexibility. However, homeschooling is not a major benefit for everyone but for certain children and families mentioned. Some children are successful with their school while others are more homeschooling.

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Education Inequality in Southern Thailand: Perspectives from Elementary School Teachers

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ABSTRACT

This research investigates educational inequality among elementary school teachers in southern Thailand, focusing on their perspectives on the causes and consequences of disparities in access to high-quality education. The research used qualitative approaches, specifically semi-structured interviews with six elementary school teachers from Pattani, Yala, and Narathiwat, in order to conduct in-depth interviews. Each participant had at least five years of teaching experience, with ages ranging from 35 to 40 years, ensuring a balanced representation of both male and female teachers, and discovered that variation in wealth, family backgrounds, inadequate distribution of resources, and lack of government aid are major causes of educational inequality. Teachers emphasize the significant effect of these inequalities on students' academic success and overall welfare. The findings are expected to provide insights into effective strategies for specific policies, more financial support, and community engagement to address these issues and advance fair education for all students in the area.

KEYWORDS: *Educational inequality, Southern Thailand, socioeconomic disparities,*

1 INTRODUCTION

1.1 Background of the Study

Education inequality is the unequal distribution of educational resources and opportunities among students from various socio-economic, ethnic, and geographical backgrounds. There are several factors that impact education inequalities in southern Thailand, including economic expansion, infrastructure, and social issues. Apart from that, understanding these differences is essential for creating effective initiatives and tactics to ensure that every child receives a fair education in this area. The primary objective of this research is to familiarize readers with the problem of educational disparity in southern Thailand, which includes Pattani, Yala, and Narathiwat, particularly by highlighting the viewpoints of primary school educators. The study aims to investigate the reasons behind these differences and how they affect students' academic achievements by examining the perspectives of teachers.

Apart from that, control over the modern Thai provinces of Pattani, Yala, and Narathiwat, as well as certain areas of Songkhla province, is at stake in the deep south. Nowadays, Muslims make up around 77% of the population in the Deep South, with Buddhists making up the remaining percentage. These used

to be part of the Muslim sultanate of Patani, along with parts of northern Malaysia (Jitpiromsri et al., 2019). In other words, education plays a significant role in shaping both individual and societal behavior and is also crucial for driving economic growth and creating a prosperous country. The quality of the education system plays a significant role in the success of a country by shaping a strong and exceptional society. However, education typically assists in advancing human development to enhance health, promote gender equality, bolster social cohesion, address inequity, and alleviate poverty. Furthermore, education can be utilized to tackle various aspects of societal advancement, including social, cultural, environmental, and economic dimensions.

Moreover, the World Bank found that with quality education, a child grows up to be a good parent, capable of making informed decisions, adapting to new technologies, handling crises, improving their standard of living, and becoming a responsible citizen. The United Nations (UN) Convention on the Rights of a Child and the Universal Declaration of Human Rights both recognize education as a basic human right (Khun-Inkeeree et al., 2016).

1.2 Problem Statement

In southern Thailand, there is a significant issue with academic disparity in elementary school. Even though education is essential for students to succeed, a large number of them lack the information necessary to go forward academically, which may have an effect on their chances for further education and employment in the future. In order to effectively devise solutions and address the underlying issue in southern Thailand, it is imperative to identify the causes of this situation. Educational differences greatly hinder the effort to ensure that all students in southern Thailand have fair access to high-quality education. It was discovered that children's learning achievement was not up to Thai standards and, more importantly, had the lowest score in the country.

This study is important because it addresses ignorance about how these differences manifest in primary schools and eventually impact children's prospects for the future. Previous studies have focused on the difficulties educators face when implementing education reform, including managing curricula, improving students' reading proficiency, handling work overloads, and managing tight finances. Handling sentiments, maintaining safety, and managing instruction were challenges when it came to social unrest. As a result of these difficulties, leadership traits like adaptability, patience, and dedication surfaced, along with the ability to steer instructional technique adjustments and forge partnerships with relevant stakeholders. However, there isn't much research on the experiences and ideas of primary school teachers in southern Thailand, which is a problem this study aims to address (Nitjarunkul et al., 2014). With the assistance of Durongkaveroj (2023), Thailand has made advances in recent years in raising the proportion of the population literate, expanding the number of individuals able to receive a primary education, as well as reducing the disparities in school attendance across income levels. This research looks at how primary education is now progressing in Thailand, focusing in particular on the academic achievements of Thai students, the factors influencing these outcomes, and the challenges the educational system confronts. Furthermore, studies show that even with significant funding for education and acknowledgment of the importance of a skilled workforce for economic growth, students still display low academic performance with no significant improvements in domestic and international evaluations.

Thus, this study aims to investigate how elementary school teachers in southern Thailand perceive the causes of educational inequality and to explore how elementary school teachers perceive the influence of educational inequality on student performance and outcomes.

2 LITERATURE REVIEW

2.1 The factors influencing the inequality in education between southern Thai primary school teachers

Southern Thailand is experiencing significant disagreement when it comes to education. In the past, the South regions of Thailand belonged to the Patani Sultanate, founded in the mid-fourteenth century, which extended into parts of Northern Malaysia as well as served as a prominent hub for Islamic culture and education. Following the Anglo-Siamese Treaty of 1909, this area officially fell under the authority of Bangkok, which then initiated a campaign for national solidarity by promoting forced assimilation of Buddhist beliefs, the Thai language, and the Thai royal family. Approximately 80% of the residents in these three provinces are Malay Muslims who feel politically oppressed due to the fact that their ethnic identity, with the Thai state violating their rights in order to practice religion and culture (Pherali, 2021).

In a similar study by Mario Novelli et al. (2017) noted that while education plays a key role in insurgency in Southern Thailand, the focus has been primarily on political dynamics between the Thai state and insurgency, with minimal consideration of how education influences conflict causes, processes, outcomes, as well as peace prospects. Therefore, the purpose of this study is to address this deficiency by examining discussions on conflict and peacebuilding, as well as educational obstacles in Southern Thailand, and offering theoretical insights utilizing Nancy Fraser's social justice theory.

In a related study, Richmond et al. (2016) stated that the educational policies of the Thai state have not effectively tackled the root causes of conflict. Their emphasis on stability and ending violence without addressing structural inequalities has not led to any significant peace results. It is unlikely that educational results will get better for politically oppressed populations in the Deep South without significant changes in the education field, as well as progressive economic policies and political changes to improve local independence. Educational practices that threaten the religious and cultural identities of communities may lead to discontent and injustices, which can contribute to violent conflicts.

Examining a study similar to Kaewsom (2017), the Thai government acknowledges the crucial role of education in addressing conflict in the region. While the security forces and the Thai administration maintain their focus on the ‘national security mindset’, collaborative results in areas such as education are being hindered, but national initiatives are starting to change this. These efforts are crucial as they would contribute to establishing a conducive atmosphere for utilizing Islamic religious education as a tool for peace-building.

The cultural identity of the three southern border provinces of Thailand sets them apart from other regions. The Pattani Malay language is used in daily life by eighty-three percent of the population in this region. Nevertheless, Thai language is the official language used in schools. Consequently, these children will be able to struggle with grasping the material taught in school due to the fact that their limited proficiency in the Thai language. Research by Phadung et al. (2013) discovered that children in Thailand are performing below the national standard, with the lowest score nationwide.

In the same focus, Rohmatun Lukluk Isnaini, (2020) highlights that the presence of Muslims in the South has made ethnicity a constant concern for the majority. The historical interactions between Muslims and Thai authorities in Pattani have influenced government decisions on the existence of Muslim communities. Islamic education in Pattani dates back to the 15th century when Islam first arrived and established itself in the region. Education in Islamic society started with the study of the Qur'an. It is compulsory for every individual in the community to recite the Qur'an. The popularity of Quranic education increased, leading to the establishment of Islamic boarding houses.

The Islamization process in Pattani is closely linked to education. Initially, informal education through preacher-local people interaction was key, leading to non-formal education and eventually formal education. The government began providing formal education in 1899 during the reign of King Chulalongkorn or Rama V. This school encountered reduced support from the public, leading to a new law in 1921 mandating elementary education from grades one to four. Despite the legislation, the Islamic community in South Thailand, particularly in the areas of Pattani, Yala, Narathiwat, and Satun, did not

approve of the new law. In 1960, data showed that just 13.67% of the population completed elementary school grades one to four in the area. The community maintained strong ties with Islamic education, as stated by Isnaini (2020).

2.2 The efficiency of the infrastructure and educational resources' quality

The Thai government has struggled to implement various educational policies due to a lack of proper management structure for educational projects. For instance, the government in Thailand lacks a specific department to monitor such initiatives, leading to a lack of continuous evaluation and updating of project procedures as well as results. Similarly, the Thai government has allocated funds for educational materials with the aim of enhancing instruction and cultivating important human resources in the Deep South. However, they have been unsuccessful in delivering the type of education that the Malay Muslims in the region deem satisfactory. More than that, Thai government officials seem to lack understanding of the concerns of Malay Muslims in southern Thailand which is particularly accurate for government officials in Thailand (Kaewsom, 2017).

According to a similar study by Herni Irmayani et al., (2018), a strategy is a method used to evaluate the quality of processes and products within an organization, involving a sequence of decisions as well as managerial actions that impact the company's long-term performance. To put things differently, time and security are also needed for strategies to operate effectively. From the previous analysis, it can be inferred that strategy is a well-thought-out managerial plan consisting of operational tactics or measures that are specific, time-bound, and secure in order to achieve goals under favorable circumstances. The art of utilizing all resources in order to support achieving goals effectively and efficiently is known as strategies directed towards goals and objectives. In terms of education, the focus should be on ensuring that the quality of education remains competitive and leads to high-quality school outcomes.

In education-related research, inadequate physical facilities are blamed for low levels of education in many countries. These conveniences are crucial, as they offer students a learning-friendly environment. Cutting-edge physical infrastructure has a positive impact on students' learning and success, ensuring a top-notch education. School facilities, including classroom buildings, labs, dorms, offices, and sports facilities, are crucial indicators of advancements and enhancements in education. Recent research carried out in the United Kingdom has revealed that infrastructure plays a major role in shaping students' academic performance, explaining 16% of the differences in primary school children's academic success (Yangambi, 2023).

In spite of the growing popularity of smart schools and rapid progress, countries are gravitating towards a limited pool of research in the sector that hinders the advancement of these schools. I find myself surrounded by the strong currents of the revolution today and have knowledge to support schools that promote student advancement. The Norwegian philosophical society needs to shift its focus to the community's view on education, specifically the impact of technology and innovations. Apart from this, it is essential to equip educators with the necessary tools to enhance intellectual skills and integrate technologies like computers in English teaching, aligning with the expectations of teachers and administrators. Consequently, there will be changes in the physical structure and internal organization of schools (Kamothamas, 2016).

In a similar study by, Siswanto & Hidayati, (2020) demonstrated that having skilled administrative personnel is crucial for effectively managing school facilities and infrastructure. Moreover, in ensuring the effectiveness of facilities management and school infrastructure, it is essential to offer training for teachers and provide well-equipped facilities like a stimulating library to enhance students' engagement in learning. All students living on campus contributed to the upkeep of current buildings and infrastructure.

In the same focus, Nurmayuli, (2022) having the necessary facilities and infrastructure is essential for a successful educational process and high-quality education in schools and other educational institutions. Active and integrated engagement within the FM organization is necessary for the evolution of sustainable FM practices. The effectiveness of an institution's educational activities is greatly influenced by its facilities and infrastructure. For instance, urban schools and educational institutions might already

possess WiFi and computer labs, enabling students to learn computer technology firsthand. On the contrary, schools and educational institutions in rural regions may lack the resources to provide computer education to students. This exemplifies the significance of facilities and infrastructure in our society.

2.3 Student academic performances in southern Thai

According to Wannaphong Durongkaveroj (2023), even with significant public funds invested in Thailand's primary education system, the academic achievement of students in national and international evaluations continues to be low. In reality, there has been little improvement over the last ten years. Throughout the years, many research studies have shown that this concerning pattern is mainly caused by a significant difference in education quality between urban and rural regions, leading to negative impacts on other development factors like economic growth and income inequality. Scholars and policymakers are debating equity in basic education due to the slowing economic growth and concerns about the middle-income trap. This paper aims to add to the discussion by investigating the academic achievement of elementary school students, studying the factors influencing it, and pinpointing key obstacles for Thailand's primary education system.

Looking at a similar study by Adebayo et al. (2020) said that the education system shows low student performance, excessive dropout rates, and disparities. Breaking down the educational system into affluent and non-affluent schools reveals that the former, usually better resourced, tend to outperform the latter, which are usually less equipped. Thus, the objective of this paper is to examine the various factors affecting academic performance in schools that lack wealth and have a history of disadvantage. It seeks to study how educational resources affect student academic performance, finding that having access to these resources increases the likelihood of students achieving international standards. The study also looks at how different factors influence student performance in schools with limited resources and explores the impact of educational resource availability on academic outcomes. The research indicates that student performances are greatly affected by the educational resources available.

In a related study, the school is a special kind of social setting where kids receive an education, training, and character development that is carried out through appropriate physical facilities, supportive psychological environments, and effective training methods as well as students are seen as the community's future. Besides that, good surroundings and good role models are essential for students to perform better during the socialization process. As schools are the primary influence on students' personalities, the physical environment of the school is crucial for learning and education, impacting students' development significantly from both social and spatial perspectives. All education and educational psychology experts concur that successful education relies on setting goals, creating conducive physical and social class environments, teacher and student motivation, students' cognitive, emotional, and motor readiness, effective class management, teacher subject mastery, and dedication to student improvement. The teacher attempts to establish an ideal learning setting in order to deter the emergence of disruptive behaviors and disturbances. Education is a societal responsibility, with public and governmental policies regarding this crucial area seen as a public right. Since no society can really have justice and equality without education, it is believed to be a necessary component in accomplishing these goals. Children enter elementary school as the first stage of their formal education, where they are exposed to a new world of knowledge and social realities outside of the family. Children and teenagers grasp the notions of social roles, duties, employment, and social connections, influencing their personalities through these encounters and perspectives. Research has also indicated a connection between academic success and mental well-being (Gilavand, 2016).

On the same idea, Wang et al. (2019), past studies have concentrated on how meeting overall psychological needs affects academic achievement, but have not investigated the significance of meeting particular needs linked to the school setting. As students dedicate a considerable amount of time to school activities, especially academic tasks, analyzing their satisfaction levels at school may offer helpful information on how to improve their academic results. Furthermore, most research studies have concentrated on adolescents. Only a small number of studies have concentrated on elementary school children, yet this is a notable mistake since academic achievement during this period heavily influences

students' future educational achievements. Moreover, most previous research has employed cross-sectional approaches. This limitation in methodology reduces confidence in the ability to draw precise conclusions as it lacks statistical adjustments for past levels of the dependent variables. Also, numerous research studies have failed to investigate the bidirectional relationship between behavioral engagement, academic achievement, and basic needs satisfaction. Transactional theory proposes that children's development is influenced by their ongoing interactions with the environment. Children both impact their surroundings and are impacted by them as well. Hence, unidirectional models may not accurately represent processes of growth and development. Therefore, we aimed to improve comprehension of the links between BPNSS, behavioral engagement, and academic success in elementary school students through the incorporation of self-system processes theory and transactional theory in a long-term study.

According to Adeyemi (2014), various school variables, such as quality instruction, effective supervision, appropriate instructional materials, standard facilities, smaller class sizes, and a conducive environment, have a significant impact on students' academic performance. He determined that in regions with a strong private school presence, there would be a significant decrease in drop-out rates and students' academic achievements would improve. He suggested that this could be because resources are accessible and, most significantly, teachers have a positive drive, which is a study in the United States comparing academic accomplishment in charter, private, and public schools, which was a main finding of the research. Moreover, the study revealed that private schools outperformed both charter and public schools in terms of scores, and a study in the United States compared the academic performance of students in private and public schools in reading and math for grades 4 and 8. The results showed that private schools excelled over public schools in both subjects and across both grades studied. Overall, the findings indicated that private schools had a higher mean score compared to public schools, and this disparity was deemed to be statistically noteworthy.

A study by Charles & Mkulu, (2020) carried out a research project in Pakistan focusing on analyzing the issues in the education sector. The research discovered deficiencies in the education sector such as inadequate funding, ineffective policies, a faulty examination system, substandard facilities, high dropout rates, and corruption playing a significant role in negatively impacting the education system in Pakistan by influencing financial allocations, staff movements, promotions, and decision-making processes.

In relation to this study, Paul & Jana (2023) found intra-district discrimination in primary-level education in Bankura district, West Bengal, revealing disparities in economic, social, cultural, and institutional indicators across different blocks. Thus, we explored challenges in education, including attendance, class differences, gender, and poverty barriers. More than that, we assessed students' reading skills and educational quality in government primary schools in India and analyzed learning outcomes in classes IV and V in government, private aided, and private unaided schools in Orissa to identify factors influencing student performance.

3. METHODOLOGY

3.1 Study Design

In exploring the answers to the research questions about educational inequality in southern Thailand, qualitative methods were chosen because they are particularly suited for understanding the nuanced perspectives and experiences of elementary school teachers in this region. Qualitative research is ideal for examining complex social issues, such as the impact of sociopolitical factors and cultural identity on education, which are not static but involve multiple interconnected elements (Rahman, 2016). Phenomenological qualitative analysis, a key method employed in this study, allows for an in-depth exploration of the lived experiences of teachers, providing insight into the factors contributing to educational inequality and how these disparities impact student performance. By focusing on personal narratives and subjective experiences, phenomenological analysis helps uncover the obstacles and challenges faced by teachers and students in southern Thailand. This method is instrumental in capturing

the rich, detailed personal accounts that quantitative methods might overlook. Furthermore, qualitative methods enable researchers to understand the context within which educational inequality exists. This includes examining the historical, cultural, and political backdrop of the region, which is essential for comprehending the full scope of the issue. The contextual understanding provided by qualitative research ensures a comprehensive analysis of the various factors influencing educational inequality. Furthermore, qualitative research allows teachers to share their individual stories and perspectives, highlighting the specific issues they face and the strategies they use to cope with these challenges. This approach offers a richer and more detailed understanding of the problem compared to quantitative methods, which often fail to capture the depth of personal experiences. Through direct insights from teachers, this study aims to present a holistic view of the educational challenges in southern Thailand (Pietkiewicz & Smith, 2014).

To collect relevant data, this study utilized in-depth interviews conducted via Google Meet, ensuring flexibility and convenience for respondents. The interviews were recorded with full consent from the respondents, who were assured of the confidentiality of their personal information. A total of six respondents, meeting specific criteria relevant to the research, were identified and contacted. The selection process involved thoroughly explaining the research title, method, overview, objectives, and pertinent research questions to potential participants, ensuring that they were well-informed and comfortable with their participation. This comprehensive approach to data collection ensures that the findings are both relevant and insightful, offering valuable perspectives on educational inequality in southern Thailand.

This research employs semi-structured interviews as a methodological approach to delve into the nuanced complexities of educational inequality experienced by elementary school teachers in southern Thailand. The semi-structured format offers a balanced blend of consistency and flexibility, allowing respondents to provide detailed insights while enabling the exploration of emergent themes. Through this approach, the study aims to capture a comprehensive understanding of the multifaceted challenges faced by teachers in the region, shedding light on the underlying factors contributing to educational disparities. Interviews were conducted using Google Meet, offering a convenient and accessible platform for data collection that accommodated geographical and scheduling constraints. This digital format facilitated a relaxed and open discussion environment, allowing participants to engage comfortably from their own locations. Prior to each interview, participants provided consent for recording, ensuring accurate data collection while upholding ethical standards. Through purposive sampling, six elementary school teachers with extensive teaching experience in southern Thailand were selected, ensuring that participants possessed relevant insights into the research topic. Participants were briefed on the study's objectives and their roles, ensuring informed consent and active engagement in the research process.

This methodological approach and participant selection strategy aim to provide valuable insights into the perspectives of elementary school teachers regarding educational inequality in southern Thailand. By employing semi-structured interviews and leveraging digital platforms, this research seeks to unravel the intricate dynamics shaping educational disparities and contribute to informed strategies for addressing these challenges.

3.2 Setting

This study took place in primary schools found in the southern regions of Thailand, particularly in Pattani, Yala, and Narathiwat. In order to encourage open and honest conversations, the interviews were conducted in specific locations at each school, like an unoccupied classroom or a peaceful spot in the school library. These sites were selected in order to guarantee confidentiality and reduce interruptions while conducting the interviews. Furthermore, interviews were arranged outside of teaching hours to prevent disturbances and enable participants to actively participate in the discussion. The peaceful surroundings at the school created an ideal space for individuals to discuss educational inequality without being disrupted by outside distractions.

Due to the geographical locations of the participants, all six interviews were carried out through Google Meet. This digital platform offered a convenient and easily accessible way to collect data,

particularly considering the logistical and scheduling limitations. Conducting interviews online guaranteed that participants could participate comfortably from their own space.

Their own places can help create a comfortable and open atmosphere for discussions. Utilizing Google Meet enabled the smooth incorporation of recording and transcription features, crucial for capturing precise data for analysis. This mix of traditional school settings and internet interviews helped guarantee a comprehensive and efficient examination of the research subject.

3.3 Sample of the study

This qualitative research used purposive sampling to choose a group of elementary school teachers in southern Thailand, with a focus on investigating educational inequality in the area. Six individuals were carefully selected for their significant teaching background, with each having at least five years of experience teaching in elementary schools. The selection criteria involved a variety of both male and female participants to provide a fair representation, with ages ranging from 35 to 40 years old. This method was created to encompass a variety of viewpoints and experiences that are important to the research topic. The sample for this study will consist of elementary school teachers from southern Thailand. The study will include:

- All selected elementary school teachers from Pattani, Yala, and Narathiwat for the initial qualitative interviews.
- A subset of these teachers, specifically those with significant insights on educational inequality, for follow-up in-depth interviews.
- A focus on teachers with at least five years of teaching experience
- aged between 35 to 40 years
- a mix of both male and female participants to ensure diverse perspectives.

The focused sampling was intended to recruit educators from different areas in southern Thailand, specifically Pattani, Yala, and Narathiwat. The research aimed to thoroughly examine the obstacles and possibilities involved in tackling educational inequality in these areas by concentrating on this particular group of people. The purposive sampling technique guaranteed that the chosen participants possessed significant knowledge and perspectives on the educational inequalities impacting their students, thus aiding in a thorough grasp of the local situation and guiding possible remedies.

Table 1 Background of the Respondents

Respondent	Gender	Age	Teaching Experience (Years)	Location
A	Female	37	10	Pattani
B	Male	39	15	Yala
C	Female	36	7	Narathiwat
D	Male	38	12	Pattani
E	Female	40	10	Yala
F	Male	35	8	Yala

3.4 Instruments

The study utilized semi-structured interviews as the main tool for gathering data, providing an adaptable yet targeted method for collecting qualitative information. The study ensured a wide range of voices could be heard by offering interviews through physical meetings or online platforms such as Google Meet, maximizing accessibility and convenience for participants.

All interviews were taped after getting the approval of the participants, ensuring precise retention of their views and opinions. The following written version of these audios helps in in-depth examination and understanding of the information, allowing researchers to recognize common themes and patterns in the stories told by participants.

Thematic analysis is used as the analytical structure in this research, allowing researchers to discover, examine, and explain patterns of significance in the data. Through organized coding and categorizing of interview responses, the study seeks to reveal key themes concerning the perceived reasons for educational inequality, its influence on student outcomes, and the government and policy's role in tackling these problems.

3.6 Themes of findings

- Perceived Causes of Educational Inequality in Southern Thailand
- Impact of Educational Inequality on Student Performance
- The Role of Government and Policy in Addressing Educational Inequality

4 FINDINGS AND DISCUSSION

4.1 Contributing Factors to Educational Inequality

All respondents agreed that numerous causes contribute to educational disparity in their areas. These encompass socioeconomic disparities, family background, disparities in educational opportunities, inadequate resource allocation, and a lack of sufficient government support. These issues combine to present major barriers to guaranteeing equitable access to quality education for all students.

Respondent A:
".....Socioeconomic status is a major factor. Students from low-income families often lack basic necessities and educational materials. This affects their ability to keep up with their peers who have more support at home....."

Respondent B:
".....Our school does not have enough resources. We need more books, technology, and learning materials to provide equal opportunities for all students. Without these, the gap between students only widens..."

Respondent C:
".....Family background plays a significant role. Students whose parents are uneducated or unemployed tend to struggle more in school. They do not get the same level of support and encouragement at home....."

Respondent D:
".....Opportunities in education are not evenly distributed. Some students have access to private tutoring and extracurricular activities, while others do not. This creates a huge disparity in educational outcomes....."

Respondent E:
".....There is insufficient government support. Many schools in disadvantaged areas are underfunded and understaffed, making it difficult to provide quality education to all students....."

Respondent F:
"....Lack of resources is a big issue. We often run out of basic supplies, and there are not enough computers for students to use. This makes it hard to implement modern teaching methods and keep students engaged....."

According to Laveria Munir et al., (2023), emphasizes that financial and material resources are critical for providing equitable education, and socioeconomic disparities can significantly hinder student achievement and access to necessary educational tools. Moreover, opportunities for low-income students in education are limited, as they often lack the financial resources needed to pursue quality education. Besides, education is commonly accepted as a crucial element that impacts an individual's social and economic achievements, as it offers a route to enhanced prospects and a higher standard of living. Socioeconomic status pertains to where individuals or families stand socially and financially in a society, including factors like income, parental education, occupation, and access to resources and opportunities. SES is a complicated idea that includes both concrete and abstract advantages and disadvantages. Studies have demonstrated that individuals from more affluent socio-economic backgrounds tend to have increased opportunities for educational resources like top-notch schools, tutoring, literature, and technology, resulting in superior academic achievements.

In terms of socioeconomic disparities, family background, unequal educational opportunities, lack of resources, and insufficient government support are critical factors contributing to educational inequality in southern Thailand. These elements create significant barriers to equitable education, as emphasized by both respondents and past research. As well as, dealing with these problems necessitates holistic plans to guarantee that every student, regardless of their economic status, has the needed resources and assistance to excel academically.

4.2 Impact of Contributing Factors on Teaching and Learning

Based on the responses, five respondents acknowledged the identified factors significantly impact both teaching methods and student learning experiences, creating challenges for educators and learners alike.

Respondent A:
"When students come to school hungry or without supplies, it affects their ability to concentrate and learn effectively."

Respondent B:
"When we contrast educational institutions in rural and urban settings, we can observe how drastically different they are. In rural locations, there are just not as many classroom supplies or equipment available....."

Respondent C:
"As a teacher, engaging students who face many external difficulties is challenging. Their struggles outside of school often spill over into the classroom....."

Respondent D:
"....Teachers do not focus too much on teaching because of their workload, which is so heavy and involves so many other tasks in addition to classroom instruction....."

Respondent E:
"....I think that we teach our students in the same way that we have always used an old technique that is no longer appropriate in today's environment...."

A study by Darling-Hammond et al. (2017) is pertinent to teaching students in the classroom using instructional materials and equipment. This study highlights the significance of sufficient teaching resources and up-to-date instructional materials in improving student learning results. The research

discovered that schools with enhanced availability of teaching resources and tools demonstrated notable enhancements in student academic achievement and involvement.

The results from the participants show that insufficient resources, updated teaching methods, and heavy workloads greatly impede successful teaching and student progress. Previous research by Darling-Hammond et al. (2017) supports these results, emphasizing the significance of having sufficient and current teaching materials to improve student success and engagement. This highlights the need for adopting particular tactics to equip teachers with the necessary tools and support to address educational inequalities successfully.

4.3 Role of Government in Ensuring Educational Equality

Five out of six teachers perceive the government's role as critical in addressing educational inequality, but they often see current efforts as insufficient.

Respondent A:
"The government needs to provide more funding and resources to schools in disadvantaged areas. Current support is not enough."

Respondent B:
"...Policy changes are necessary. We need more comprehensive and targeted programs to address the specific needs of our students….."

Respondent C:
"...The government must provide instructional resources, such as computers and laptops, for students to use in school…"

Respondent D:
"...The government pays for everyone's access to school for a minimum of 12 years; this includes free stationary, books, and lunch allowances on that day. However, this is still insufficient to ensure that children receive a high-quality education…."

Respondent E:
"All children must receive free, compulsory education from the government, which must also support a variety of educational programs adapted to the needs of different communities. The government should also promote partnerships with other countries and the private sector to deliver high-quality education at all levels while adhering to international standards….."

Respondent F:

"....As stakeholders raise awareness of this issue, policy support for sustainable education grows…."

According to Eden et al. (2024), The history behind education policy reform shows a complicated mix of achievements and setbacks in advancing fairness and inclusion in education. Although advancements have been made in increasing educational options and reducing inequalities, continual work is necessary to guarantee that every student has fair access to high-quality education and the chance to excel. Education policy is intertwined with larger social systems and interactions in various manners, showcasing and impacting cultural values, norms, and power dynamics. Education policies are influenced by the cultural, political, and economic environments in which they are implemented, rather than being created in isolation. Education policies frequently mirror current cultural beliefs and values regarding the objectives and aims of education. Cultural beliefs about gender roles, diversity, and citizenship can impact

what is taught, how it is taught, and policies on inclusion and diversity, which are influenced by various stakeholders like policymakers, advocacy groups, and educational institutions, making them inherently political.

Political beliefs, party policies, and election periods can affect the focus and course of education policy, shaping choices regarding financial support, educational content, and management. Economic factors, like budget limitations, workforce needs, and global interconnectedness, also impact educational policy. Discrepancies in the economy can impact access to educational resources and opportunities, influencing decisions about school funding, teacher salaries, and vocational education. This research highlights the significance of government involvement and policy change, such as more funding and specific programs, to guarantee equal access to education. Prasert contends that schools in disadvantaged areas are unable to offer essential resources and opportunities to all students without significant government assistance. The study emphasizes the importance of adequate funding and effective policies in closing educational disparities and ensuring fair learning conditions.

According to Diwakar Kishore and Dhwani Shah (2019), it is important to note that there are gaps in the evidence regarding this topic which focused interventions, such as introducing technology in schools and offering training programmes for teachers, greatly enhanced educational results in disadvantaged areas. Although it was costly, giving students access to computers or tablets did not lead to immediate improvements in learning outcomes. This might be related to the fact that both students and teachers require time to adjust to utilizing computers for learning and instruction. Furthermore, these interventions are complex, and learning gains are determined by the efficacy of all aspects of the process, including teacher training. Positive results have been observed in China and India, where effective interventions were implemented and the assessment focused on a specific region. Below, we provide a summary of important findings from studies on the topic. Further research is necessary to analyze how ICT can improve collaboration among teachers and simplify assessment procedures in developing nations.

This study emphasizes the relevance of government policies in providing equitable education by ensuring that schools have appropriate resources and that educational activities are intended to meet the diverse needs of students. The research indicates that successful government involvement requires more than just financial support; it also necessitates the careful planning and execution of initiatives aimed at tackling specific community issues. Increased government involvement and policy changes are necessary to tackle educational disparities, especially through enhanced funding and specific support initiatives. It emphasizes the essential importance of the government in guaranteeing that every student, regardless of their circumstances, is able to obtain high-quality education and also emphasizes the importance of government policies that are both thorough and specific, ensuring that communities in need receive the resources and support necessary to overcome their unique challenges.

4.4 Negative Impact of Educational Inequality on Student Performance

All respondents expressed that educational inequality is perceived to have a direct negative impact on student performance and academic outcomes. The teachers highlighted how disparities in resources, family support, and socioeconomic status affect students' ability to perform well academically.

Respondent A:
"....Students who lack resources or face economic hardships tend to perform worse academically. They struggle to keep up with their peers who have more support and better learning environments…."

Respondent B:
"...There is a clear correlation between a student's background and their academic success. Those with more support at home tend to do better in school, while students from disadvantaged backgrounds fall behind....."

Respondent C:
"...Many of my students come from low-income families. They often miss school or come unprepared, which affects their academic performance significantly....."

Respondent D:
"...The lack of access to basic educational materials and extracurricular activities puts students from poorer families at a disadvantage. They can't compete on equal footing with those who have more opportunities....."

Respondent E:
"...I have seen how educational inequality leads to lower self-esteem and motivation among students who feel they are at a disadvantage compared to their peers....."

Respondent F:
"....Students who face economic hardships are often distracted by their personal circumstances, making it difficult for them to focus on their studies and perform well academically....."

Based on this research, Munir et al. (2023) have been more interested in closing the achievement gap caused by socioeconomic status disparities in recent years. Moreover, efforts have been made to create policies and strategies to diminish educational inequalities and ensure fair educational opportunities for every student, regardless of their economic status. Policymakers and educators can collaborate to develop targeted strategies that tackle the impact of socioeconomic status on academic achievement and advocate for equity in education.

Socioeconomic status is connected to academic success through various interaction systems such as students' ethnicity, grade level, and location of school or neighborhood. It is proposed that family socioeconomic status not only offers resources at home but also indirectly offers "social capital" through supportive relationships and partnerships between parents and schools. Social capital facilitates the transmission of cultural expectations and beliefs, which is crucial for achieving academic success. Therefore, the economic status of the family, which heavily influences where the child lives and goes to school, has a major impact on academic success (Aashiq et al., 2023).

Educational disparities lead to worse academic performance among impoverished kids, stressing the significance of particular interventions to assist these children. Both studies discovered that socioeconomic variables had a major influence on academic performance, with pupils from impoverished backgrounds frequently performing poorly academically. These findings emphasize the importance of financial stability and access to educational resources for student achievement. Moreover, it underscores the necessity of addressing socioeconomic disparities to ensure that every student has an equal chance to succeed academically. In order to lessen the impacts of educational inequality, policies and programmes that aid underprivileged students and give more resources must be put into place.

4.5 Variety of method in Measurement of Student Performances and Outcomes

All Teachers use various methods to measure student performance and outcomes, including standardized tests, classroom assessments, and continuous observation. These diverse assessment strategies help provide a comprehensive understanding of each student's progress and needs.

Respondent A:
"...We use standardized tests to assess academic performance, but we also rely on regular classroom assessments and observations to get a complete picture of a student's abilities and challenges...."

Respondent B:
"...Continuous observation helps us understand the day-to-day progress and challenges faced by our students. It is not just about test scores; it is about overall growth....."

Respondent C:
"...Classroom assessments, such as quizzes and projects, allow us to see how well students understand the material on a regular basis. This ongoing evaluation is crucial for identifying and addressing learning gaps...."

Respondent D:
".....Standardized tests provide a benchmark for academic performance, but they do not capture everything. We need to look at students' work habits, participation, and effort as well....."

Respondent E:
"...Observational methods help us identify behavioral and emotional issues that might be affecting a student's academic performance. These insights are essential for providing appropriate support...."

Respondent F:
".....Using a combination of assessment methods allows us to tailor our teaching strategies to meet the individual needs of our students. It helps in creating a more inclusive and supportive learning environment...."

Mark Wilson (2018) emphasizes the significance of using various assessment methods to gain a comprehensive understanding of student performance. The research discovered that depending exclusively on standardized tests may be restrictive, while integrating ongoing observation and frequent classroom assessments offers a more comprehensive understanding of a student's skills and development. As professionals in the field of education measurement, our main focus is on creating and utilizing different types of tests and assessments. A large portion of the funding supporting the development of these tests originates from the choices made by education policymakers, primarily officials at state and federal levels responsible for overseeing education, as well as administrators at various educational levels.

Through utilizing a range of assessment methods, educators are able to obtain a thorough understanding of their students' achievements and provide personalized assistance to address individual needs. Besides that, a comprehensive evaluation strategy is essential to effectively tackle educational disparities and enhance student success. The use of a multidimensional assessment approach leads to improved educational results and more equitable learning settings by considering all aspects of a student's learning and growth.

4.6 Observable negative Patterns in Student Performance

All Teachers have observed consistent patterns in student performance, particularly among those from disadvantaged backgrounds. These patterns include lower test scores, higher dropout rates, and persistent underperformance among students facing socioeconomic, language, and cultural barriers.

Respondent A:
".....Students from lower-income families consistently score lower on tests and have higher dropout rates. This trend has been evident over the years and shows no signs of improvement....."

Respondent B:
"....There are clear patterns of underperformance among students who face language and cultural barriers. They struggle more with academic content and often require additional support....."

Respondent C:
"....We see a higher incidence of absenteeism and tardiness among students from disadvantaged backgrounds, which correlates with lower academic achievement and engagement……"

Respondent D:
"...Students who do not have access to additional learning resources, such as private tutoring or after-school programs, tend to fall behind their peers in both grades and comprehension….."

Respondent E:
"....The performance gap is quite stark. Students from wealthier families perform consistently better, while those from poorer backgrounds face numerous challenges that hinder their academic progress….."

Respondent F:
"...Disadvantaged students often exhibit lower self-confidence and motivation, which further impacts their academic performance. They need more encouragement and support to overcome these barriers….."

According to Langthaler et al. (2023), this study highlights the urgent necessity for policy actions and aid systems to lessen the negative impacts of educational disparities, stressing the significance of tackling both tangible and intangible obstacles to student achievement. These trends are frequently deeply rooted and necessitate extensive tactics to tackle the root causes of educational inequalities. At present, many scientific fields and methods are examining disparities and injustices in education, including economics, sociology, political science, and pedagogy. In this paper, it is helpful to distinguish between theoretical perspectives rooted in optimism and those rooted in critical and relational views of social aspects. From a developmental standpoint, the initial group sees education in a positive light as a tool for combating poverty and promoting human welfare. On the other hand, the second method emphasizes the relationship between education and other socioeconomic issues.

Particularly noticeable developments regarding student success reveal the systematic presence of educational injustice and the need for targeted solutions. It is critical to address these persistent discrepancies in order to ensure equitable educational outcomes for all students. Implementing comprehensive approaches that provide academic and socio-emotional support will help mitigate the consequences of these discrepancies and ensure that all kids have an equal opportunity to flourish.

4.7 Necessary Support and Resources to Address Educational Inequality

All respondents emphasize the need for additional support and resources to mitigate the effects of educational inequality, including increased funding, tailored programs, and community involvement. They highlight specific areas where resources are lacking and the types of support that could help bridge the educational gap.

Respondent A:
"...We need more funding for educational resources and programs that address the specific needs of disadvantaged students. Without proper funding, it's hard to provide the necessary support….."

Respondent B:
"Tailored educational programs are essential. Standardized curriculums often do not account for the diverse needs of students from different backgrounds."

Respondent C:
"...Community involvement is crucial. Parents and local organizations can play a significant role in supporting students and addressing inequality. When the community is engaged, students benefit greatly…"

Respondent D:
"...Professional development for teachers is important. We need training on how to effectively support students facing educational inequality. This includes understanding their unique challenges and how to address them…."

Respondent E:
"...Access to technology and modern teaching tools is lacking in many schools. Providing students with these resources can significantly enhance their learning experience and help bridge the gap…."

Respondent F:
"....We need more mental health and counseling services. Many students dealing with educational inequality also face emotional and psychological challenges that need to be addressed…."

Socioeconomic inequalities in education refer to the uneven distribution of educational resources, opportunities, and outcomes based on one's socioeconomic status. The variances could significantly impact students from impoverished families, limiting their exposure to top-notch education and increasing the achievement disparity. To ensure educational fairness for all students, it is important to tackle disparities and create learning spaces that prioritize student needs. It has been shown time and time again that there are socioeconomic differences in schooling that have negative effects. Due to the potential for increased academic achievement and social mobility among children from low-income homes relative to their richer counterparts, addressing socioeconomic disparities in education is crucial. Students from underprivileged families frequently deal with a variety of issues, such as inadequate support networks, limited access to technology, and financial difficulties. Enhancing educational experiences and reducing the achievement gap can be achieved through creating learning settings that focus on the unique needs of each student and prioritize both participation and personalized instruction (Adeoye et al., 2023).

Likewise, numerous boards, committees, and organizations play a role in influencing education funding. This ultimately results in our work primarily focusing on a top-down approach, at the request and with the intentions of these policymakers and administrators. This is completely suitable because they are the individuals and organizations that are essential in making significant decisions in our educational efforts. Nonetheless, there is a different perspective to consider in the educational endeavor, starting from the ground level. Educational measurement's main goal is to assist every student's educational development as they acquire knowledge. The individuals directly concerned are the student and the teacher. From this point of view, the teacher-student duo are the ones leading the key moments in student learning, where crucial decisions are made and significant impacts occur.

To sum up, tackling educational inequality requires a holistic strategy involving more funding for resources and programmes specifically designed for disadvantaged students. This involves putting in place customized educational programs that acknowledge various student backgrounds, increasing community engagement to offer important support systems, and giving importance to teacher training to adequately cater to student requirements. Furthermore, it is essential to have modern teaching tools accessible and to expand mental health services in order to promote a fair learning environment. Through the implementation of these approaches, individuals with vested interests can collaboratively strive to reduce educational inequalities and advance equal chances for every student.

5 DISCUSSION

The results of this research give a thorough look at the beliefs of elementary school teachers in southern Thailand about the reasons for and effects of educational inequality. The data show that teachers mostly believe that socioeconomic gaps, familial background, unequal access to school, poor resource allocation, and a lack of government support are important factors in educational inequality. Respondents' observations and existing literature underscore the significant obstacles to ensuring equal access to high-quality education for all students.

Moreover, social and economic status play a significant role in academic achievements, as students from low-income households frequently lack essential resources and educational tools, leading to difficulties in keeping pace with their classmates. This is in line with Munir et al. (2023), who stress that equal access to financial and material resources is essential for fair education, and differences in socioeconomic status greatly impact student success. The challenges are made worse by family background, such as the level of education and job status of parents, which results in a lack of vital home support and motivation needed for academic achievement.

Likewise, teachers have pointed out the significance of insufficient resources such as books, technology, and learning materials in schools. The absence of resources hinders the use of up-to-date teaching techniques and decreases student involvement, leading to a wider educational disparity. Regarding that, Boyer et al. (2019) highlight the link between socioeconomic status and academic success, indicating that levels of wealth, social connections, and cultural knowledge in the family can help pass on advantages through different generations, which are frequently absent in families facing disadvantages.

More than that, teachers also feel that the government is not doing enough to tackle educational inequality. Apart from this, they emphasize the importance of more funding, specific programs, and thorough policies to help underprivileged areas. The results of the Eden et al. (2024) study validate this perspective, emphasizing the intricate relationship between cultural, political, and economic influences on education policies. Successful government intervention necessitates both funding and well-thought-out programs to cater to the unique requirements of various communities.

Furthermore, the results also show that disparities in education have a direct impact on students' academic performance and outcomes. Students from underprivileged backgrounds consistently achieve lower academic performance, experience attendance challenges, as well as show reduced self-esteem and motivation levels. Munir et al. (2023) and Aashiq et al. (2023) support the connection between socioeconomic status and academic achievement, highlighting the significance of social capital and supportive relationships in reaching educational goals.

Above all, educators use different assessment methods to evaluate how students are performing, understanding the constraints of standardized tests. Afterward, a more comprehensive picture of students' strengths and shortcomings is provided in the classroom through regular evaluations and consistent monitoring. Wilson (2018) asserts that addressing educational disparities and raising student accomplishments require a multimodal strategy.

At the same time, identifiable trends in student achievement also emphasize the enduring presence of disparities in education. Students who come from lower-income families typically achieve lower test scores, experience higher rates of dropping out, and encounter notable academic and emotional obstacles. Langthaler et al. (2023) highlight the importance of targeted interventions to tackle these deep-rooted inequalities, underscoring the significance of providing both concrete and abstract assistance to enhance student success.

Finally, the research highlights the need for more assistance and resources to address the impacts of educational disparities. Enhanced financial support, customized initiatives, engagement from the community, ongoing training for educators, availability of up-to-date teaching resources, and mental wellness support are essential in establishing a fair educational setting. Adeoye et al. (2023) emphasize the significance of tackling socioeconomic inequalities to improve educational experiences and narrow the achievement gap.

6 RECOMMENDATION

The findings of this research offer important revelations about the perspectives of primary school educators in southern Thailand on educational inequity. Nevertheless, the results are not comprehensive, and additional research is necessary to achieve a more thorough comprehension of the intricacies at play. I strongly recommend that future researchers take into account the following suggestions in order to improve the precision and relevance of the study findings.

First and foremost, it is crucial to engage people from various regions in Thailand and other countries in order to fully grasp educational inequalities. Extending the study's geographical scope will facilitate the identification of regional differences and convergences, providing a more comprehensive comprehension of the issue and potential remedies.

Furthermore, it is important to guarantee that the sample comprises educators and learners from diverse socioeconomic backgrounds, nationalities, and educational environments. A more thorough grasp of the intricate structure of educational disparity is made possible by broadening the sample to include people from different backgrounds. Researchers can improve their understanding of educational inequalities by involving a diverse range of participants to examine how various factors intersect and impact disparities in education.

Apart from that, it is essential to assess the effectiveness of current government policies and initiatives aimed at reducing educational inequality. Evaluating present governmental actions can assist in recognizing pros and cons in current policies and programs, laying the groundwork for suggesting enhancements and fresh strategies. This assessment can verify that resources are being utilized efficiently and that policies are tackling the underlying factors of educational inequality.

Finally, it is crucial to analyze how the ongoing training of teachers impacts their ability to cater to the needs of disadvantaged students. Studying how professional development affects teachers' skills in helping marginalized students can provide valuable information on improving teacher training to decrease educational inequality. Continuously improving teacher competence and understanding through regular professional development is crucial in preparing them to meet the various needs of their students successfully.

7 CONCLUSION

In conducting this study, the review of papers from prior studies and the use of qualitative interviews provided insights demonstrating that examination of how elementary school teachers in southern Thailand view educational inequality, pointing out that social class differences, lack of resources, and limited government backing are main factors contributing to this issue. Teachers' assessments indicate how these elements affect students' academic achievements, emphasizing the critical requirement for structural changes. Students from disadvantaged economic backgrounds encounter more obstacles in obtaining high-quality education, impacting their academic advancement and overall growth. To tackle these problems, it is necessary to implement holistic approaches such as targeted guidelines, extra funding for educational tools, and community participation in order to establish an inclusive educational setting that caters to the needs of various students. Enhancing teacher education, providing up-to-date teaching materials, and ensuring equitable resource distribution are crucial steps. Collaboration among schools, communities, and policymakers is essential to sustain efforts in closing educational gaps. Focusing on these aspects can help stakeholders develop equitable educational experiences that enable students from all economic backgrounds to achieve their academic potential and contribute positively to society. This research underscores the importance of addressing educational disparity and offers actionable recommendations for policymakers, educators, and communities to promote equal opportunities for every student.

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Enhancing HSE Learning Through SafeLoad's Metaverse Simulation

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ABSTRACT

Health, Safety, and Environment (HSE) education is essential for preparing students to recognize hazards, implement preventive measures, and contribute to safer workplaces. However, conventional lecture-based approaches often fall short in conveying the real-world implications of safety protocols. This study presents SafeLoad: A Virtual Guide to Suspended Load Safety, a metaverse application developed within a metaverse environment to enhance HSE training. Built using the Rapid Application Development (RAD) methodology, SafeLoad simulates a realistic warehouse setting to reinforce the HSE rule on suspension load. The application features immersive learning checkpoints and interactive assessments, allowing users to navigate safety scenarios in a controlled digital space. Usability testing involving ten final-year engineering students—who had prior HSE exposure—revealed that 80% found the simulation highly impactful in clarifying suspended load safety practices. Participants also rated the interface as user-friendly and engaging, highlighting the potential of metaverse technology in HSE learning. Despite challenges such as development costs and technological requirements, the study underscores the promise of immersive virtual environments for training and recommends future research into scaling the platform and incorporating AI-driven personalization.

KEYWORDS: Health, Safety and Environment, Metaverse, Immersive Technology, Virtual Guide

1 INTRODUCTION

Health, Safety and Environment (HSE) courses are indispensable in university programs because they give students the knowledge and skills to anticipate, manage and mitigate risks across a range of industries. By cultivating an ethos of safety and environmental stewardship, HSE learning helps future professionals recognize hazards, apply preventive measures and support safer, more sustainable workplaces. Yet most HSE instruction still relies on traditional lectures—an approach that often leaves learners unable to appreciate how safety procedures play out in real life. Immersive virtual-reality (VR) simulations have begun closing this gap by letting students practise their responses to realistic hazards without putting anyone in danger, thereby deepening comprehension and retention of key safety principles.

While Virtual Reality (VR) has proven effective for Health, Safety, and Environment (HSE) education, it does have limitations. Traditional VR applications are often limited to single-user

experiences. While VR can provide immersive simulations for understanding specific risks in the workplace—such as scenarios involving falling hazards or equipment operation—it typically does not support multi-user interactions or social engagement. In contrast, the metaverse allows many users to inhabit the same virtual space simultaneously, encouraging collaboration and communication while conducting training exercises. This enhancement improves teamwork skills and fosters a sense of community among trainees, which is critical for developing a robust safety culture (Chamola et al., 2025).

Moreover, VR applications typically create isolated experiences where users engage with a pre-designed scenario. Once the session is completed, the user often cannot revisit the same environment or scenario to continue practicing skills or revise concepts. Alternatively, the metaverse enables persistent environments where users can return, practice, and refine their knowledge and skills over time without starting from scratch. This ongoing access supports continued learning and aligns with the principles of competency-based education, allowing individuals to master HSE principles progressively (Zhao et al., 2022).

The metaverse distinguishes itself from traditional virtual reality (VR) applications by offering a more expansive, interconnected, and immersive digital environment that enhances various aspects of learning, collaboration, and interaction. the metaverse leverages advanced technologies such as augmented reality (AR), artificial intelligence (AI), and blockchain, creating a rich and layered educational experience Gonzalez et al., 2023; Usmani et al., 2022). These technologies are integrated into the metaverse framework, which allows for adaptability and personal customization of learning pathways. Educators can tailor experiences according to individual student needs or preferences, making learning more relevant and effective (Wang et al., 2022). This adaptability is less prevalent in conventional VR applications, where experiences are typically pre-defined. Looking ahead, the metaverse promises an even more transformative leap for HSE training. Fully interactive, networked virtual worlds can stage complex, multi-user scenarios that reflect the fluid conditions of real-world worksites. Within these shared spaces, learners can collaborate, investigate and adapt to evolving safety challenges in ways that foster richer engagement and deeper learning.

2 LITERATURE REVIEW

This literature review aims to synthesize existing knowledge concerning Health, Safety, and Environment (HSE) training, with a specific focus on the integration of advanced technologies, particularly metaverse environments. It begins with an overview of HSE culture, transitions to an analysis of training methodologies, and concludes with an examination of the burgeoning role of metaverse technologies in educational and training contexts.

2.1 Overview of Health, Safety and Environment

Health and Safety Environment (HSE) refers to the systematic approach adopted by organizations to ensure the safety, health, and environmental integrity of their operations. This framework encompasses both employee welfare and the environmental impacts of organizational activities, making it crucial for fostering a sustainable organizational culture. An effective HSE management system not only addresses regulatory compliance but also promotes a proactive safety culture and commitment to continuous improvement, enhancing overall organizational performance (Dehaghi et al., 2022;Wachter & Yorio, 2014; Mamashli et al., 2019)

Kongsvik, Gjøsund, and Vikland (2016) revealed significant variations in the implementation of specific HSE regulations, such as §15, across different petroleum companies. These disparities were attributed to differences in the firms' histories, complexities, and strategic orientations. The concept of "translatory mutation" or "drift" emerged, indicating deviations from initial regulatory aims, influenced by the companies' unique circumstances and learning processes. Their findings underscore that converting statutory requirements into organizational practices is an intricate and context-dependent process. Effective organizational learning in HSE requires both adherence to legislative mandates and the capacity to modify them to suit specific business needs. The study concluded that tailored approaches are necessary, acknowledging the diverse interpretations and applications of HSE culture across organizations.

2.2 HSE Learning at Universities

Health and Safety Environment (HSE) learning is increasingly recognized as a crucial component of higher education curricula across various disciplines. The incorporation of HSE in university programs equips students with essential knowledge and skills related to safety, health, and environmental management, preparing them for future professional responsibilities in their respective fields. Herein, several reasons for the importance of HSE learning at the university level will be elucidated.

Firstly, teaching HSE empowers students to understand the significant impact of workplace safety and environmental sustainability. A comprehensive HSE curriculum fosters awareness of risks and instills a proactive approach to risk management, helping students recognize the importance of creating safe and healthy working environments (Lestari et al., 2021). Through HSE learning, students learn to analyze safety practices and environmental policies, enabling them to contribute to their organizations more effectively. For instance, courses that integrate HSE focus on real-life applications where students can engage in case studies and simulations that demonstrate the principles of safe working behaviors, thus enhancing their practical understanding of risk assessment and mitigation strategies (Gute et al., 1993).
Moreover, universities that incorporate HSE into their curricula contribute to the development of a safety culture that spans beyond academia and into professional practice. This exposure benefits individual students and cultivates a broader societal impact by producing graduates who prioritize health and safety in their work environments (Lestari et al., 2021). Research indicates that applying sound HSE principles can lead to a reduction in workplace incidents and enhance employee well-being, underscoring the broader implications of HSE learning on public health and safety outcomes (Geiger et al., 2009).

2.3 Metaverse

The metaverse facilitates a shared, persistent virtual space where multiple users can interact with each other and the digital environment simultaneously. This characteristic of multi-user engagement allows for a more collaborative learning experience than traditional VR applications, which often focus on individual experiences. In the metaverse, learners can participate in group activities, discussions, and problem-solving exercises in real-time, thus enriching social interactions and collective knowledge sharing Lau et al.,2025; Ghaempanah et al., 2024) . Studies highlight that this shared experience can lead to a deeper understanding of health and safety concepts as learners engage with peers in scenario-based training or simulations (Bernardes et al., 2024).

In addition to collaborative features, the metaverse supports persistent environments that remain consistent over time. Unlike standalone VR applications that reset after each user session, metaverse environments allow users to return to the same space, where they can continue their learning journey. For instance, medical students using metaverse platforms can revisit their training scenarios or simulations, reinforcing their learning without the need for a complete re-setup of the virtual space (Lampropoulos et al., 2024). This continuity can significantly enhance skills retention and proficiency in applying health and safety environment (HSE) principles, ultimately leading to better real-world application in professional settings (Jo et al., 2025; Tang et al., 2024).

The metaverse's immersive quality enhances the ability to simulate complex, real-world scenarios that are vital in health and safety training. Learners can interact with 3D models representing hazards, explore the consequences of safety violations, and practice emergency responses in a controlled yet realistic environment (Ghaempanah et al., 2024; Gonzalez et al., 2023). Traditional VR might provide similar simulations, but the metaverse’s integration of various elements allows for more realistic and engaging scenarios that can mirror real-life conditions and facilitate better learning outcomes.

2.4 The Role of Metaverse in HSE Learning

The metaverse represents a transformative opportunity for educating individuals about Health and Safety Environment (HSE). Its immersive nature and the ability to create engaging, interactive environments make it particularly well-suited for conveying complex HSE concepts. Here are several roles the metaverse can play in enhancing HSE learning.

Firstly, the metaverse enables experiential learning, which allows users to engage with HSE scenarios in safe, simulated environments. This immersive quality can lead to greater retention of knowledge and skills compared to traditional classroom settings. For example, learners can participate in virtual simulations of workplace hazards, practicing safety protocols and emergency responses without

the risks associated with real-life training (Park & Kim, 2022; Tang et al., 2024). This kind of hands-on learning is crucial, especially in fields where adherence to safety procedures is paramount.

Moreover, the metaverse helps bridge geographical and physical barriers, making HSE learning accessible to a wider audience. For students who might face challenges in traditional educational settings—such as those with disabilities or those living in remote areas—the metaverse provides a flexible and inclusive platform for learning (Zaky & Gameil, 2024; Suh & Ahn, 2022). This aspect is vital in ensuring that all individuals, regardless of their circumstances, receive adequate training in health and safety practices.

Additionally, the collaborative features of the metaverse allow learners to work together in virtual environments, fostering a culture of teamwork and shared responsibility for safety. By interacting with peers and instructors in these immersive settings, students can enhance their understanding of HSE topics through peer-reviewed assessments and collaborative problem-solving exercises (Zaky & Gameil, 2024; Roy et al., 2023). This interaction not only promotes engagement but also reinforces the notion that safety is a collective responsibility.

Another key role of the metaverse in HSE learning is the incorporation of gamification elements. The use of game-based learning in the metaverse can make the learning process more engaging and enjoyable, motivating students to actively participate in their education (Rahman et al., 2023; Gündüz & Sincar, 2024; Zaky & Gameil, 2024). By framing HSE training within game-like scenarios, learners may become more invested in mastering safety protocols and understanding the consequences of unsafe practices, thereby retaining critical knowledge more effectively.

Furthermore, the metaverse can facilitate the visualization of abstract HSE concepts, enabling students to see the immediate impact of safety measures and environmental considerations in simulated environments. This visualization capability can enhance understanding and appreciation of HSE principles, making the theoretical more tangible (Kalınkara & Özdemir, 2023; Tang et al., 2024). For instance, students can observe the potential consequences of neglecting safety regulations in a controlled virtual setting, reinforcing the importance of compliance.

3 METHODOLOGY

The development of SafeLoad is based on the Rapid Application Development (RAD) methodology. This approach was structured into several key phases to ensure systematic progress and effective outcomes. The process began with the Planning phase, where the research problem was clearly defined, a project timeline was established, and a detailed literature review was conducted to ground the study in existing knowledge. Following this, the Conceptual Design and Development phase focused on identifying and formulating the learning objectives for the metaverse application, specifically tailored to Health, Safety, and Environment (HSE) learning. Input from literature and collaborative sessions with the Health, Safety & Environment Department at a private university helped shape the application's requirements. This stage also involves narrative design, crafting the user's journey, story, and overall progression within the virtual world. Storyboard creation visually maps out the entire experience, sketching scenes, interactions, and transitions to visualize the flow and design before any development begins. This phase also includes prototyping, wireframing, and the creation of a technical design document to outline specifications.

In the Technical Development phase, the virtual environment was built using the Spatial.io platform, with 3D models developed in Unity or sourced externally. The digital environment underwent multiple design iterations, each refined based on feedback from the university’s HSE stakeholders to ensure relevance and accuracy. The Usability Testing phase followed, during which a custom evaluation instrument was designed to assess the perceived effectiveness of the VR application. Users participated in heuristic evaluations to identify usability issues and suggest improvements. Data collected during testing was then examined in the Data Analysis phase to evaluate the application's overall performance and user experience. Finally, in the Recommendation phase, insights from the analysis were used to propose enhancements and future research directions aimed at strengthening the application’s role in HSE training.

4 DESIGN AND DEVELOPMENT

SafeLoad consists of six interconnected scenes. As depicted in Figure 1, the user's avatar moves sequentially through these scenes, beginning with the first and ending with the sixth.

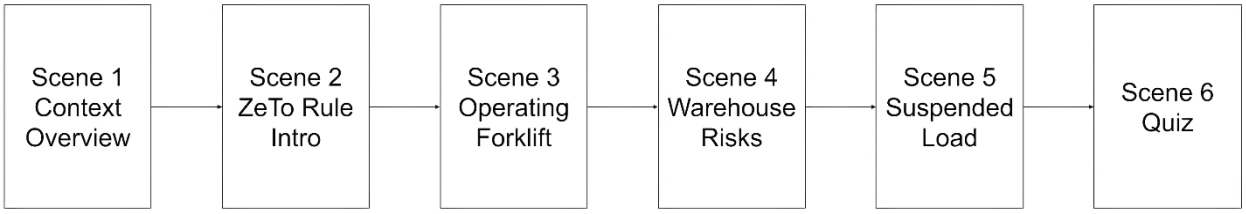


Figure 1 SafeLoad Scene Structure

To fully complete the experience, the avatar must visit three designated checkpoints in scenes three, four, and five. At each checkpoint, the user learns about forklift safety, warehouse dangers, and associated risks with suspended loads. Once all checkpoints have complete visited, the user must take a quiz to demonstrate their understanding of the material.



Figure 2: Scene 1 - Context Overview



Figure 3: Scene 2 – Suspended Load Introduction

Figure 2 shows Scene 1 - Context Overview. This scene provides the context of the learning and the virtual world itself. From this scene, the avatar will begin its tour of the virtual world after this scene. Figure 3 shows Scene 2 - Zeto Rule Introduction. The HSE rule for this metaverse is called Suspended Load. The HSE rule "Suspended Load" would primarily focus on educating students about the significant hazards associated with lifting operations and objects suspended in the air and objects placed in high places. The narrative begins with the scene at the main entrance of the warehouse. The warehouse consists of several high shelves.

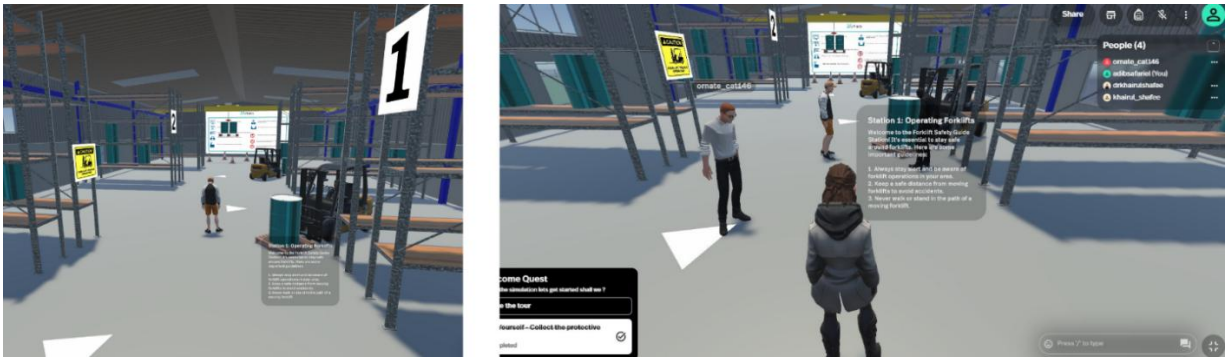


Figure 3: The Interior of the Warehouse

Figure 3 shows the interior of the warehouse. Scene 1 - Context Overview. This scene provides the context of the learning and the virtual world itself. From this scene, the avatar will begin its tour of the virtual world after this scene. Figure 3 shows Scene 2 - Zeto Rule Introduction. The HSE rule for this metaverse is called Suspended Load. The HSE rule "Suspended Load" would primarily focus on educating

students about the significant hazards associated with lifting operations and objects suspended in the air and objects placed in high places. The narrative begins with the scene at the main entrance of the warehouse. The interior of the warehouse consists of several high shelving. Some of these shelving units are marked with a number which indicates specific operational stations for personnel. The shelving units with the numbers indicates the station that the avatar must go to learn about the suspended load rule. At each respective station, narrative explanations are provided to inform the avatar regarding the specific hazards present within that area. Figure 4 shows at the end of the warehouse where a several drums were suspended on a platform using wires. A warning message triggers as the avatar approaches the area near the suspended drums.

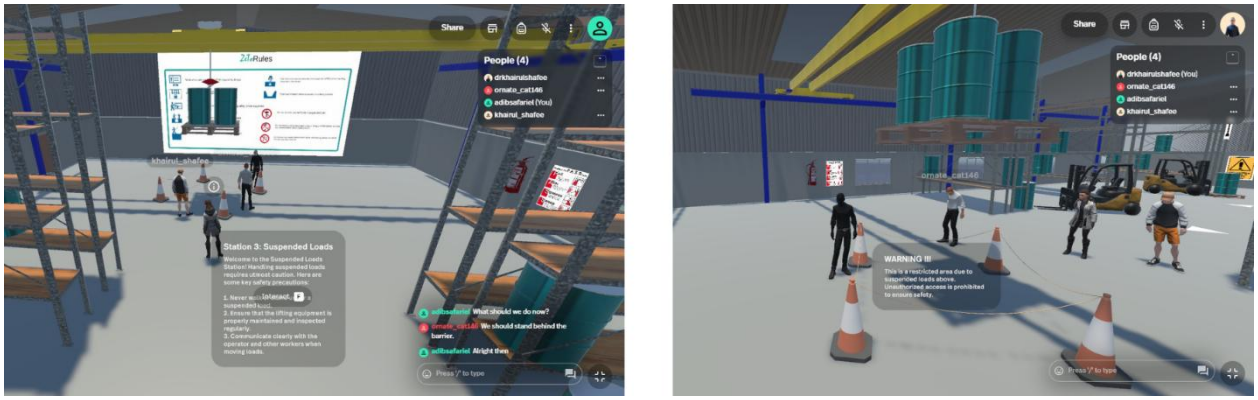


Figure 4: The Suspended Drums

Overall, SafeLoad employs a streamlined narrative structure to deliver its instructional content. Notwithstanding this narrative simplicity, the module addresses procedural guidelines pertinent to navigating close to the suspended loads and accessing elevated shelving units. The total interaction time for an avatar, encompassing the avatar enters the simulated warehouse environment, progression through all instructional stations, and subsequent exit, is estimated to be between three and five minutes.

5 USABILITY TESTING

A group of ten participants took part in evaluating the effectiveness and usability of SafeLoad. These participants were fourth-year engineering students who had previously completed Health, Safety, and Environment (HSE) courses and had gained practical exposure to HSE practices during their internships in industry. They were invited to explore the SafeLoad application and assess its performance through a structured questionnaire administered via Microsoft Forms. Overall, the feedback was largely positive. Regarding effectiveness, 80% of the participants agreed that SafeLoad was highly effective in demonstrating and clarifying the essential dos and don'ts related to working in warehouse environments with suspended loads. These results indicate that the metaverse-based simulation successfully communicated key HSE practices. In terms of usability, participants reported that SafeLoad delivered a high-quality user experience. The findings suggest that the interface was intuitive and well-designed, enhancing user engagement and supporting a productive and immersive learning experience.

6 DISCUSSION

The development and evaluation of SafeLoad provide valuable insights into the evolving role of immersive technologies in HSE training. The findings support the notion that metaverse-based learning environments can significantly improve learners' understanding and retention of safety practices compared to traditional methods. The integration of interactive 3D simulations, narrative-driven checkpoints, and real-time assessments within SafeLoad allowed participants to engage with the learning material in a way that mirrors real-world scenarios while maintaining a safe, controlled environment. One of the key strengths identified during usability testing was the system's intuitiveness and ease of use, which facilitated a seamless learning experience for the participants. The majority of users reported that the virtual environment effectively demonstrated the key dos and don'ts of working with suspended loads, a critical aspect of workplace safety often underemphasized in conventional classroom instruction. This

aligns with current literature emphasizing the importance of experiential and simulation-based learning in high-risk domains such as construction, manufacturing, and oil and gas. The collaborative potential of the metaverse was not fully explored in this initial implementation, but its promise remains significant. Unlike traditional VR, which typically supports single-user sessions, metaverse platforms allow for multi-user interactions, fostering teamwork, communication, and a shared understanding of safety culture. These aspects are vital in real-world workplace settings, where health and safety are collective responsibilities.

However, several challenges were also noted. The development of a metaverse-based training module requires considerable technical resources, including software platforms, skilled developers, and VR-capable hardware. Moreover, accessibility and user readiness remain concerns, particularly in institutions or organizations with limited exposure to immersive technology. While SafeLoad was tested on a small, targeted group of engineering students familiar with HSE concepts, broader implementation will require addressing digital literacy and scalability issues. Another limitation is the current scope of the simulation. While SafeLoad effectively demonstrates a single HSE rule related to suspended loads, future iterations should incorporate more diverse scenarios, including other safety principles, emergency response drills, and environmental compliance tasks. Expanding content breadth will ensure the platform's relevance across a wider range of industries and learning objectives.

Overall, this study affirms the pedagogical value of the metaverse in HSE education and highlights the need for further research into its scalability, adaptability, and long-term impact on behavior and performance in real-life work environments. Future enhancements, including artificial intelligence integration for personalized learning paths and analytics-driven feedback, could further elevate the learning experience and effectiveness of platforms like SafeLoad.

5 CONCLUSION

This study demonstrates the transformative potential of metaverse technology in enhancing Health, Safety, and Environment (HSE) training. Through the development and evaluation of *SafeLoad: A Virtual Guide to Suspended Load Safety*, it is evident that immersive metaverse experiences can bridge the gap left by traditional lecture-based methods. The simulated warehouse environment, complete with interactive learning checkpoints and assessments, allowed users to actively engage with safety protocols in a controlled, risk-free setting. Usability testing showed that students not only found the experience intuitive and engaging but also highly beneficial in understanding critical safety practices related to suspended loads.

While challenges such as high development costs and the need for advanced infrastructure remain, the benefits of immersive, collaborative, and persistent learning environments are substantial. The study highlights that the metaverse offers more than just visual immersion—it supports deeper learning through interaction, continuity, and social engagement. Moving forward, future research should explore how such platforms can be scaled across industries and enhanced with advanced technologies like artificial intelligence to deliver personalized, adaptive HSE training experiences.

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Enhancing Digital Twin Learning via Project-Based and Open-Ended Learning Approaches: A Case Study on Electric Vehicle Range Prediction Case

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ABSTRACT

This paper presents a problem-based learning approach and open-ended task delegation strategies that are combined to explore in delivering a Digital Twin course, featuring an electric vehicle (EV) range prediction project. The course is designed for second year Computer Engineering students with limited exposure or experience in cloud-based development and machine learning approaches. The project required students to implement a full-stack digital twin solution, beginning with the ingestion of synthetic or historical sensor data (e.g., battery voltage, temperature, speed) up to building and developing machine learning models using cloud-based services to produce real-time EV range predictions. The purpose of the course is to instil conceptual understanding through open-ended, practical and system-level problem solving. Approached utilized in blended learning includes flipped classroom delivery, collaborative problem-solving and milestone-based deliverables and assessments. Students are also furnished with pre-recorded videos and asynchronous technical resources from Amazon Web Services educational/technical sites which serve as technical fundamental. On the other hand, live classroom and laboratory sessions focused architectural design discussion, code troubleshooting and peer discussion. The open-ended task delegation is designed such that the students were given freedom to search and select modelling tools, data pre-processing techniques, machine learning-based prediction algorithms and visualization tools to develop the complete EV range prediction DT system. A total of 8 students took this course in September 2024 successfully deployed functional digital twin systems, with majority of them scoring A or A− grades in the course. Informal feedback highlighted improved confidence, creativity, and autonomy in tackling complex technical problems. This study highlights the value of combining structured instructional frames with open-ended tasks exploration. The EV digital twin system development serves as a replicable model for fostering technical proficiency, problem-solving, and innovation in modern engineering education.

KEYWORDS: problem-based learning, open-ended, engineering education, blended-learning.

1 INTRODUCTION

Digital Twin (DT) is a concept initialized in this technological era to replicate any object, process, or system virtually. This virtual copy is also referred to as the digital copy of a physical entity. This DT technology has surfaced as a paradigm shift in engineering, particularly in real-time monitoring, simulations, real-time predictions of physical systems via virtual copies and boundlessly. Many sectors

and fields have seen an increasing trend in adopting DT solutions such as in energy, manufacturing, smart cities, transportation, healthcare, etc. This emphasizes the need to integrate DT knowledge, DT development skills and competencies into the engineering programme, so that the students are well aligned and competitive in line of the technology. However, crafting and teaching DT course imposes andragogical challenges as it requires muti-tech integration, which blends mathematical modelling, system modelling, twining tools, cloud-based system development, IoT and artificial intelligence/machine learning.

This paper presents a case study performed with an undergraduate DT course for second year Computer Engineering program, which requires students to design and develop a digital twin solution for predicting the range of an electric vehicle (EV). The project required students to implement a full-stack digital twin solution, beginning with the ingestion of synthetic or historical sensor data (e.g., battery voltage, temperature, speed) up to building and developing machine learning models using cloud-based services to produce real-time EV range predictions The project was intentionally structured to replicate real-world digital system development, requiring students to integrate multiple cloud services, data pipelines, and AI models in an open-ended and collaborative setting.

As to how complex the muti-technology integration sounds, it is not an easy task to get the all the students to be aligned which requires students from varied backgrounds to learn, work and build on DT solutions. Therefore, a problem-based learning strategy, and open-ended task delegation approach has been adopted to deliver the course at the best possible. This includes utilizing flipped classroom technique, ie, using pre-recorded Amazon Web Services (AWS) tutorials and examples, review of milestones often during classes, design discussions during class and lab sessions. The lab sessions are also reserved for high level architectural review and deep dive, hands-on trouble shooting and group-based code reviews. Students were guided based on the problem in hand, ie, building a digital replica of an EV car to predict the range it can travel, but are not entirely micro-guiding which leads to gaining ownership and self-directed learning among students. The students are also given the opportunity to explore and choose their own solutions tools, such as choosing their preferred data preprocessing techniques, 3D digital models, machine/deep learning models and visualization platforms.

The open-ended nature of the project empowered students to explore different technical paths—choosing their own data preprocessing techniques, machine learning algorithms, and visualization platforms. This flexibility mirrored real-world engineering tasks and promoted critical thinking and creativity.

The objective of this paper is to share how blending structured guidance with open-ended problem-based learning improved student engagement, technical proficiency, and innovation in a DT learning environment. The EV case study serves as a replicable model for integrating complex digital systems into engineering curricula while promoting autonomous learning and multidisciplinary integration.

2 LITERATURE REVIEW

Teaching Digital Twin course imposed a challenge to the lecturer as the lecturer has to ensure that the teaching strategy is efficient and effective. Technically, teaching theoretical knowledge alone would be insufficient for this type of course as the impact of the course on the students' understanding is not measurable. Therefore, the effectiveness of delivery can be measured if the students are able to integrate multiple cloud services, data pipelines, and AI models in an open-ended and collaborative setting to produce a DT solution.

In the past, it has been demonstrated that blended learning which combines asynchronous course delivery and in-class active learning would significantly improve conceptual understanding and learner autonomy, particularly in technically demanding subjects (Capone, 2022; Ardianti et al.,2020; Eugenijus, 2023). In parallel, open-ended and project-based learning have been recognized for their ability to simulate real-world complexity and promote innovation (Hanif et al., 2019; AD Owens et al., 2022; KD Wang et al., 2023). In the case of open-ended learning, especially when a problem is designed into collaborative project, this method encourages students to move beyond the normal learning mechanism toa higher-order thinking capacity, such as synthesis, evaluation, and design. These strategies are well-aligned with the multi-technology nature of Digital Twin implementation. Therefore, the design of this course revolves around these learning strategies. The course design also included practical considerations as the students had limited exposure to cloud platforms, IoT infrastructure, or machine learning tools. To tackle this, the

project was purposefully designed as open-ended so that students could explore their own pathways to system design, model development, and data visualization.

3 METHODOLOGY

3.1 Course Context and Participants

As part of an initiative to explore the effectiveness of incorporating project-based learning and open-ended task delegations, a course that requires multi-technology integration is chosen, ie, the Digital Twin course offered to second year Computer Engineering students. Since they are second year students who are still at elementary stage of their study, this first batch of students (8 students in this cohort) possess limited proficiency in programming, cloud platforms, and machine learning. Nevertheless, the project-based learning and open-ended task assignment is imposed to achieve the objective. The primary objective of the course was to enable students to design, develop, and integrate a predictive Digital Twin system, simulating real-time range prediction for electric vehicles (EVs).

3.2 Course Design

The course is designed to cater inclusiveness among different competency levels of students with the help of project-based learning and open-ended learning strategy, as well as the common blended learning strategies to ensure smooth delivery of the course. First and foremost, the project is introduced to the students in the beginning of the semester so that they are prepared and could anticipate what comes and required with the course. Essentially, a problem is brought into as part of a coursework component which leads to problem-based learning. An example of the guidelines and deliverables expected are released to the students as shown in Figure 1 and 2.

Once the project/problem has been introduced, the blended learning strategies and open-ended learning strategies are gradually incorporated into the course. Fundamentally, the learning framework can be categorized into four.

The first is the (1) flipped classroom technique. Students are furnished with pre-recorded lectures and tutorials on foundations such as IoT architecture, AWS services, and machine learning models prior to class. Next, the (2) in-class and laboratory sessions are dedicated to delivering lectures on digital twin solutions, consisting of elements to develop the solution, ie, the data, data transfer protocols, mathematical modelling and prediction techniques with the data using machine learning, and digital replication. On top of that, the classes are also allocated to review architectures of the systems, application-based discussions, and troubleshooting technical challenges. Thirdly, (3) collaborative problem solving elevate students to work in teams to address weekly project milestones and present their project progress during class. Finally, (3) open-ended task assignment is progressively assigned to the student on weekly basis, for example, allowing students to freely explore tool selections, modelling strategies, and visualization tools, based on the weekly target.

Project of RBB 2013 Digital Twin **Lecturer: Ir Dr Ashvaany E**

PROJECT 2

Design and Development of a Digital Twin Solution for Predicting the Range of an Electric Vehicle (EV) Using AWS IoT TwinMaker and Machine Learning

The aim of this project is to develop a preliminary digital twin solution for electric vehicles (EVs) using AWS IoT TwinMaker, and to integrate a machine learning model to predict the total range (in kilometers) that an EV can travel based on real-time data. Students will use historical and artificially created sensor data to build a predictive model, connect it to the digital twin, and visualize the results.

System Requirements:

1. Digital Twin Setup:
   i. Set up a digital twin in AWS IoT TwinMaker that simulates the key aspects of an EV, such as battery capacity, top speed, and efficiency.
   ii. Simulate or use real-time sensor data streams using AWS IoT Core. The data should include relevant features like battery voltage, speed, temperature, and other key indicators that affect range prediction.
2. Data Preprocessing:
   i. Use the provided dataset or generate synthetic historical data representing vehicle parameters like acceleration, top speed, battery efficiency, and charge status to train the model.
3. Machine Learning Model Development:
   i. Use Amazon SageMaker to build and train a machine learning model (e.g., Linear Regression, Random Forest, or Gradient Boosting) to predict the Range_Km based on real-time and historical data.
   ii. Evaluate the model using appropriate performance metrics (e.g., RMSE, MAE, R^2) and explain the performance.
   iii. Deploy the trained model as an API endpoint using SageMaker to allow real-time predictions within the digital twin environment.
4. Real-Time Integration (optional):
   i. Use AWS Lambda to trigger predictions based on real-time sensor data streaming from AWS IoT Core. These predictions should update the digital twin's range estimation in real time.
   ii. Ensure that the predicted Range_Km values are continuously reflected and visualized within the AWS IoT TwinMaker digital twin environment.
5. Visualization:
   i. Use AWS IoT TwinMaker's Scene Composer to create a 3D or interactive dashboard that displays real-time data from the vehicle's digital twin, including predicted range.
   ii. Integrate with Amazon QuickSight to provide detailed charts or visual insights about the vehicle's range over time, efficiency, and other key performance indicators.

Figure 1: Guidelines for the Project for Problem-based learning

Deliverables:

1. A high-level architecture diagram showing the integration between AWS IoT TwinMaker, AWS IoT Core, Amazon SageMaker, and AWS Lambda, illustrating how real-time data flows through the system.
2. A folder repository with all code used for:
   i. Data ingestion via AWS IoT Core.
   ii. Digital twin creation in AWS IoT TwinMaker.
   iii. Machine learning model training and deployment via Amazon SageMaker.
   iv. Lambda functions for real-time predictions and integration.
3. Screenshots or a live demo of the digital twin showing real-time vehicle status and optional (predicted range updates).
4. Documentation & Presentation:
   i. Description of the digital twin solution architecture, including AWS services used (IoT TwinMaker, IoT Core, Lambda, SageMaker).
   ii. An explanation of the machine learning model and how real-time data is used for predictions.
   iii. Visualizations from the digital twin dashboard.
   iv. Future improvements or enhancements for the digital twin solution.
5. Optional:
   i. Additional features like notifications or alerts when the predicted range falls below a critical threshold.
   ii. Advanced visualizations or further enhancements to the digital twin.

Figure 2: Deliverables of the Project

3.3 Project-based Assessment

To assess the effectiveness of problem-based and open-ended learning strategies, the assessment component has been split into two parts.

i. **Part 1 (40%)**: Focused on data ingestion, synthetic data generation, machine learning model training, and backend integration.
ii. **Part 2 (20%)**: Emphasized real-time predictions, system visualization, and deployment of a functional prototype.

Students were assessed based on a rubric covering system design, coding implementation, ML integration, visualization quality, innovation, and documentation. The rubric is shown in Figure 3 below.

Criteria	Weight (%)	Low (0-50%)	Medium (50-80%)	High (80-100%)
1. Digital Twin System (40%)				
Data Ingestion via AWS IoT Core	10%	Little or no code provided or doesn't work (0-5%)	Partial code with limited functionality (5-8%)	Complete, functional code for data ingestion (8-10%)
Digital Twin Creation in AWS IoT TwinMaker	10%	No or minimal code provided (0-5%)	Partially functional code with some features missing (5-8%)	Fully functional code for digital twin creation (8-10%)
ML Model Training and Deployment via SageMaker	10%	Little or no code provided, or doesn't work (0-5%)	Partial code for ML model, some missing parts (5-8%)	Complete and functional model training and deployment code (8-10%)
Lambda Functions for Predictions	5%	No or minimal code provided (0-2.5%)	Partial code with some missing functionality (2.5-4%)	Fully functional Lambda functions for predictions (4-5%)
Screenshots or Live Demo of Digital Twin	5%	No or poor-quality screenshots/demo (0-2.5%)	Screenshots or demo partially show real-time data (2.5-4%)	Complete screenshots or demo showing real-time status and predictions (4-5%)
2. Presentation and Report (20%)				
Digital Twin Solution Architecture Description	5%	Incomplete or unclear explanation of the architecture (0-2.5%)	Adequate explanation, missing some details (2.5-4%)	Clear and thorough explanation of the architecture (4-5%)
Machine Learning Model Explanation	5%	No or limited explanation of the ML model (0-2.5%)	Partial explanation, lacks depth (2.5-4%)	Detailed explanation of the model and real-time data usage (4-5%)
Visualizations from Digital Twin Dashboard	5%	Little or no visualization provided (0-2.5%)	Partial visualizations with some gaps (2.5-4%)	Complete and relevant visualizations (4-5%)
Future Improvements or Enhancements	5%	No or vague suggestions for future improvements (0-2.5%)	Basic suggestions provided (2.5-4%)	Clear, insightful suggestions for future enhancements (4-5%)

Figure 3: The Assessment Rubric

The effectiveness of these learning approaches is evaluated based on the project deliverables and final presentations. As stated earlier, the evaluation is based on a structured rubric shown above, emphasizing technical implementation, system integration, and model performance. Eventually, these project components contributed 60% to the overall coursework marks, making them a central indicator of student mastery. In addition to this, classroom observations, discussions, informal verbal feedback were taken into consideration during milestone reviews and final project presentations.

4 RESULTS AND DISCUSSIONS

The implementation and exploration of incorporating problem-based learning and open-ended learning into the course to develop a DT functional DT solution has led to apparent and measurable improvements in students' engagement, learning outcomes and technical skill development. Although they are second-year students with limited exposure to cloud platforms, machine/deep learning models and with basic programming knowledge, all of the students have successfully developed and submitted functioning digital twin prototype solutions, on distance range prediction of electric vehicles.

4.1 Students' Feedback

A short open-response feedback survey was answered by the students to capture their perception of the course. Although survey is brief and yielded minimal responses, ie, 6 out of 8 students responded, the feedback still provided an insight into student's overall experience. The outcome is tabulated in Table 1 below. Two of the students who provided minimal or no comments, while the other 4 students described the course positively. While the responses are short which hinders thematic analysis, the sentiment of the

students reflects a favourable influence towards this problem-based and open-ended learning strategies used in this course. This reinforces the earlier observation that students appreciated the flexibility and relevance of the course, even if not all chose to elaborate further in the survey.

Course	Student ID	Student's Feedback
Digital Twin	Student 1	Nothing much
	Student 2	-
	Student 3	A great course as I learned a lot throughout all the classes
	Student 4	good
	Student 5	Perfect
	Student 6	Amazing course for computer engineering students exposure with current real world development

Table 1: Students' Feedback

4.2 Project Outcome

Students have demonstrated impressive and commendable performance in developing the DT solution for electric vehicles. All of them have used the AWS services to build their DT solutions. The grades (from the rubrics) obtained after developing, presenting and reporting their DT solutions are tabulated below in Table 2. The grades obtained by students reflect an effective impact of the method for this multi-technology-based course, with all the students scoring A and A-. This indicated their ability to apply cross-disciplinary knowledge to solve complex, open-ended problems. These results also suggest that the combination of early project introduction, scaffolded milestones, and technical autonomy helped bridge the competence gap that typically hinders early-stage learners in high-tech subjects.

Student Name	Grade
Student 1	A-
Student 2	A-
Student 3	A
Student 4	A
Student 5	A-
Student 6	A-
Student 7	A-
Student 8	A-

Table 2: Scoring of Mini-projects and the EV solution using DT Project

Some screenshots of the solutions developed by students is shown in Figure 4.

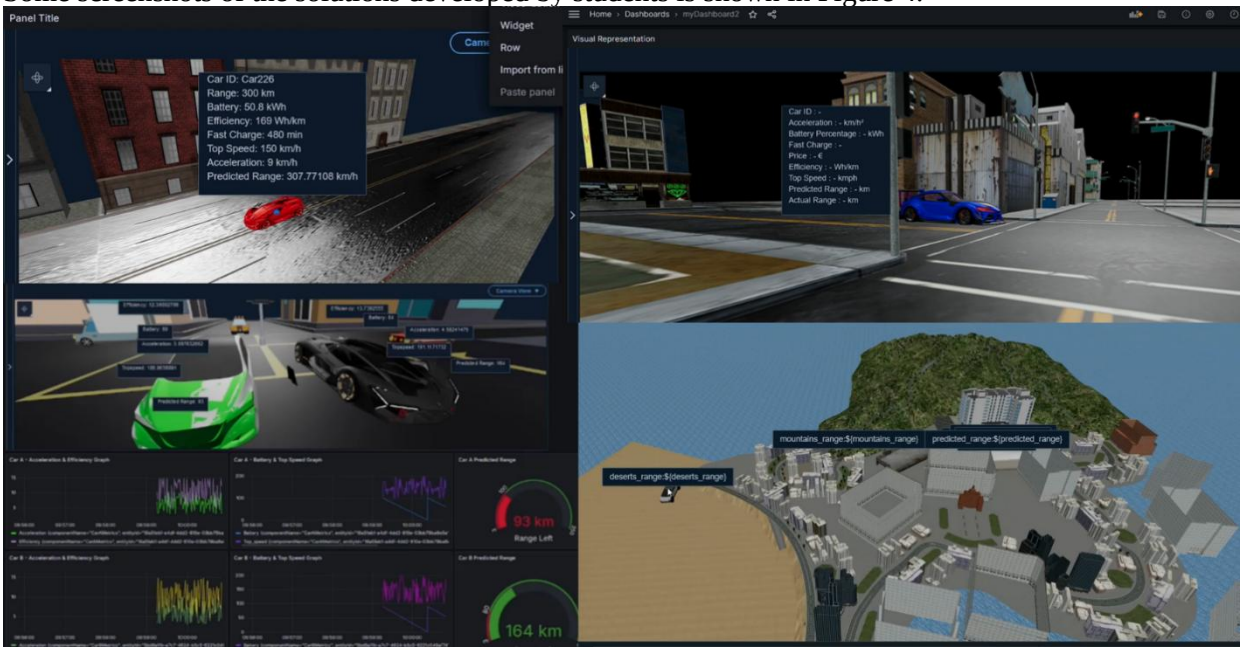


Figure 4: Screenshots of the solutions

Since this course is designed to investigate on a central problem, ie, the EV range prediction problem, the project and course outcomes has proved that it has created a meaningful context for students to apply what they have learnt. Weekly in-class checkpoints, architecture reviews, and iterative design discussions required students to continually evaluate their progress, debug complex systems, and adapt their approaches. This in-class discussions have provided insights about students' engagement level, confidence in exploring new technologies and reflections on the open-ended nature of the project. The authors agree that a structured reflection and course survey is not conducted, however, the qualitative interaction gathered from students reinstate the depth of their understanding and their attitudes toward project-based learning.

This concludes that blended and open-ended learning fosters higher-order thinking, such as synthesis and evaluation. No formal post-course survey was conducted, however, the depth of student involvement observed through classroom interactions and their final deliverables leads to convincing evidence of the effectiveness of this andragogical method.

5 CONCLUSIONS

The implementation of problem-based learning and open-end task delegations in the design and delivery of Digital Twin course, particularly in developing an EV range prediction DT solution enhanced student engagement, technical competence, and innovation. Students were required to develop this DT solution by integrating multi-technology integration including multiple cloud services, data pipelines, and AI models. Although they have limited exposure to these technologies as they are still at the elementary stage of their undergraduate studies, ie, the 2nd year cohort of Computer Engineering program, the structured problem-based and open-ended learning strategies empowered students to explore various technical solutions independently, fostering creativity and ownership. The performance of the students is outstanding, with all of them achieved A or A- as their grades. These outcomes suggest that incorporating problem-based and open-ended project frameworks into technically demanding courses not only improves mastery of content but also prepares students with the higher-order skills needed for real-world engineering challenges. As Digital Twin technology becomes more prominent in industry, this approach offers a replicable and scalable model for modern engineering education.

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Enhancing Offshore Safety with Immersive Virtual Reality (VR) Training for Emergency Response

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ABSTRACT

The offshore oil and gas sector presents complex safety challenges, particularly during emergency situations such as fires, where rapid and effective evacuation is crucial. This study explores the integration of virtual reality (VR) technology into Health, Safety, Security, and Environment (HSSE) training programs. A VR-based emergency evacuation simulation was developed at Universiti Teknologi PETRONAS (UTP) to train students in managing fire-related emergencies where users can rehearse evacuation procedures and identify potential hazards under simulated stress conditions. Evaluation of the training outcomes focuses on key performance indicators such as situational awareness, response time, and emergency preparedness. Results
, a VR-based emergency evacuation simulation was developed to help students prepare for fire-related incidents on offshore platforms. The simulation allows users to experience a realistic virtual environment where they can practice escaping through designated routes and responding to hazards. To evaluate the training's effectiveness, participants were assessed on their situational awareness, reaction time, and preparedness to real-life emergencies. The results show that immersive VR training significantly improves understanding of evacuation procedures and enhances critical decision-making during high-pressure situations. These findings suggests that VR can be powerful tool for improving training in high-risk industries like offshore oil and gas.

KEYWORDS: Virtual Reality (VR), Health, Safety, Security, and Environment (HSSE), Emergency Evacuation, Offshore Platform Training, Simulation-Based Training

1 INTRODUCTION

The offshore oil and gas industry is a dangerous place, where workers deal with complex operations and constant environmental risks. In such high-pressure setting, proper training in emergency response and evacuations is critical to keep everyone safe. Being able to evacuate quickly during events like gas leaks, explosion, or fires is one of the most important skills. However, traditional safety training methods like physical drills and classroom lessons, often don't prepare workers for the real panic and unexpected challenges that happen during actual emergencies (Salas et al., 2009). To overcome these challenges, virtual reality (VR) has emerged as a powerful and innovative training tool, allowing participants to experience high -risks situations in a realistic, and more practical learning.

VR-based training provides a safe yet realistic environment where learners can engage with complex emergency situations, promoting deeper understanding and longer retention of safety procedures (Freina & Ott, 2015; Krokos et al., 2019). As part of the Health, Safety, Security, and Environment (HSSE) course, a VR fire evacuation simulation was developed at Universiti Teknologi PETRONAS (UTP) to strengthen student's preparedness and decision-making during emergencies. In this simulation, students wear VR headsets and navigate a virtual offshore platform engulfed in flames situation. They must locate emergency exits, avoid hazards like fire, smoke, and debris, and follow proper evacuation protocols. This approach reinforces theoretical knowledge while testing the student's real-time response, simulating pressures that traditional training methods cannot (Borsci et al., 2016).

Research consistently supports the effectiveness of VR in safety training. Studies have shown that VR significantly enhances hazards recognition, situational awareness, and decision-making skills, particularly in high-risk fields like offshore and gas, aviation, construction, and nuclear energy (Jensen & Konradsen, 2018; Gallagher et al., 2022). A meta-analysis by Burke et al. (2006) found that hands-on training, such as simulation-based learning shows solid safety outcomes than lecture-based formats. VR also aligns with practical learning, a key aspect of adult education theory. By immersing trainees in real environments that demand active participation, VR helps learner retain emergency procedure more effectively (Kolb, 1984; Gutierrez et al.,2007). The fire evacuation simulation includes sensory feature such as blaring alarms, smoke, flickering flames, and congested pathways to replicate the chaos and urgency of actual emergency situations. These elements help students develop cognitive and emotional resilience required in high-pressure situations (Smith et al., 2014; Makransky & Lilleholt, 2018).

Throughout the simulation, data is collected on how guickly students evacuate, the path they choose, how accurate they make decisions, and how well they follow safety rules. Survey before and after training measure how much their knowledge and confidence improve, while performance data shows improvements in response speed, hazard identification, and decision-making under stress. VR is becoming increasingly popular as an affordable and scalable option for safety training. It allows students to safely experience dangerous situations, makes learning more engaging, and provides instructors clear data for focused improvements (Liu et al., 2020). As the offshore oil and gas industry continues to focus on safety, using VR in HSSE training is smart, innovative way to better prepare workers for real emergencies.

2 METHODOLOGY

Universiti Teknologi PETRONAS (UTP) has developed a virtual reality (VR) training module under its Health, Safety, Security, and Environment (HSSE) program to simulate a fire emergency on an offshore oil platform. The training recreates key areas such as the control room (including the crane and drilling zones), crew accommodations, and the helipad. The objective of this module is to educate students how to evacuate safely by following planned escape routes and avoiding dangers like fire and smoke. Using a first-person view, the VR simulation gives students a realistic and hands-on way to practise emergency drills. Figure 1 shows an overview of the fire drill scenario.

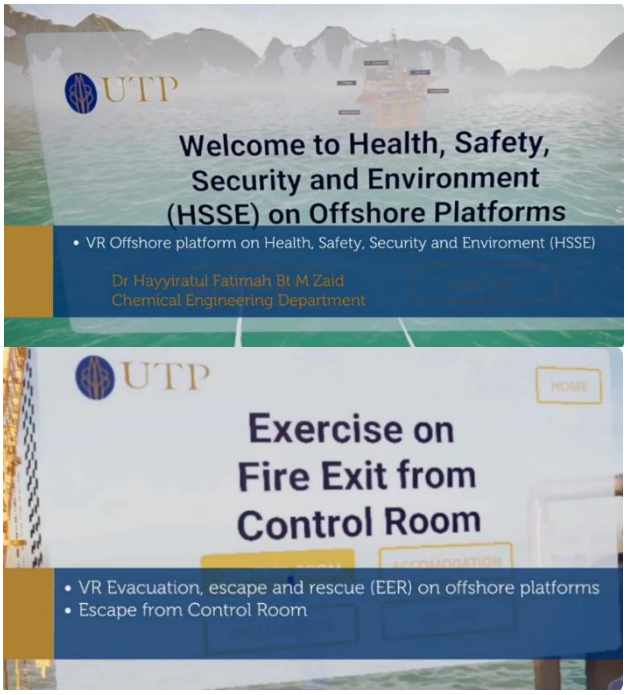


Figure 1: Introduction to the VR fire evacuation scenario

2.1 Orientation via Pre-Simulation Video

Before starting the virtual training, participants watch a video that introduces them to the offshore platform's layout. The video shows important area and explains why they matter during an emergency evacuation.

Control Room Overview: The video begins with the control room, where critical operations such as crane handling and drilling activities are managed. It highlights the control room's strategic location and its connection to nearby sections. Understanding this area is crucial for helping students make fast decision in an emergency. Figure 2 shows a view of the control room during virtual evacuation.

Crew Quarters: The video then covers the living quarter, which include sleeping areas, recreation rooms, and social spaces for offshore staffs. It points out the main escape routes and stresses the need to be aware of alternative exist in case primary path are blocked. Figure 3 shows a scene from te virtual evacuation of the crew quarter.

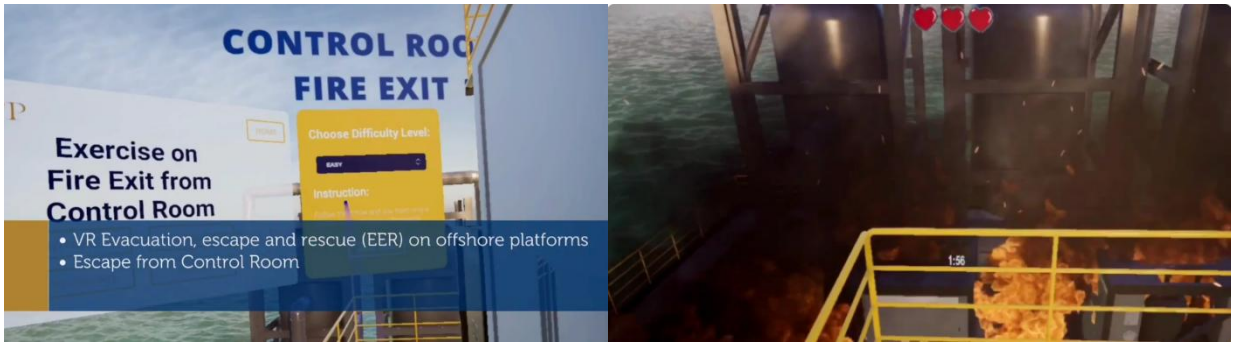


Figure 2: Simulation showing control room evacuation



Figure 3: Simulation showing evacuation from accommodations

Helipad Access: The video ends by showing the helipad, which is important for evacuations by helicopter when boats can't be used. Its guides students on the safest way to reach the helipad during emergency. Figure 4 shows the evacuation path to the helipad in the simulation.



Figure 4: Virtual evacuation sequence leading to the helipad

The video serves two main purposes in preparing students for the simulation. By learning the key areas early on, students can focus more on making smart decisions and reacting quickly during an emergency.

2.2 Hands-On Exploration in the VR Scenario

After completing the video briefing, they enter the main VR simulation, where a fire emergency is happening on the offshore platform. In this hands-on session, they freely move around, searching for safe exist while avoiding dangers like smoke, blocked hallways, and fires.

Students must quickly decide which paths are safe and which are not, mimicking rge pressure of a real-life emergency. Immediate feedback during session tells them if they made good choices or missed safer routes.

Throughout the exercise, key data is collected, such as:

1. Time taken to complete the evacuation
2. Paths chosen compared to optimal escape routes
3. Success in identifying and avoiding dangerous zones

This data is reviewed to see how much students improved their quicks thinking, safety awareness, and evacuation skills. The goal is to make them more prepared and confident in facing actual offshore emergencies.

3 RESULTS AND DISCUSSION

The use of a pre-simulation video briefing in the VR emergency evacuation training significantly improved student preparedness and performance. The video provided a detailed introduction to the offshore platform's layout, acting as an essential orientation guide. It highlighted important features like

evacuation paths, emergency exits, and key areas students would encounter in the VR scenario. This early exposure helped reduce confusion and cognitive load during the simulation, allowing students to stay focused on responding effectively to the emergency instead of trying to orient themselves in an unfamiliar space. As a result, they were able to make quicker and more accurate decisions under pressure. These outcomes support earlier research showing that prior knowledge of a training environment enhances situational awareness, lowers stress levels, and leads to better results during high-intensity simulations (Stanney et al., 2003).

3.1 Influence of the Pre-Briefing Video

Student feedback supported the impacts of the video orientation on their performance during the VR simulation. Survey results showed that 92% of participants found the pre-simulation video to clarify and planning the layout of the offshore platform. This early familiarization allowed them to mentally map the space, giving them a clear advantage when navigating during the emergency scenario. These results align with cognitive theory, which suggests that when learners are familiar with the layout and steps of a task beforehand, they can use more of their energy on solving problems and making decision under stress (Paas & van Merriënboer, 1994).

3.2 Improvements in VR Training Outcomes

Data collected after the simulation showed clear significant improvements in how quickly and accurately students responded to emergencies. After the briefing, evacuation times were reduced by 40% compared to before the training. On average, students completed the evacuation in just 5.1 minutes, down from 8.5 minutes indicating a substantial improvement in preparedness and response efficiency.

Hazard awareness also improved significantly. After training, 87% of participants correctly chose the safest escape route, compared to only 65% before. Additionally, 80% students became better at spotting ad avoiding dangers like blocked exits and smoke-filled hallways. These results show that the training not only made students more familiar with their environment but also improved their ability to assess risks and make fast, safe decisions during emergencies.

3.3 Observed Challenges and Limitations

Despite the clear benefits, the use of VR training came with some challenges. About 12% of participants reported mild physical discomfort, such as motion sickness or eye strain. These symptoms are common in VR-based learning environments, especially during long sessions or when using older or less advanced hardware (Stevenson et al., 2008; Rebenitsch & Owen, 2016). While these discomforts were temporary and didn't prevent participants from completing the exercise, they highlighted the need to consider ergonomic factors and session length in future training designs.

In addition, a minority of students struggled navigating unfamiliar areas during simulated emergency conditions, even after watching the briefing video. This indicates that while pre-simulation orientation can help reduce confusion, it may not fully prepare full users for the fast-paced, high-pressure decision-making required in VR environments. This finding supports the need for extra training, such as guided VR walkthroughs or repeated practise sessions, to help users become more comfortable and confident in navigating VR especially in pressure situation (Makransky et al., 2019).

3.4 Overall Effectiveness and Educational Impact

Overall, combining VR technology with a preparatory video component proved to be highly effective in improving safety training outcomes. Students reported increased confidence in handling emergency evacuations and found the VR environment both engaging and realistic. The immersive nature of the training encouraged active learning and enhanced retention emergency procedures, which are important in high-risk industries like offshore oil and gas operations.

The pre-exercise video briefing played a key role in minimizing cognitive strain during the simulation, allowing students to concentrate on applying emergency protocols instead of getting familiar with the virtual space. This approach which combining pre-task preparation with immersive simulation offers a scalable, data-driven model for future safety training programs in similarly hazardous fields.

4 CONCLUSIONS

Using virtual reality (VR) simulations alongside a video briefing has improved Health, Safety, Security, and Environment (HSSE) training at Universiti Teknologi PETRONAS (UTP). The video helps students get familiar with the offshore platform layout before they enter a realistic VR emergency scenario. This step-by-step approach made students more aware of their surroundings, better at spotting hazards, and quicker at making decisions during emergencies.

The success of this training shows how VR can change the way we safely teach, especially in high-risk fields like offshore oil and gas. Compared to traditional methods, VR offers a safe, hands-on experience where students can practise emergency actions without facing real danger. Clear improvements in evacuation speed and safety behaviours prove its value. Some students did experience mild motion sickness, but it was temporary and didn't impact the overall training results. A VR technology keeps improving, these minor issues are expected to become less of a problem.

Overall, combining video briefings with VR simulations is a powerful way to train students for real-world emergencies. With further development, VR can become a standard tool for teaching safety skills in industries where preparation is important.

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Augmented Reality (AR) Application for Enhancing Safety Protocols in Teaching and Learning

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ABSTRACT

To ensure the safety of engineering equipment is a top priority in industrial sectors, augmented reality (AR) is revolutionizing the safety practices by providing real-time visual overlays that deliver essential information directly to personnels such as equipment status updates, safety procedures, and hazard alerts. This immersive technology improves situational awareness, enabling personnel to make informed decisions promptly and accurately. Beyond real-time guidance, AR transforms training by offering interactive simulations where personnel can practice complex procedures and emergency responses in a simulated environment. This hands-on training not only enhances skill proficiency but also ensures that personnel are well-prepared for various operational scenarios, contributing to a safer workplace overall. Additionally, AR facilitates more efficient maintenance processes by providing an instant access to equipment manuals, schematics, and diagnostic data overlaid onto physical equipment components. This capability streamlines troubleshooting efforts, reduces downtime, and enhances maintenance accuracy. In this study, by leveraging AR to promote safety in enhancing safety protocols in teaching and learning mode, the personnel and organization are not only able to assess the risk and improve operational efficiency but also cultivate a culture of safety where everyone is empowered with the tools and knowledge to operate and maintain equipment safely and effectively.

KEYWORDS: Augmented Reality (AR), Safety Protocol, Standard Operating Procedures (SOP), Job Safety Analysis (JSA), Hazard Identification and Risk Assessment and Risk Control (HIRARC)

1 INTRODUCTION

Traditional engineering practices often rely on manual procedures, physical equipment, and two-dimensional data representations. These methods suffer from limitations in interactivity, accessibility, and efficiency. Additionally, the reliance on outdated safety protocols when using engineering equipment contributes to frequent accidents and operational inefficiencies. These challenges highlight the need for more innovative and interactive engineering education and practice approaches.

Augmented Reality (AR) technology presents a potential solution by overlaying digital information onto the physical world, creating an immersive and interactive user experience. AR allows users to visualize complex data and equipment in three dimensions, making it easier to understand intricate systems and processes. This technology has rapidly evolved, offering promising opportunities to enhance various fields, including engineering education and research.

By seamlessly integrating virtual and physical realms, AR enables users to interact with digital content in real time, leading to improved understanding and safety practices when using engineering equipment. This innovative approach not only enhances the learning experience for students but also ensures that engineers and technicians can operate equipment more safely and efficiently.

In modern engineering settings, there exists a growing demand for innovative solutions that leverage augmented reality (AR) technology to enhance various aspects of procedures in using engineering equipment and handling the equipment cautiously. Furthermore, users, specifically students, often have difficulty understanding the usage of engineering equipment and its Standard Operating Procedures (SOPs), Job Safety Analysis (JSA), and Hazard Identification, Risk Assessment, and Risk Control (HIRARC). Therefore, creating AR systems that display physical engineering setups and interfaces can significantly ease users' challenges.

2 LITERATURE REWIEW

Researchers and educators recognize the potential of AR to streamline the use of engineering apparatus, visualize complex equipment, display standard operating procedures (SOPs), and enhance hazard identification, risk assessment, and control measures (HIRARC). By providing real-time, interactive guidance and information, AR can significantly improve the accuracy and efficiency of engineering tasks. Furthermore, AR can enhance safety protocols by providing immediate, context-aware safety information and alerts, thus reducing the likelihood of accidents and promoting safer working environments.

According to Li et al. (2017), engineering problems are generally modelled mathematically to represent physical phenomena across various fields such as solid mechanics, heat transfer, fluid dynamics, electrical engineering, and magnetism. Mathematical models can depict nearly all physical phenomena in diverse disciplines including mechanical, biological, aerospace, and chemical engineering. These models use assumptions and axioms to describe the properties of physical systems. Techniques like numerical simulations allow for the approximation of solutions to these problems.

Augmented reality (AR), which has been researched extensively over many years, can be integrated with human capabilities to significantly enhance engineering analysis. Technically, AR systems overlay computer-generated content onto the physical environment, thus improving a user's perception and understanding of their surroundings (Azuma, 1997). AR allows users to interact with both virtual and real objects in their environment, facilitating the simultaneous assessment of multiple parameters and more effective problem analysis. A comprehensive AR system must include tracking, registration, and visualization components (Li et al., 2017).

Li et al. (2017) also highlights that AR applications in engineering have evolved from desktop systems to mobile platforms, driven by the portability and accessibility of mobile devices. This transition enables engineers to access and interact with relevant information on-site, enhancing problem-solving capabilities. AR supplements traditional numerical simulation methods, such as the finite element method (FEM), offering an intuitive and scientific approach to practical problem analysis. Key applications of AR include real-time structural analysis, environmental simulation, and collaborative design processes.

The integration of AR in engineering education has been widely studied. AR tools have been found to improve spatial visualization skills, which are crucial for engineering students. Studies, such as those by Álvarez-Marín and Velazquez-Iturbide (2021), indicate that AR applications can boost student motivation and engagement by offering interactive and immersive learning experiences. Pilot studies, like that of Mejías Borrero and Andújar Márquez (2012), demonstrate AR's effectiveness in remote labs and practical classes by making complex electrical engineering concepts more accessible.

In addition, AR technology blends virtual elements with the real world, allowing simultaneous interaction with both. In engineering education, AR has been shown to improve student engagement, understanding, and motivation. For example, Criollo-C et al. (2021) developed an AR mobile application (NetAR) to complement traditional engineering education. Their study found that AR applications could enhance learning by providing interactive 3D elements for students to manipulate, thereby deepening their understanding of complex concepts.

In practical engineering, AR applications range from maintenance and assembly tasks to design and simulation. Palmarini et al. (2018) conducted a systematic review of AR applications in maintenance, highlighting the technology's potential to increase accuracy and reduce downtime. Similarly, Blanco-Novoa et al. (2018) evaluated AR systems in industrial settings, demonstrating significant improvements

in operational efficiency and worker safety. Furthermore, AR improves the visualization of engineering designs by enabling engineers to overlay digital models onto physical objects, aiding in identifying design flaws and validating design choices (Álvarez-Marín & Velazquez-Iturbide, 2021). This is particularly valuable in fields like civil and mechanical engineering, where accurate spatial understanding is essential.

Despite its benefits, AR in engineering faces several challenges. High development costs and the need for specialized hardware are significant barriers to widespread adoption. Technical challenges such as tracking and registration errors, as well as issues like lag, limited field of view, and high computational power requirements, can impede the seamless integration of AR into engineering workflows. Moreover, user interfaces and interaction techniques must be intuitive and user-friendly. Studies, including those by Criollo-C et al. (2021), have shown that mobile device size and AR interface complexity can affect learning outcomes and user satisfaction.

Nevertheless, the future of AR in engineering appears promising, with ongoing advancements. Integrating AR with other emerging technologies, such as artificial intelligence and the Internet of Things (IoT), could further enhance its capabilities. Continued research and development are crucial to overcoming current limitations and unlocking the full potential of AR in engineering. According to Criollo-C et al. (2021), the development of more sophisticated AR devices, such as smart glasses with better resolution, wider fields of view, and enhanced computational capabilities, holds great promise. Additionally, creating AR applications tailored to specific engineering disciplines and educational levels can offer more targeted and effective learning experiences, addressing the diverse needs of students and professionals in the engineering field.

In conclusion, AR holds significant potential to transform engineering education and practice through superior visualization, enhanced training methodologies, and heightened operational efficiency. Despite existing challenges, continuous advancements in AR technology suggest a promising future for its deployment in the engineering sector. Ongoing research and innovation are essential to addressing current limitations and maximizing the benefits of AR in engineering

3 RESEARCH METHODOLOGY

Augmented Reality (AR) technology is revolutionizing the interaction between the users and their engineering equipment. By overlaying digital information onto the real-world environment, AR provides instant access to Standard Operating Procedures (SOP), Job Safety Analysis (JSA), and Hazard Identification, Risk Assessment, and Risk Control (HIRARC) information. This technology not only improves operational efficiency but also enhances safety and regulatory compliance. In this work, a prototype that utilizes AR is developed as a solution focusing on one of the identified issues regarding awareness and understanding of safety protocols. The designed prototype is called as EngineAR which is an AR application that visually presents safety protocols including SOP, JSA, HIRARC and 3D models of the engineering equipment in an engaging and interesting manner. Figure 1 shows a flowchart in terms of user interface (UI) that had been made to understand the working flow of the app and its function with details.

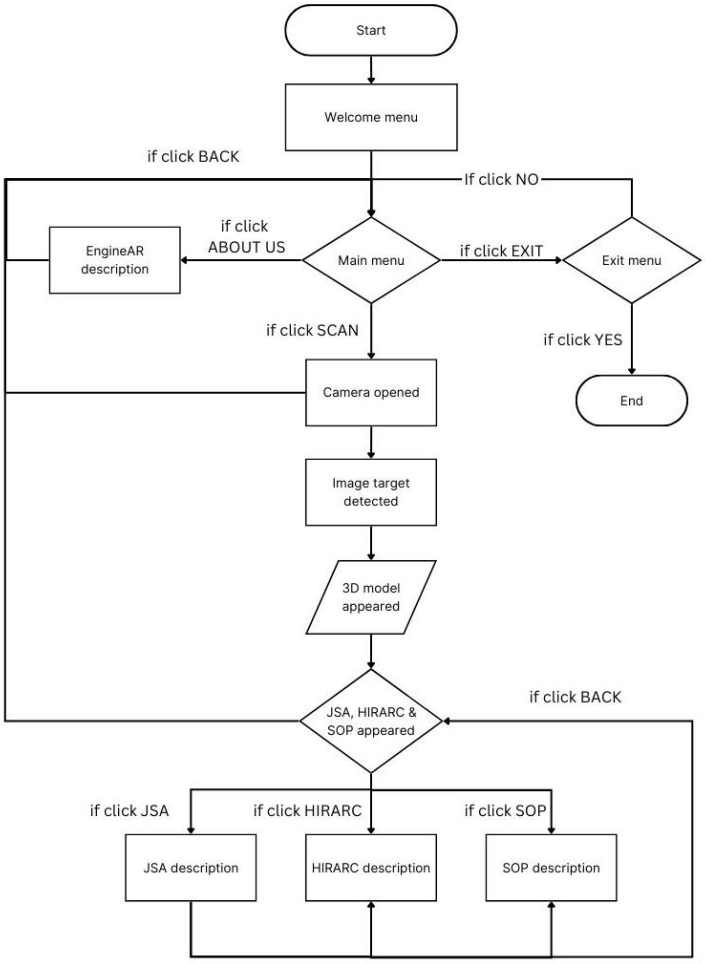


Figure 1 : Flowchart of EngineAR

4 RESULT AND DISCUSSION

EngineAR could revolutionizing the interaction between the users and their engineering equipment. By overlaying digital information onto the real-world environment, EngineAR provides instant access to Standard Operating Procedures (SOP), Job Safety Analysis (JSA), and Hazard Identification, Risk Assessment, and Risk Control (HIRARC) with User Interface (UI) information as shown in Figure 2

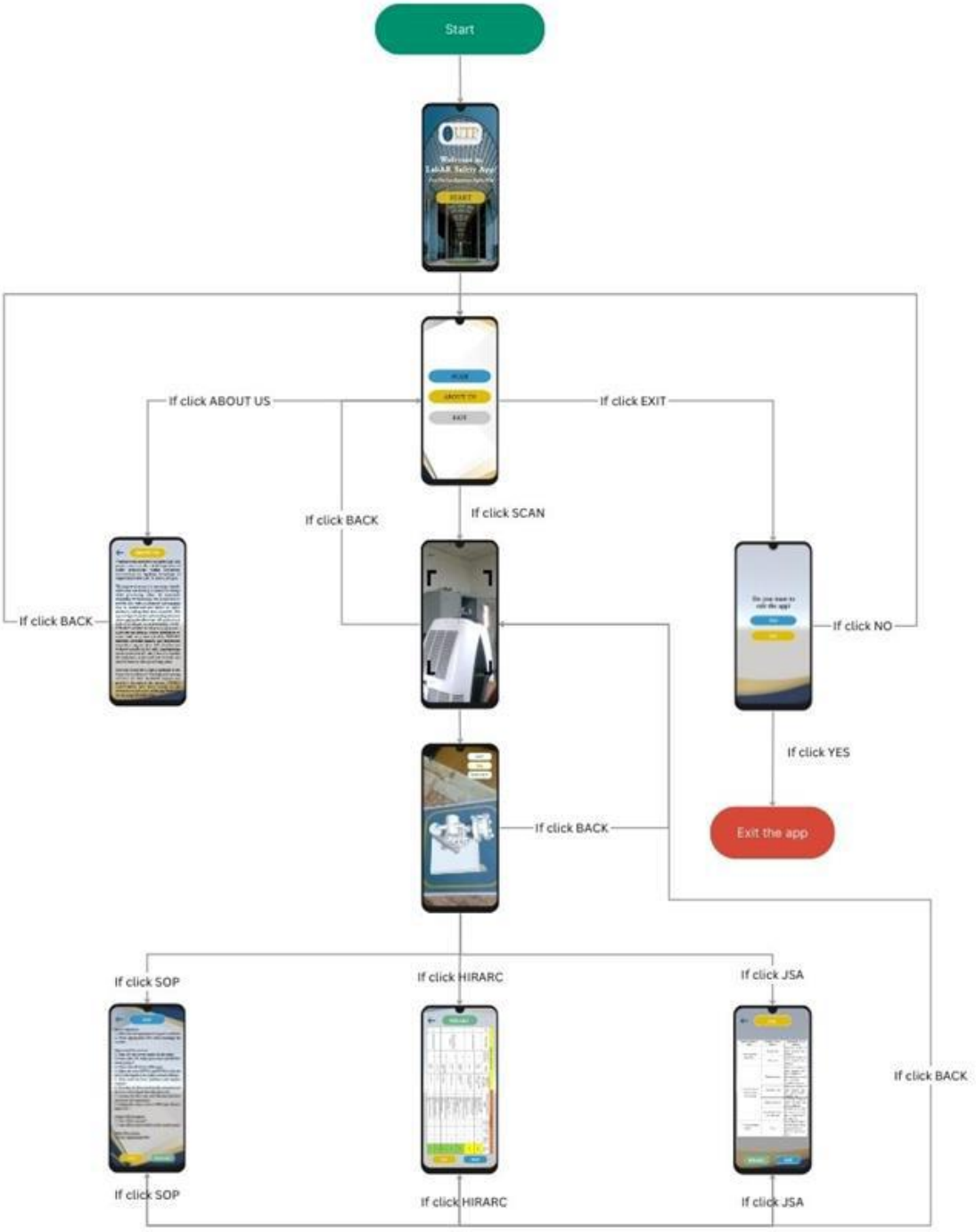


Figure 2 EngineAR User Interface (UI) information flowchart

5 CONCLUSION

In conclusion, the integration of AR for SOP, JSA, and HIRARC in the engineering sector holds great promise for enhancing safety education and practice. The project demonstrated that EngineAR could effectively bridge the gap between theory and practice, providing an easier learning environment and preparing users for real-world applications. As we move forward, expanding the use of AR in various engineering domains can lead to improved safety standards, reduced incidents, and a more knowledgeable and safety-conscious workforce.

6 ACKNOWLEDGEMENTS

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"Cheating has never been this easy!" Faculty Acceptance of ChatGPT in Higher Education - A TAM-Based Qualitative Study

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ABSTRACT

ChatGPT holds significant promise for transforming education by enabling real-time interaction with students through advanced machine learning and natural language processing (NLP) technologies. This personalized, interactive tool can cater to individual learning needs. This study applies the Technology Acceptance Model to examine faculty attitudes towards ChatGPT in a public Pakistani university. Semi-structured interviews were conducted with 15 faculty members. Findings revealed that faculty members approach ChatGPT with caution, expressing generally negative perceptions. Concerns about cheating and plagiarism were prominent, though benefits such as assistance in lesson planning and assessments were acknowledged. The study suggests that more information and training on ChatGPT is essential for faculty to make informed decisions. Future research should also explore student perspectives and employ quantitative methods to deepen understanding of ChatGPT's role in education.

Keywords: *AI in Education, ChatGPT, Educational Technology, TAM, Artificial Intelligence*

1 INTRODUCTION

ChatGPT, a revolutionary chatbot, has quickly garnered attention since its release (Sundar, 2023), amassing over a million users within just days (Shankland, 2023). Powered by Artificial Intelligence (AI), ChatGPT engages in natural, human-like conversations with users. Trained on vast amounts of data, it

mimics real human interaction, creating an experience that feels more like conversing with a person than with a machine (Cousins, 2023).

Developed by OpenAI, ChatGPT is an open-source natural language processing (NLP) model (Vallance, 2022). It relies on GPT-3, the largest unsupervised language model, combined with advanced dialogue management techniques, making it capable of producing highly realistic conversations. Unlike traditional chatbots that rely on fixed rules or keyword matching, ChatGPT maintains context throughout interactions and recalls previous conversations, enabling it to perform well in tasks such as customer service and virtual assistance (Hughes, 2022).

Following its successful launch, ChatGPT captivated audiences with its ability to generate coherent, sophisticated responses to user input. Within two months, the app reached an estimated 100 million active users, making it the fastest-growing consumer application ever (Ruby, 2023). While the technology has impressed many, it also raised concerns about potential privacy risks and misuse in educational settings.

Educators and academic institutions have voiced apprehensions regarding the use of ChatGPT, particularly in relation to academic dishonesty (Willems, 2023). ChatGPT's ability to complete tasks such as writing essays or answering test questions creates the potential for students to use the tool for cheating. Additionally, there are fears that overreliance on the chatbot might impede critical thinking and creative problem-solving, potentially diminishing the quality of students' learning experiences (Zhai, 2022).

In response to these concerns, teachers and educational institutions have started implementing measures to safeguard students from the potential risks associated with ChatGPT (Roose, 2023). Some schools have restricted access to the chatbot, while others have tightened rules for assignments and exams. These actions aim to prevent cheating and ensure students participate in activities that promote critical thinking and creativity.

Despite the concerns, ChatGPT offers several advantages for education. This AI-powered tool can enhance learning by creating engaging, interactive experiences. For instance, ChatGPT can be used to design real-time, interactive tutorials that respond to students' questions or provide conversational coaching on complex topics. It can also serve as a tool for delivering personalized content or offering automated feedback on assignments. With these capabilities, ChatGPT holds the potential to transform the educational landscape, creating innovative ways for teachers to connect with their students.

This paper examines how university teachers perceive and accept the use of ChatGPT. As an innovative technology, ChatGPT can be a valuable addition to university classrooms, allowing students to interact with digital resources naturally and acquire practical skills. However, the concern remains that over-reliance on this tool could hinder students' learning processes. Thus, the purpose of this study is to investigate the attitudes of educators toward ChatGPT.

The goal of this research is to assess university faculty members' views on ChatGPT. While this chatbot can benefit students by enabling natural interaction with digital content, its use may also present challenges by impeding deeper learning. Therefore, this study aims to evaluate the perceptions of higher education instructors toward this AI-driven technology to determine whether the advantages of ChatGPT outweigh its risks in academic settings.

The main objective of this research is to explore university teachers' perceptions of using ChatGPT in their teaching. Specifically, this study seeks to:

- Identify the potential benefits and risks of ChatGPT in higher education.
- Investigate teachers' attitudes toward the use of ChatGPT.
- Assess the level of acceptance among university faculty regarding ChatGPT and its impact on teaching and learning.
- Explore strategies to mitigate the risks of using ChatGPT while leveraging its benefits.

1.1 Rationale of the Study

ChatGPT has the potential to significantly impact the education sector, and it seems likely that both students and educators will adopt it for various academic purposes (Siemens, 2023). Given this possibility, it is essential to understand how university teachers view this emerging technology to determine whether its potential advantages outweigh the associated risks. This study aims to explore the extent to which university faculty accept ChatGPT and the implications it holds for teaching and learning. By gaining insight into educators' perceptions, we can devise strategies to mitigate risks while maximizing

the benefits of ChatGPT. Additionally, this research may guide educators in utilizing the technology to enhance their instructional methods and improve student learning outcomes.

1.2 Significance of the Study

This study holds significance for several reasons. First, it provides crucial insights into university teachers' attitudes and acceptance of ChatGPT, shedding light on the potential advantages and challenges of using this technology in educational environments. Second, the findings will help guide decisions on how to best integrate ChatGPT in higher education, ensuring that its benefits are fully realized while minimizing potential drawbacks. Lastly, this research offers a broader understanding of educators' attitudes toward technological tools, particularly AI-driven innovations, which are becoming increasingly common in academic settings. Understanding these attitudes is key as education continues to evolve alongside technological advancements.

2 CONCEPTUAL FRAMEWORK

The Technology Acceptance Model (TAM) is a well-established framework used to predict how and when individuals will adopt new technology (Davis, 1989). The model identifies two key factors that influence users' attitudes toward technology: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Perceived Ease of Use refers to how effortless or difficult individuals believe the technology will be to use, based on the cognitive effort required. Perceived Usefulness, on the other hand, is the extent to which individuals believe the technology will enhance their productivity for a specific task.

Research has consistently shown that when users find a technology both useful and easy to use, they are more likely to adopt it (Granić & Marangunić, 2019). Venkatesh and Davis (1996) highlighted the influence of external factors on PU and PEU, suggesting that these external elements play a crucial role in shaping users' attitudes. Mathieson (1991) further emphasized that understanding external factors helps explain the acceptance of new technologies. As a result, researchers have expanded TAM by incorporating external variables to explore the acceptance of eLearning tools and similar innovations (Scherer et al., 2019).

Although many studies have applied TAM to various technologies, the results have often varied. For example, Wojciechowski and Cellary (2013) found that TAM factors significantly influenced students' attitudes toward learning in an augmented reality (AR) environment for Chemistry lessons. Likewise, Briz-Ponce et al. (2017) revealed that PU and PEU directly impacted attitudes toward mobile technology in education. Murillo et al. (2021), investigating the continued use of the Moodle e-learning system, discovered that PEU affected PU but had no direct impact on Behavioral Intention (BI), while PU did directly influence BI.

Nikou and Economides (2017) suggested that PEU positively affects PU, both of which are critical predictors of BI. Similarly, Yang et al. (2021) demonstrated a direct relationship between PEU and PU, showing their influence on attitude (AT) but not necessarily on BI. Revythi and Tselios (2019) reached comparable conclusions but argued that neither PEU nor PU directly impacted Behavioral Intention. Sánchez-Prieto et al. (2017) proposed that teachers' exploration of mobile device usage in education was influenced by PEU, with both variables having a direct effect on intention. Mailizar et al. (2021), however, noted that PEU did not necessarily impact PU. Ngabiyanto et al. (2021) further highlighted that inexperienced user prioritize learning to use the technology, while experienced users focus more on its usefulness.

Despite extensive research on TAM across various technologies, there is little to no research applying the model to ChatGPT. This study aims to fill that gap by evaluating university teachers' attitudes toward ChatGPT using TAM, contributing to the understanding of how this AI-driven tool might be accepted in educational settings.

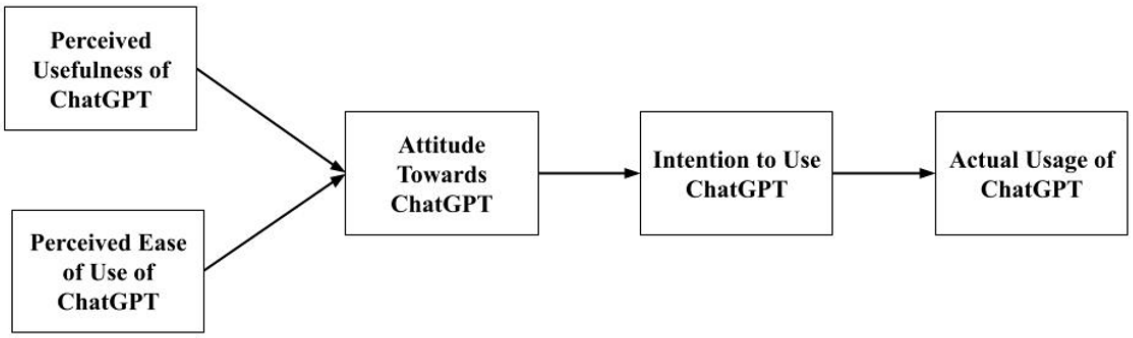


Figure 1 *Conceptual Model*

3 METHODOLOGY

This study employed a qualitative research approach to explore university teachers' perceptions of ChatGPT. Semi-structured interviews were conducted with 15 faculty members from a public university in Pakistan. The interview questions were designed to address two main constructs from the Technology Acceptance Model: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Additional external factors that might influence teachers' attitudes toward ChatGPT in educational settings were also explored.

The qualitative method was chosen because it allows for a deeper understanding of participants' beliefs and perceptions, going beyond mere numbers and statistics. Semi-structured interviews provided the flexibility to delve into the complexities of teachers' views, capturing nuances in their attitudes toward the technology. This in-depth exploration enabled a richer understanding of the participants' thoughts, which is essential for a topic as multifaceted as the integration of ChatGPT in education.

The interviews were conducted over two months, each lasting approximately 60 minutes. All interviews were recorded, transcribed, and then analyzed using NVivo 11 software. A thematic analysis, following Braun & Clarke's (2006) six-phase model, was used to identify recurring themes related to PU, PEU, external factors, and overall teacher support for ChatGPT. This approach helped to systematically analyze the data, offering insights into the factors shaping teachers' attitudes toward this innovative technology.

4 FINDINGS

The findings of this study indicate that university faculty members hold predominantly negative attitudes towards ChatGPT, with many expressing concerns about its potential misuse in educational settings. The majority of participants feared that students could exploit the technology for cheating or avoiding genuine engagement with the learning material. At the same time, however, some educators acknowledged that ChatGPT could offer certain benefits, particularly in automating routine tasks such as providing feedback. This complex mix of apprehension and cautious optimism underscores the need for a more nuanced understanding of how ChatGPT might fit into higher education.

The analysis of interview data revealed several key themes, each reflecting a different dimension of the participants' perceptions. These themes are organized into five categories: Perceived Educational Impact, Perceived Ease of Use, Attitude Towards Technology, Intention to Use, and Actual Usage. Within these categories, both the challenges and potential benefits of using ChatGPT in the classroom were explored.

Table 1: Themes and Sub-themes

Themes	Sub-Themes
Perceived Educational Impact	Cheating and student reliance

Themes	Sub-Themes
	Lack of meaningful learning
	Engagement and motivation potential
Perceived Ease of Use	Complexity and technical barriers
	Lack of support and training
Attitude Towards Technology	Trust and skepticism
	Concerns about data privacy and security
Intention to Use	Reluctance for classroom use
	Interest in personal academic tasks
	Potential for limited integration
Actual Usage	Minimal adoption
	Experimental use only
	Lack of confidence in regular use

4.1 Perceived Educational Impact

A dominant theme that emerged from the interviews was the belief that ChatGPT would negatively affect students' educational experiences, primarily through encouraging academic dishonesty. Participants were concerned that the ease of access to ChatGPT's automated responses might lead students to rely on it for completing assignments or tests, thereby circumventing the learning process. This theme comprised three sub-themes: cheating and student reliance, lack of meaningful learning, and engagement and motivation potential.

4.1.1 Cheating and Student Reliance

The majority of participants expressed serious concerns that ChatGPT could be used by students as a tool for cheating. Many believed that students would exploit the technology to generate essay responses, complete assignments, or even find answers during exams, without truly understanding the content. This perception was the most frequently mentioned concern, with many faculty members arguing that it could severely undermine academic integrity.

"ChatGPT would make it too easy for students to cheat. They wouldn't bother trying to learn the material if they could just ask the bot for the answers." – P4

"I worry that students would use ChatGPT to shortcut their way through assignments, and that’s not learning." – P9

"With the ability to generate essays or answers, I fear it will encourage laziness and cheating." – P1

These concerns suggest that the educators see ChatGPT not as a learning aid, but rather as a potential threat to the development of critical thinking and problem-solving skills among students. Participants believed that students might misuse the technology to avoid grappling with difficult concepts and instead resort to relying on the bot for immediate, ready-made answers.

4.1.2 Lack of Meaningful Learning

In addition to concerns about cheating, participants felt that ChatGPT does not foster meaningful learning experiences. Many believed that while ChatGPT can produce answers, it does not encourage the deeper cognitive processes that are central to education, such as critical thinking, analysis, and creativity.

"I don’t see how ChatGPT can foster real learning. It just gives answers; it doesn’t encourage students to think for themselves." – P12

"Relying on a chatbot for information could weaken students' ability to solve problems independently." – P18

These comments suggest that many teachers view ChatGPT as a tool that could promote passive learning, rather than active engagement. They argued that while the bot can provide factual information or even generate complex responses, it cannot replace the active learning that occurs when students engage deeply with the material, ask questions, and form their own conclusions.

4.1.3 Engagement and Motivation Potential

Despite the overwhelming concerns, a few participants noted that ChatGPT might offer potential benefits in terms of increasing student engagement and motivation. These participants felt that, if used correctly, ChatGPT could provide a new and engaging way for students to interact with learning materials. Some believed that ChatGPT's conversational abilities could make learning more dynamic and help keep students interested.

"I can see how ChatGPT could be used to engage students, maybe even motivate them to interact more with the material." – P13

"Interactive technologies like ChatGPT could create more engagement, especially for students who are less inclined to participate in traditional classroom settings." – P5

These educators argued that ChatGPT could potentially serve as a supplement to traditional teaching methods, providing students with instant feedback and allowing them to explore topics in an interactive manner. However, even those who saw this potential emphasized the need for clear guidelines and proper integration to avoid misuse.

4.2 Perceived Ease of Use

The perceived ease of using ChatGPT was another major theme that emerged during the interviews. Most participants reported that they found ChatGPT to be complex and difficult to use in an educational setting. This theme was broken down into two sub-themes: complexity and technical barriers, and lack of support and training.

4.2.1 Complexity and Technical Barriers

Several faculty members mentioned that they found ChatGPT to be difficult to use, especially when it came to integrating it into their teaching practices. Some reported that they had experimented with the tool but found it challenging to incorporate into their lessons in a meaningful way. Others felt that the time and effort required to learn how to use ChatGPT effectively outweighed any potential benefits.

"ChatGPT seems complicated, and I don't have the time to learn how to use it properly, let alone teach my students how to use it." – P5

"I think it would take a lot of effort to figure out how to implement it in a way that actually helps students." – P11

The perceived complexity of ChatGPT seemed to be a significant barrier to its adoption, with many participants feeling that the tool would require substantial investment in terms of time and effort to integrate successfully into their teaching practices.

4.2.2 Lack of Support and Training

Another key barrier to ChatGPT's adoption was the perceived lack of institutional support and training. Many participants felt that they had not received adequate guidance or resources from their institutions on how to use ChatGPT effectively in the classroom. Without proper training and support, faculty members felt ill-equipped to integrate the technology into their teaching.

"There's no support or training for us to figure out how to use ChatGPT in the classroom. Without that, how can we be expected to adopt it?" – P9

"If there was more guidance on how to use ChatGPT, I might be more open to it, but right now, we're left to figure it out on our own." – P10

This lack of support and training was cited by many participants as a major reason for their reluctance to use ChatGPT in their classrooms. Without institutional backing, they felt that the risks associated with ChatGPT outweighed its potential benefits.

4.3 Attitude Towards Technology

The attitudes of faculty members towards ChatGPT were generally skeptical. Themes that emerged from this category included trust and skepticism and concerns about data privacy and security.

4.3.1 Trust and Skepticism

Many participants expressed a general lack of trust in ChatGPT, both in terms of its reliability and the quality of the information it provides. Some faculty members were concerned that ChatGPT might provide inaccurate or misleading information, which could confuse students or lead to misunderstandings.

"I'm not convinced that ChatGPT is reliable enough for me to trust it with my students' learning." – P15

"I don't trust the answers it gives—there's too much uncertainty about how accurate it is." – P9

These comments highlight the underlying skepticism that many educators feel towards ChatGPT. They expressed concerns that the technology might not be reliable or accurate enough to be trusted as a learning tool, especially in an educational setting where accuracy is crucial.

4.3.2 Concerns About Data Privacy and Security

Another recurring concern was the issue of data privacy and security. Some participants expressed apprehension about how student data might be handled by ChatGPT and whether the use of the tool could lead to potential breaches in student privacy.

"We need more transparency about how data is being used and protected. I wouldn't feel comfortable using ChatGPT without that assurance." – P19

These concerns suggest that data privacy and security are important considerations for faculty members when evaluating whether or not to use ChatGPT. Many participants felt that they needed more information about how data would be handled before they could feel confident incorporating the tool into their classrooms.

4.4 Intention to Use

The majority of participants expressed little to no intention of using ChatGPT in their classrooms in the immediate future. However, some were open to using it for personal academic tasks or for limited, non-critical classroom activities. Three sub-themes emerged in this category: reluctance for classroom use, interest in personal academic tasks, and potential for limited integration.

4.4.1 Reluctance for Classroom Use

Most participants were not interested in using ChatGPT as a regular tool in their classrooms, primarily due to concerns about cheating, distraction, and misuse. Many faculty members felt that the risks associated with using ChatGPT outweighed its potential benefits, especially in a classroom setting.

"I don't see myself using ChatGPT anytime soon. The risks seem to outweigh the benefits right now." – P8

"I don't think ChatGPT would add much value to my classroom—it seems more like a distraction than a helpful tool." – P13

4.4.2 Interest in Personal Academic Tasks

While most faculty members were reluctant to use ChatGPT in the classroom, some expressed interest in using it for their own academic work. They believed that ChatGPT could be a useful tool for tasks such as conducting research, gathering information, or organizing lesson plans.

"I think it could be helpful for my research, maybe even for organizing lesson plans." – P3

"I'm not sure about the classroom, but I might use it for my own academic work." – P19

4.4.3 Potential for Limited Integration

A few participants expressed interest in using ChatGPT for simpler, non-critical tasks, such as providing feedback to students or helping with basic research tasks. These participants felt that while ChatGPT might not be suitable for complex educational activities, it could still be useful for routine or repetitive tasks.

"Maybe for some small tasks, like gathering information or helping with basic questions." – P16

"I wouldn't use it for important tasks, but it might be useful for providing quick feedback or answering simple questions." – P5

4.5 Actual Usage

The actual usage of ChatGPT among participants was minimal, with most reporting that they had either never used the tool or had only experimented with it in limited capacities. The themes of minimal adoption and experimental use only were prominent in this category.

4.5.1 Minimal Adoption

The majority of participants reported that they had not used ChatGPT in their classrooms and did not anticipate using it in the near future. Many cited concerns about its effectiveness, reliability, and potential for misuse as reasons for avoiding the tool.

"I tried using it a few times, but I didn't find it particularly useful, so I stopped." – P6

4.5.2 Experimental Use Only

A few participants reported that they were experimenting with ChatGPT to explore its potential uses, but had not yet committed to using it regularly in their teaching.

"I'm still figuring out how to use it effectively, so for now I'm just testing it out." – P20

4.6 Other Findings

4.6.1 Potential Benefits

Some participants mentioned that ChatGPT could potentially be useful for simplifying lesson planning and providing timely feedback to students. These participants felt that while ChatGPT might not be suitable for complex educational tasks, it could still be helpful in reducing the administrative burden on teachers.

"ChatGPT could be helpful in lesson planning—it could free up time for me to focus on other aspects of teaching." – P11

4.6.2 Strategies to Mitigate Risks

To address concerns about cheating and misuse, participants suggested implementing more oversight, setting clear guidelines for usage, and providing more training for both teachers and students.

"More supervision and clearer rules about its use could help mitigate the risks." – P15

5 DISCUSSION AND CONCLUSION

The findings of this study indicate that university faculty members are hesitant about fully adopting ChatGPT as a teaching tool in their classrooms. Most participants expressed a general reluctance, with many either not using the technology at all or using it only occasionally and for minor tasks. The prevailing sentiment among the participants was one of caution, as they felt that ChatGPT could potentially do more harm than good, particularly in relation to academic integrity. Concerns about cheating, plagiarism, and students' reliance on automated answers were the most frequently mentioned issues. These worries contributed to their resistance toward the integration of ChatGPT into their teaching practices.

Despite the negative perceptions, it's important to note that very few faculty members advocated for a complete ban on ChatGPT. This is because some educators acknowledged the potential benefits the technology could bring to higher education. Some participants recognized that ChatGPT could streamline specific educational processes, such as lesson planning and providing feedback, both of which are time-consuming tasks for educators. Additionally, the participants saw potential for ChatGPT to engage students in new and innovative ways. However, these potential advantages were often overshadowed by concerns about misuse, specifically regarding the ease with which students could use the tool to circumvent genuine learning. Teachers were concerned that students might use ChatGPT to complete assignments or even exams without truly understanding the material.

The most significant concern that emerged was the risk of academic dishonesty. Many educators feared that students would exploit the tool, using it as a shortcut to complete tasks rather than engaging in

critical thinking or problem-solving. Several participants worried that this could undermine the educational process, leading students to rely too heavily on the technology instead of developing their own ideas or working through complex problems.

"I worry that my students would use ChatGPT as a way to cheat on assignments rather than to learn the material," said one participant. Another remarked, "It's dangerous—students could use ChatGPT to plagiarize work, and we wouldn't even know it." These concerns highlight a fundamental tension in the attitudes of educators: while recognizing the potential value of ChatGPT, many feel its risks are too significant to ignore without proper safeguards.

In terms of potential advantages, several participants mentioned that ChatGPT could be helpful in improving efficiency in classrooms. For example, some teachers noted that the chatbot could be used to provide quick feedback on student work or assist with administrative tasks, such as organizing lesson plans. This could allow educators to focus more on higher-order teaching activities, such as engaging with students in discussions or providing one-on-one support.

One participant expressed optimism, stating, "I could see ChatGPT helping me with grading or providing feedback to students quickly so I can spend more time actually teaching." This perspective suggests that some educators see value in ChatGPT as a tool for reducing administrative burdens, even if they remain wary of its potential to negatively impact students' learning.

Another potential benefit raised by participants was the use of ChatGPT to engage students more actively. Some teachers believed that the interactive nature of the chatbot could help maintain student interest in subjects they might otherwise find challenging or uninteresting. By offering immediate responses to questions, ChatGPT might encourage students to explore topics more independently, providing them with opportunities to deepen their understanding outside of traditional classroom instruction.

However, even participants who recognized these potential advantages emphasized the need for caution. They argued that if ChatGPT is to be integrated into education, it must be done in a controlled and responsible way. Several participants suggested that, to mitigate risks, there should be clear guidelines and policies in place for its use in academic settings. Educators recommended increased supervision of student interactions with ChatGPT, alongside rules that specify how the technology should and should not be used.

For instance, one participant suggested, "There need to be strict guidelines for how students use ChatGPT, and teachers should monitor their use closely to ensure it's not being misused." Another teacher remarked, "It's not about banning the technology, but rather about using it responsibly. We need to find a balance."

This research highlights that while faculty members are cautious about adopting ChatGPT, they do not see it as entirely without merit. Instead, they advocate for responsible usage with proper oversight to prevent misuse while allowing educators to benefit from its time-saving and engagement-enhancing features.

6 LIMITATIONS OF THE STUDY

Several limitations of this study should be noted. Firstly, the sample size was relatively small, with only 15 participants from a single public university in Pakistan. This limits the generalizability of the findings, as the attitudes and perceptions of educators at other institutions, particularly public universities or those in different cultural contexts, may differ. Future research should aim to include a larger, more diverse sample to gain a more comprehensive understanding of how university teachers perceive ChatGPT.

Additionally, this study focused solely on the perspectives of university teachers. While faculty attitudes are crucial to understanding the potential impact of ChatGPT in educational settings, it is equally important to consider the perspectives of students. Students are the primary users of this technology, and their experiences, attitudes, and behaviors regarding ChatGPT could provide valuable insights into its efficacy and risks. Future research should aim to include student perspectives to better understand how ChatGPT is being used and perceived in academic contexts.

Finally, this research did not assess the practical ways in which ChatGPT is currently being used in classrooms. While some participants mentioned experimenting with the technology, there was no in-depth exploration of specific teaching strategies or applications. Further studies should investigate how

ChatGPT is being integrated into various educational activities, such as assignments, exams, and feedback mechanisms, to understand its practical impact on both teaching and learning.

7 FUTURE RESEARCH DIRECTIONS

To build upon this study, future research should explore how ChatGPT is being practically implemented in classrooms, as well as its effects on both educators and students. Quantitative research methods, such as surveys, could provide a broader perspective on the acceptance and use of ChatGPT across different institutions and regions. This would help identify trends in how ChatGPT is being adopted and the common challenges faced by educators.

Additionally, future research should assess student attitudes towards ChatGPT. Understanding how students perceive the technology—whether as a helpful tool, a distraction, or a means to avoid effort—could shed light on its broader implications for academic integrity and learning outcomes. Surveys, focus groups, and interviews with students could provide valuable insights into their experiences with ChatGPT, including how they use it and whether it enhances or hinders their learning.

Finally, future studies should focus on developing best practices and strategies for integrating ChatGPT into higher education. This could include exploring ways to enhance student engagement while mitigating the risks of cheating and plagiarism. Research could also focus on the development of training programs for teachers, ensuring that they feel confident and supported in using the technology effectively in their classrooms.

8 CONTRIBUTIONS OF THE STUDY

This study represents one of the first efforts to examine university teachers' perceptions of ChatGPT within higher education contexts of Pakistan. The insights gathered here provide a starting point for ongoing discussions about the role of AI-driven tools in education. By exploring both the potential benefits and risks, this research contributes to a more nuanced understanding of how technologies like ChatGPT might be integrated into university teaching practices.

The findings highlight the importance of responsible usage, with educators calling for clear guidelines and increased supervision to prevent misuse while maximizing the tool's potential benefits. As AI technologies continue to evolve, this study provides a foundation for future research, helping educators and administrators navigate the complexities of integrating such tools in a way that supports meaningful learning.

Further exploration of ChatGPT's role in education will be crucial in determining how it can best be used to enhance both teaching and learning. Ultimately, the insights gained from this research are not only valuable for understanding current faculty attitudes but also for shaping future policies and practices that ensure the responsible and effective use of AI in educational contexts.

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Enhancing Entrepreneurial Education Through Technology and Innovation for Space-UTM Students

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ABSTRACT

The evolving digital landscape transforming entrepreneurial education is changing how future business leaders are prepared for an innovation-driven economy. This study critically investigates the incorporation of advanced technologies such as Artificial Intelligence (AI), gamification, augmented and virtual reality (AR/VR), and collaborative digital platforms into entrepreneurship curricula. Based on Experiential Learning Theory, the Technology Acceptance Model, and Constructivist Learning Theory, the study demonstrates how these tools improve student engagement, enhance experiential learning, and bridge the gap between theoretical instruction and real-world entrepreneurial application. Empirical findings reveal that the impact of technology and innovative teaching methods is the strongest predictor of students' awareness and perceived benefits ($\beta = 0.374$, $p < 0.001$), followed by the effectiveness of entrepreneurship courses ($\beta = 0.253$, $p < 0.001$) and future opportunities for technology use ($\beta = 0.127$, $p = 0.030$). The post-pandemic shift to online learning has raised students' expectations for dynamic, interactive, and technologically integrated education. Real-world applications such as Kahoot and Google Workspace, demonstrate how digital tools facilitate accessibility and collaboration. The findings highlight the increasing necessity for digital competencies in entrepreneurship, consistent with current literature on future career readiness. However, challenges such as digital inequality, institutional inertia, and cybersecurity concerns remain. To address these challenges, the study proposes strategic alternatives such as faculty upskilling, student-centered pedagogies, and cross-sector collaborations. Ultimately, this study contributes to the scholarly discourse on digital innovation in higher education by offering actionable insights and evidence-based recommendations for enhancing entrepreneurial education through sustainable, future-ready technological integration.

KEYWORDS: Education, technology, entrepreneurship, innovation.

1 INTRODUCTION AND BACKGROUND

The evolution of education has been significantly shaped by technological advancements, transforming traditional learning models into dynamic, technology-integrated approaches. Entrepreneurial education, in particular, has emerged as a vital component in modern economies, encouraging students' creativity, problem-solving skills, and innovation-driven mindsets. This study explores the role of entrepreneurial education in providing students with the necessary competencies to navigate the complexities of today's marketplaces, focusing on how digital tools and technological innovations enhance the effectiveness of entrepreneurial learning. Education has evolved significantly to meet the changing demands of human societies. Initially, education was informal and focused on teaching cultural information and survival skills within families or small communities. Ancient civilizations such as those in Mesopotamia, Egypt, and Greece formalized education, introducing structured systems that

emphasized philosophy, mathematics, rhetoric, and vocational training (Marrou, 1956; Oppenheim, 1977; Davies, 1999). Since these systems were mostly available to the wealthy elite, there were significant disparities in educational access and prospects, reinforcing existing social hierarchies and limiting upward mobility for the lower classes (Marrou, 1956; Oppenheim, 1977).

The establishment of universities throughout Europe during the Middle Ages broadened the scope of formal education while maintaining exclusivity by emphasizing the fields of theology, law, and medicine. The Industrial Revolution brought widespread education to meet the demands of increasingly industrialized societies. This period promoted standardized curricula and rote memorization to efficiently train individuals for industrial jobs, which frequently stifled creativity and critical thinking (Watters, 2015; Davis, 2024). However, the 20th century saw a renewed emphasis on education as a means of promoting social mobility and driving innovation. Yet, the rigid frameworks of traditional systems started to expose their shortcomings in meeting the demands of modern challenges.

The shift from traditional to modern education represents not just a passing trend but a vital progression prompted by the shortcomings of rigid, teacher-led approaches. Kolb (1984) argues that conventional educational frameworks, which rely heavily on passive learning through lectures and rote memorization, do not adequately prepare students for the demands and complexities of the 21st century. These approaches inhibit students' creativity, critical thinking, and problem-solving skills - competencies essential in today's fast-evolving job markets. In contrast, modern education emphasizes a student-centered model that incorporates experiential learning and interdisciplinary collaboration. Within this educational shift, innovation plays a pivotal role in advancing and enriching learning standards. Tools such as flipped classrooms and blended learning are more than temporary trends; they represent fundamental changes. As Graham (2019) highlights, these methods enable students to engage with online materials outside the classroom and take part in meaningful in-class discussions. This, in turn, enhances the learning experience, making it more effective, flexible, and aligned with the skill demands of the modern workforce.

Entrepreneurial education plays a vital role in equipping students with the critical skills needed to thrive in an increasingly complex and evolving business environment, while simultaneously fostering innovation. As the job market and labor dynamics continue to shift, there is an increasing emphasis on nurturing entrepreneurial competencies among students. These competencies include the ability to identify and seize business opportunities, a readiness to embrace risk, strong problem-solving skills, and a flair for creativity. In recent times, technological progress has significantly enhanced the learning experience by introducing advanced tools like digital platforms, interactive software, virtual simulations, and e-learning solutions. These technologies offer the potential to create more tailored, hands-on, and stimulating educational environments, allowing students to bridge theory with practice through experiential and reflective learning.

Traditional methods of teaching entrepreneurship are increasingly viewed as insufficient for preparing students to meet the demands of today’s dynamic business environment. Rodrigues (2023) notes that conventional approaches, such as lectures and theoretical instruction, often fall short in providing students with the essential skills needed to thrive amid the ever-evolving business landscape. These traditional methods frequently lack experiential and hands-on elements crucial for cultivating key entrepreneurial abilities like adaptability, creativity, and problem-solving. In response, innovative instructional models - such as digital integration and project-based learning - have shown promising results in bridging these gaps. For instance, research on web-based entrepreneurship education has found that combining online coursework with project-based experiences greatly boosts student engagement and learning effectiveness. This evolution from passive, theory-heavy teaching to a more interactive, student-driven approach nurtures innovation and better equips learners to face real-world entrepreneurial challenges (Sun, 2024).

This study aims to bridge the existing gap by assessing the existing state of technology incorporation in entrepreneurship education at School of Professional and Continuing Education (SPACE-UTM), examining its impact on students' entrepreneurial skills, and making recommendations for improvement. In doing so, it seeks to tackle the limitations of traditional teaching methods and propose more effective alternatives. In light of these challenges and prospects, the objective of this study is to assess and enhance the quality of entrepreneurial education at the SPACE-UTM through the application of technological tools and innovative teaching practices. The study endeavors to deliver both practical and theoretical contributions that can inform the development of more relevant, inclusive, and forward-looking entrepreneurship education models within lifelong learning contexts.

2 LITERATURE REVIEW

Entrepreneurial education is a dynamic field that provides learners with the essential knowledge, skills, and mindset to effectively navigate the complexities of today's economic environment. It extends beyond the mere creation of new ventures to include a wide range of competencies such as creativity, innovation, adaptability, and strategic thinking (Neck & Greene, 2011). This form of education empowers individuals to identify opportunities, address real-world challenges, and make significant contributions to both economic growth and societal progress. The focus has moved away from conventional, theory-dominated instruction toward a comprehensive educational approach that fosters an entrepreneurial mindset across various fields. Experiential learning strategies - like startup incubators, business simulations, and design-thinking workshops—are increasingly employed to support active engagement, encourage risk-taking, and build resilience (Sun, 2024).

Technology has significantly transformed entrepreneurial education, enhancing its accessibility and effectiveness. Digital tools like gamification applications and virtual reality (VR) simulations create immersive learning environments where students can safely explore and test business ideas. Additionally, online learning platforms have expanded access to entrepreneurship education by eliminating geographic and socioeconomic constraints (Chen et al., 2021). At the same time, essential competencies such as creativity, problem-solving, adaptability, leadership, and collaboration have become integral to entrepreneurial training. Techniques including brainstorming sessions, augmented reality (AR) problem-solving exercises, simulation-based decision-making, and the use of collaborative platforms like Slack and Trello help students prepare for real-world scenarios and build the interpersonal and cognitive agility needed in today's innovation-centric workspaces (Fernández Batanero & Reyes Rebollo, 2017; Marín Díaz, 2017; Paredes-Saavedra et al., 2024; Sun, 2024).

Entrepreneurship is broadly recognized as a fundamental catalyst for innovation, economic development, and social change. Entrepreneurs play a vital role in advancing national progress by generating new markets, creating employment, and fostering technological innovation. Studies have shown a significant link between entrepreneurial activity and Gross Domestic Product (GDP) growth, especially within developing nations (Munyo & Veiga, 2022; Neumann, 2020). Prominent institutions such as Massachusetts Institute of Technology (MIT) and Babson College illustrate how universities can nurture entrepreneurial ecosystems by blending technical knowledge with entrepreneurship education (Sun, 2024). In addition, the emergence of social entrepreneurship has aligned business strategies with global priorities like sustainability and social justice. Programs supporting the United Nations Sustainable Development Goals (SDGs) highlight how entrepreneurship can effectively address environmental and societal issues while promoting systemic transformation (Alvord et al., 2004; Curigliano et al., 2013).

Despite the progress made, traditional entrepreneurial education programs continue to encounter considerable obstacles. Conventional lecture-based instructional methods frequently fall short of aligning with the practical demands of entrepreneurship, thereby inhibiting innovation and critical thinking (O'Connor, 2013; Rahman et al., 2024). The absence of interdisciplinary collaboration further restricts the comprehensive development of entrepreneurial skills, as institutional silos prevent integrated, cross-functional learning experiences (Bridgstock et al., 2018; Duval-Couetil, 2013). Resource limitations including inadequate funding, facilities, and partnerships with industry also hinder the delivery of effective experiential learning (Rasmussen & Sorheim, 2006). Moreover, resistance within institutions to embrace change can slow the adoption of progressive teaching strategies (Caruth & Caruth, 2007). Adding to these challenges is the difficulty of evaluating the effectiveness of entrepreneurship education, as conventional assessment methods often fail to reflect the intricate cognitive, emotional, and behavioral shifts involved in entrepreneurial development (Kozlinska et al., 2020; Nabi et al., 2017). Overcoming these hurdles is vital to creating entrepreneurial education systems that are more flexible, effective, and suited to the needs of the future.

3 METHODOLOGY

This study employs a quantitative research design to explore the impact of technological integration and innovative teaching methods on entrepreneurial education at SPACE-UTM. A structured questionnaire was designed to measure multiple constructs, including the course effectiveness, teaching and learning approaches, challenges in technology integration, perceived impact on entrepreneurial skills,

and strategic recommendations for future improvements. The survey utilized a Likert-scale to gauge participant responses, with reliability confirmed through a pilot test followed by necessary adjustments to the items. The validity of the constructs was established using Cronbach's Alpha, with all scores surpassing the accepted benchmark of 0.70, signifying high internal consistency.

Data analysis was carried out using Statistical Package for Social Science (SPSS), incorporating various statistical methods to ensure comprehensive interpretation. Initially, descriptive statistics were utilized to outline demographic characteristics and identify general patterns. Pearson correlation analysis was then conducted to examine the relationships between variables. Furthermore, multiple regression analysis was employed to determine the main predictors affecting students' awareness and perceived benefits of using technology in entrepreneurial education. Before performing the regression analysis, standard assumption tests including assessments for normality, multicollinearity, and heteroscedasticity were undertaken to validate the suitability of the data for inferential analysis. This methodologically rigorous approach ensured that the results were statistically reliable and offered valuable insights into advancing entrepreneurship education through technological innovation.

4 RESULTS AND ANALYSIS

Table 1 shows the demographic profile of respondents in this study. It comprises a total of 226 full-time students enrolled at School of Professional and Continuing Education (SPACE-UTM).

Table 1: Demographic Profile of Respondents

Characteristics	Description	Frequency	Percentage (%)
Age	21 – 30 years old	51	22.6
	Above 30 years old	1	0.4
	Under 20 years old	174	77.0
Gender	Female	144	63.7
	Male	82	36.3
Level of Education	Bachelor's Degree	40	17.7
	Diploma	21	9.3
	Foundation	165	73.0
Field of Study	Accounting	4	1.8
	Architecture	16	7.1
	Business	76	33.6
	education	2	0.9
	Engineering	4	1.8
	Foundation	82	36.3
	Quantity Surveyor	5	2.2
	Life Science	5	2.2

	Management	23	10.2
	Others	9	4
Technology Accessibility	Advanced	37	16.4
	Limited	50	22.1
	Moderate	139	61.5
Assessment of the overall quality of entrepreneurial education at SPACE-UTM	Excellent	28	12.4
	Good	96	42.5
	Neutral	94	41.6
	Poor	8	3.5
Level of satisfaction with the existing entrepreneurial curriculum	Dissatisfied	2	.9
	Extremely Dissatisfied	2	.9
	Extremely Satisfied	24	10.6
	Neutral	92	40.7
	Satisfied	106	46.9

Most of the respondents are below 20 years of age (77%), while only 1% are above 30 years old. Female respondents have a greater share of the sample (63.7%) as compared to male. 73% of the respondents are pursuing foundation in social science, followed by 17.7% in bachelor's degree program, and 9.3% in diploma program. The fields of study were mostly Business (33.6%), Foundation (36.3%), and Management (10.2%). Other fields included Architecture, Engineering, Quantity Surveying, Life Sciences, and a mix of various disciplines. This indicates that students from a range of academic backgrounds are engaging with entrepreneurship education.

Additionally, most respondents (61.5%) reported that they have moderate technology access, while 22.1% have limited access, and only 16.4% have advanced access. This highlights some gaps in digital readiness that may affect how students engage with tech-driven learning. When asked about the quality of entrepreneurial education at SPACE-UTM, more than half of the students responded positively, rating it as either good or excellent. However, 41.6% remained neutral, which may suggest a lack of strong impressions about the program. Similarly, 57.5% of students reported being satisfied or extremely satisfied with the existing entrepreneurial curriculum, while 40.7% expressed a neutral stance.

These findings suggest that even though many students value the entrepreneurial education offered, there is still an opportunity to strengthen the curriculum and better engage students who remain neutral and undecided.

Table 2: Reliability Analysis

Construct	No. of Items	Cronbach's Alpha
Awareness and Benefits of Technology in Education	12	0.919
Effectiveness of Existing Entrepreneurship Courses	10	0.960

Challenges to Incorporating Technology	10	0.896
Teaching and Learning Approaches	6	0.942
Impact of Technology and Innovative Teaching Methods on Entrepreneurial Skills	10	0.962
Strategic Recommendation for Elevating Technology Use	10	0.964
Future Research and Opportunities	6	0.936

Reliability analysis shown in Table 2 shows that all constructs exceed the threshold of 0.70 (Pallant, 2016). This indicates high internal consistency and confirms that all the constructs are statistically reliable. Classical assumption test was used to figure out whether the residual values produced from the regression were normally distributed or not. Table 3 shows the result of the normality test, conducted using the Kolmogorov-Smirnov test. The result showed a value of less than 0.05, which indicates that the residuals were not normally distributed. However, according to Field (2018), regardless of the shape of the population, estimates in samples of parameters will have a normal distribution provided the samples are big enough. Hence, due to the current study's large sample size (N = 226), the violation of normality is not considered critical, as the central limit theorem supports the robustness of parametric tests in this context of study (Field, 2018).

Table 3: Classical Assumption Test

Test	**Normality Test**		**Multicollinearity Test**			**Heteroscedasticity Test**
	Kolmogorov-Smirnov	Asymp. Sig	Variable	Tolerance	VIF	Sig. Value
Dependent Variable (DV)	0.091	0.000	IV1_Effectiveness	0.545	1.836	> 0.05
			IV2_Challenges	0.829	1.206	> 0.05
			IV3_Teaching	0.282	3.546	> 0.05
			IV4_Impact	0.291	3.442	> 0.05
			IV5_Strategic	0.256	3.900	> 0.05
			IV6_Futureresearch	0.286	3.495	> 0.05
Significance Limit		0.05				0.05

Apart from that, the multicollinearity test had variables' tolerance values greater than 0.1 and VIF value of less than 5, indicating that there was no multicollinearity issue among the predictors (Hair, Black, Babin, & Anderson, 2019). In terms of heteroscedasticity test, the significance values for all independent variables were greater than 0.05, confirming the absence of heteroscedasticity and thus the regression estimates are reliable and trustworthy. The result of heteroscedasticity is important as it affects whether the hypothesis tests are either too stringent or too insensitive (Hair, Black, Babin, & Anderson, 2019). These findings confirm that the regression model meets the key assumptions required for valid analysis. Therefore, the results derived from the regression can be considered statistically sound and suitable for interpretation.

Table 4: Correlation Analysis Among Study Variables

Scale	1.	2.	3.	4.	5.	6.	7.
1. Awareness and Benefits of Technology in Education	-						
2. Effectiveness of Existing Entrepreneurship Courses	0.687**	-					
3. Challenges to Incorporating Technology	0.287**	0.148*	-				
4. Teaching and Learning Approaches	0.711**	0.651**	0.299**	-			
5. Impact of Technology and Innovative Teaching Methods on Entrepreneurial Skills	0.790**	0.607**	0.286**	0.797**	-		
6. Strategic Recommendation for Elevating Technology Use	0.713**	0.555**	0.377**	0.747**	0.747**	-	
7. Future Research and Opportunities	0.707**	0.535**	0.384**	0.701**	0.731**	0.821**	-

Note: **p < 0.01 (2-tailed), *p<0.05 (2-tailed), N=226

Furthermore, the relationship between the constructs were investigated using Pearson correlation coefficient. The correlation analysis in Table 4 showed that most study variables are significantly and positively related. Awareness and Benefits of Technology in Education was strongly correlated with Impact on Entrepreneurial Skills ($r = 0.790$, $p < 0.01$), Teaching and Learning Approaches ($r = 0.711$, $p < 0.01$), Strategic Recommendations ($r = 0.713$, $p < 0.01$), and Future Research ($r = 0.707$, $p < 0.01$). These strong correlations suggest interdependent association between these variables. Simply put, as students become more aware and acknowledge the benefits of technology in education, they are more likely to experience enhanced teaching strategies, support the implementation of strategic technological use, and recognize opportunities for future educational innovation.

Next, a multiple regression analysis was conducted to examine how six predictors (effectiveness of existing entrepreneurship courses, challenges to incorporating technology, teaching and learning approaches, impact of technology and innovative teaching methods on entrepreneurial skills, strategic recommendation for elevating technology use, future research and opportunities) influence awareness and benefits of technology in education. The R^2 value (coefficient of determination) was used to measure the ability of the independent variables to explain the variation in the dependent variable. The result in Table 4 shows that an adjusted R^2 value of 0.711 was obtained. This means that 71.1% of the dependent variable was influenced by the independent variable, indicating a strong model fit.

Table 5: Results of Multiple Regression Analysis and Hypotheses Testing

Model		B	β	t-values	p-values	Results
1	Constant	0.540		3.340	0.001	
	IV1_Effectiveness	0.253	0.293	6.040	0.001	Significant
	IV2_Challenges	0.025	0.028	0.702	0.484	Not significant
	IV3_Teaching	-0.010	-0.011	-0.161	0.872	Not significant
	IV4_Impact	0.374	0.421	6.333	0.001	Significant
	IV5_Strategic	0.098	0.112	1.586	0.114	Not significant
	IV6_Futureresearch	0.127	0.147	2.188	0.030	Significant
	Constant R^2	0.718				
	Adjusted R^2	0.711				

Note: DV= Awareness and Benefits of Technology in Education, B = unstandardized regression coefficients; Beta = standardized regression coefficients.

Among the predictors, three variables emerged as statistically significant. Effectiveness of entrepreneurship courses ($\beta = 0.253$, $t = 6.040$, $p < 0.001$), Impact of technology and innovative teaching methods ($\beta = 0.374$, $t = 6.333$, $p < 0.001$), as well as Future Research and Opportunities ($\beta = 0.127$, $t = 2.188$, $p = 0.030$). This implies that students' awareness and perceived benefits of technology-driven education are primarily influenced by effectiveness of the courses, impact of innovative teaching, and future potential of technology use in entrepreneurship education. These findings shine some light on how technology-driven learning is shaping entrepreneurial education at SPACE-UTM.

A well-structured entrepreneurship course enables the students to become more aware of how technology facilitates learning and business innovation. This can be supported by Rahayu et al., (2023) and Mahmudin (2023) who established that technology's role in entrepreneurship education is significant, necessitating approaches that are adaptable to rapid technological advancements and shifting business environments (Rahayu, Mayasari, Fitriyatinur, & Agustina, 2023; Mahmudin, 2023). Additionally, in line with the goals of the National Entrepreneurship Policy 2030, the focus on educational institutions to equip their students with technology-driven skills would contribute to the development of quality entrepreneurs in Malaysia. This aligns with the national agenda of strengthening entrepreneurial capabilities and innovative entrepreneurial ecosystem.

Next, the impact of technology and innovative teaching methods was the strongest predictor of awareness and benefits, indicating that students recognize the impact of technology-incorporated teaching. This can be supported by several studies who underscore the importance of digital skills in shaping future career prospects within entrepreneurship, emphasizing the integration of digital technologies into education (Rosli, Kadir, Jamaluddin, & Kang, 2023; Gunaseelan, Subramaniam, Sern, Jabor, & Rathakrishnan, 2022). Ever since the pandemic started at the end of 2019, most industries had to switch to online platforms, especially educational sectors. This has reshaped how students engage with content and teachers. The strong significance of this variable implies that students notice and appreciate when teaching goes beyond traditional lectures. Gamified learning environments and collaborative platforms such as Kahoot and Google Workspace not only increase accessibility but also support experiential learning. All of these are important especially in entrepreneurial education.

Moreover, the factor of future research and opportunities plays a significant role towards awareness and benefits of technology in education, even though it is weaker than the other factors. This implies that students expect continuous innovation in entrepreneurship education. They value curriculum development that incorporates emerging technologies such as blockchain in business, digital entrepreneurship, as well as Artificial Intelligence. This result is consistent with the study by Edenkwo &

Nwaoburu (2025) who emphasized that emerging technologies should be incorporated in business and entrepreneurship education. They further recommend that retraining programs for educators are necessary and should be conducted to cater to students' anticipation and to align with advancement of modern technology (Edenkwo & Nwaoburu, 2025). Therefore, developing a curriculum that embraces technological advancements is important not to only meet student needs, but also to align with evolving industry expectations.

5 CONCLUSION

Based on the findings, this study concludes that entrepreneurial education at SPACE-UTM has a solid foundation but shows room for strategic enhancement, particularly through the integration of technology and innovative teaching practices. The data reveals that students generally hold a positive view of the entrepreneurial curriculum, with many expressing satisfactions regarding its effectiveness. However, a significant portion remain neutral both in their perception of curriculum quality and satisfaction indicating a lack of strong engagement or impactful experience. Younger, foundation-level students make up the majority of the sample, highlighting the importance of tailoring pedagogical strategies to early learners who may benefit more from practical, hands-on approaches. Furthermore, students with only moderate or limited access to technology may experience barriers in fully benefiting from tech-driven learning initiatives, which could widen disparities in outcomes.

To address these gaps, the study recommends the implementation of more experiential learning strategies such as simulation tools, gamified content, and collaborative platforms to foster stronger engagement and skill development. Institutional efforts should also focus on improving digital infrastructure and providing equal access to technological resources, especially for students with limited means. Faculty development programs aimed at equipping educators with digital teaching competencies should be prioritized, alongside curriculum reviews to include emerging areas like digital entrepreneurship, Artificial Intelligence (AI) applications, and sustainability-focused business models. Additionally, the university should invest in continuous monitoring and assessment mechanisms to gather longitudinal feedback and measure long-term outcomes of entrepreneurial learning. These steps are crucial not only for enhancing student learning experiences but also for aligning SPACE-UTM's entrepreneurial education with national priorities and global trends in entrepreneurship development.

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A Gamified STEM Activity Using Process Simulation to Explore Sustainable Energy Use at Home

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ABSTRACT

This paper presents a hands-on, gamified educational module titled *"Simu Avengers Malaysia"*, designed to introduce secondary school students to fundamental concepts in chemical engineering and sustainability through process simulation. Using Aspen HYSYS, students simulate a household water heating system to analyze energy consumption, perform cost estimation, and understand basic energy balances. The activity contextualizes real-world problems, such as rising utility costs and household energy use, in an engaging narrative, empowering students to act as simulation superheroes. By integrating technical skills with relatable challenges, this activity not only demystifies engineering tools but also promotes critical thinking, digital literacy, and environmental awareness among young learners. The paper discusses the instructional design, simulation workflow, and learning outcomes observed during classroom implementations. This initiative highlights the potential of process engineering tools in STEM outreach and learning technologies, especially in cultivating early interest in sustainable solutions.

KEYWORDS: STEM education, process simulation, Aspen HYSYS, digital learning tools

1 INTRODUCTION

Process simulation is a powerful tool in chemical engineering education, traditionally used at tertiary levels to analyze energy, material balances, and process efficiency (Towler & Sinnott, 2020). Tools like Aspen HYSYS allow students and engineers to model complex systems and explore various scenarios without the risks and costs of real-life experimentation. These simulation platforms are staples in undergraduate chemical engineering curricula but are rarely introduced to younger learners.

However, its adaptation for STEM outreach at the secondary school level remains limited (Honey, Pearson, & Schweingruber, 2014). In response to the need for more interactive, real-world STEM activities, *Simu Avengers Malaysia* was developed under the Professor@School initiative to introduce young students to engineering tools in a fun and relatable context. The central theme explores energy use in household water heating, a daily experience for most students, and challenges them to optimize its operation through simulation.

The activity had four main goals: to introduce students to basic ideas in chemical engineering, like energy use and process simulation; to teach them how to use Aspen HYSYS, a special software tool; to build their digital and problem-solving skills; and to help them understand the importance of saving energy and living in a more sustainable way. By embedding technical problem-solving in a real-world scenario, the activity helps build digital literacy and systems thinking—skills that are increasingly essential in 21st-century education (Voogt & Roblin, 2012).

2 METHODOLOGY

2.1 Target Audience

The Simu Avengers activity was specifically designed for upper secondary school students aged 15 to 17. These students were assumed to have no prior exposure to chemical engineering concepts or tools. The objective was to provide an accessible, introductory-level experience that could spark interest in engineering and sustainability through a relatable and hands-on format.

2.2 Tools and Resources

Aspen HYSYS, a commercial process simulation software widely used in chemical engineering education and industry, was selected as the primary tool for the activity. To make it suitable for the secondary school level, the simulation was simplified and supported by a visual step-by-step guide created using Microsoft PowerPoint. This guide walked students through the simulation interface, helping them understand each process element without requiring advanced technical knowledge.

2.3 Simulation Case Design

Students were given a pre-built Aspen HYSYS file titled "Simu Avengers." The case modeled a simple household water heating system (Figure 1), consisting of four main components: a water tank (V-100), a pipeline (PIPE-100), a pump (P-100), and a heater with controlled heat input (Q-100). Students explored the flow of water through the system, analyzed energy consumption, and modified variables such as temperature and flow rate to simulate different operating conditions. This allowed them to observe how changes in the system affect energy efficiency and cost.

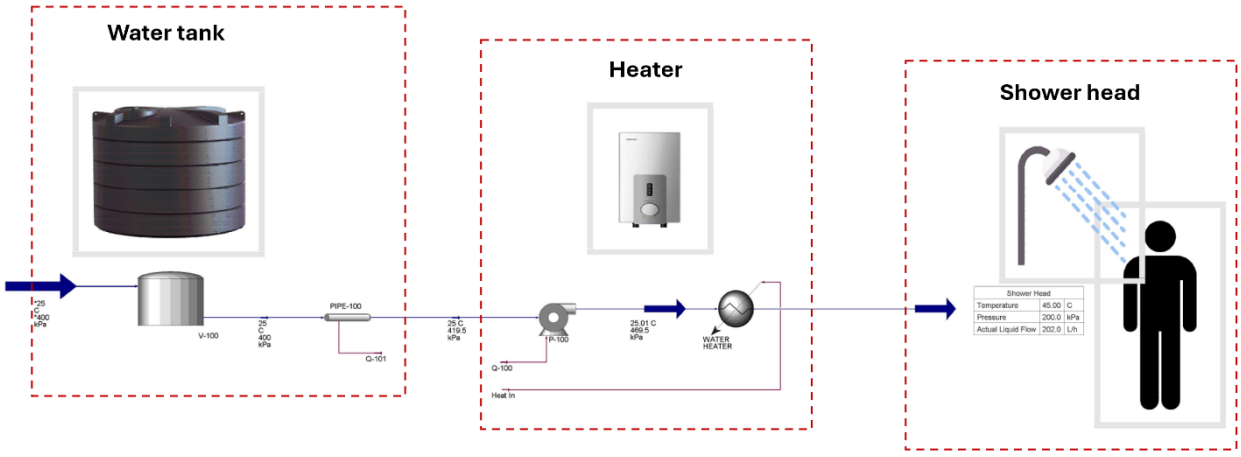


Figure 1: Modeled case from Aspen HYSYS

2.4 Real-World Scenario

To connect the simulation to students' everyday lives, the activity was based on a common Malaysian household routine, daily showers, as shown in Table 1. The scenario assumed each person takes a 10-minute shower with a flow rate of 2.1 gallons per minute (equivalent to approximately 476.5 kg/h). The simulation aimed to increase water temperature from 25°C to 40°C. Using this data, students calculated monthly water and electricity usage, applying local utility rates: RM0.218 per kWh for electricity and RM2.70 per cubic meter for water. This exercise provided a practical application of energy balance and cost estimation principles.

Table 1 Case study of Malaysian household routine of daily showers

Item	Value
Number of residents	2
Duration of bath	3

Bath per day	3
Water heater temperature	Low: 33 ℃ Medium: 40 ℃ High: 45 ℃
Water mass flow rate	475.2 kg/h
Electricity cost	RM 0.218/kWh
Water cost	RM 2.70/m3

2.5 Learning Session Format

The full activity was delivered in a two-hour interactive session, structured into four key phases to ensure both engagement and understanding:

- **Introduction to daily energy use (15 minutes):** A brief discussion to highlight how energy is consumed in everyday tasks and to set the stage for the simulation.
- **Simulation walk-through and setup (30 minutes):** A guided presentation using PowerPoint to introduce Aspen HYSYS, explain the case file, and demonstrate basic simulation steps.
- **Hands-on simulation (45 minutes):** Students worked individually or in pairs using structured worksheets to adjust inputs and observe system behavior.
- **Group sharing and discussion (30 minutes):** Participants shared findings, discussed cost-saving strategies, and reflected on sustainability themes.

3 RESULTS AND DISCUSSION

The implementation of the *Simu Avengers Malaysia* module yielded encouraging outcomes, echoing similar positive responses. Students demonstrated significant engagement during the simulation tasks, particularly when analyzing the effects of shower duration and temperature on monthly energy and water bills. By adjusting variables within the Aspen HYSYS environment, participants were able to identify strategies to reduce energy consumption, such as optimizing the water heater temperature setpoint. These technical findings not only contextualized sustainability in daily life but also empowered students to evaluate cost-efficiency in household systems.

Aspen HYSYS can help school students understand complex engineering concepts more easily. By focusing on relatable scenarios such as energy use at home, students were able to connect simulations to real-life experiences, making learning more meaningful. Simulation-based learning, whether adjusting virtual equipment or assessing hazards, helped students see the direct outcomes of their actions, an important element in active STEM education (Eliyasni et al., 2019).

Both programs also benefited from team-based learning and guidance from experienced facilitators, which increased student confidence and participation. However, challenges remain, including limited access to digital tools, varied computer literacy, and time constraints. To expand the reach and impact of such programs, future efforts could explore hybrid learning models or mobile-friendly simulations to improve accessibility for all students (Kementerian Pendidikan Malaysia, 2019). Overall, these findings highlight the importance of practical, engaging, and well-supported STEM programs to inspire future engineers and innovators.

4 CONCLUSION

This initiative shows the potential of gamified process simulation in promoting STEM engagement at the school level. Beyond technical knowledge, students developed critical thinking and a stronger sense of environmental responsibility. Scaling this program could enhance early exposure to engineering careers, particularly in the context of energy sustainability.

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Improving Student Outcomes in Foundation Mathematics Through Early Detection and Support

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ABSTRACT

After the restructuring of the mathematics curriculum in the Foundation program at Curtin University in the year 2023, the Foundation Mathematics course becomes compulsory for all Foundation Engineering, Science, and Commerce students who have no science and advanced mathematics backgrounds. Consequently, most of these students face significant challenges in this course since the fundamental of the advanced mathematics is required. To address this issue, the project aims to identify students with weak mathematics proficiency early in the semester through a diagnostic test. This project emerged from the concern of lecturers for students taking the Foundation Mathematics course, particularly those with a weak mathematics background. Identified students are provided with targeted support through weekly guided clinic sessions and a mentor-mentee peer support program. These initiatives are designed to enhance their motivation and problem-solving skills, then improving their exam performance. The findings also show that students who participated in the program were more motivated and engaged in studying mathematics. Additionally, an early intervention framework was developed and is proposed for implementation in future semesters. This framework has the potential to provide continuous and effective support, helping students overcome challenges and achieve better outcomes in their studies.

KEYWORDS: Early detection, early support, student outcomes, diagnostic test, mentor-mentee, mathematics proficiency

1 INTRODUCTION

Mathematics has long been a key part of education because it helps students develop logical thinking and problem-solving skills, which are essential abilities useful in nearly every field of study and career path (Delgado & Kassim, 2019; Flores, 2022; Muñoz & Sanchez, 2023; Regala, 2023). Including math in the curriculum benefits students not just academically, but also in preparing them for real-world challenges. Working through mathematical problems also sharpens the mind, acting like a workout for the brain. While it can be tough at times, many students find math to be both intellectually satisfying and creatively engaging.

The role of mathematics today goes far beyond its traditional use in science, technology, and engineering. It has become an important part of business, commerce, and management education as well, helping students develop essential skills like critical thinking, problem-solving, and the ability to break down complex problems. Studying mathematics also builds analytical thinking, quantitative reasoning, logical judgment, and the ability to work with precise and abstract ideas. In addition, it helps students

form clear arguments, spot flaws in reasoning, make better decisions, and think more flexibly. It even encourages creativity through brainstorming and exploring different approaches to problems (Akhil & Biju, 2020). These skills are increasingly important for succeeding in today's complex and fast-changing world.

Despite its significance, mathematics is often perceived as a difficult subject, leading to high failure rates among students. This perception, whether it stems from the complexity of the material or from students' own anxieties, plays a major role in the development of math-related fear (Tarteer & Ismail, 2020). According to Sa'ad et al. (2014), students' low achievement in mathematics is often linked to negative attitudes and fear, largely because the subject demands higher-order thinking skills. The use of complex formulas and strict rules in math lessons can also heighten anxiety and make the subject feel even more intimidating (Altintas & Ilgün, 2017). A growing body of research highlights that how students perceive mathematics has a direct influence on their academic performance (Salendab, 2023; Sanchez et al., 2022).

Therefore, identifying students who struggle with mathematics at the pre-university level as early as possible is crucial. Shim et al. (2017) highlight the importance of assessing students' foundational knowledge before introducing new concepts, allowing educators to design more effective, targeted interventions. Similarly, Kustitskaya et al. (2022) developed a predictive model as part of an early warning system that monitors student performance in real time to provide timely academic support. Building on this idea, the current project seeks to identify students with weak mathematical skills early in the semester and provide them with the necessary support and motivation to enhance their problem-solving abilities and improve their exam performance. These students often require additional attention and personalized guidance to succeed in the course. The objectives of this project are to raise the passing rate through targeted academic support and to enhance students' motivation and engagement in mathematics by using tools such as Quizgecko, which offers interactive and additional practice opportunities.

2 BACKGROUND

Many students have long faced challenges in learning mathematics, and this remains a concern in Malaysia today. It is encouraging to see that educators are continuing to explore and apply strategies to support students early in their academic journey, especially at the foundation and pre-university levels. Selvarajan (2022) points out that remedial instruction can be a practical way to help students who are falling behind. Likewise, Huang (2010) highlights that the main goal of remedial education is to give these students more chances to strengthen their understanding of core subjects so they can meet basic academic requirements. In this study, three main initiatives were introduced to support students who struggle with mathematics: a diagnostic test, weekly guided clinic sessions, and a peer mentoring program. These efforts were designed to provide consistent, timely support and help students build the confidence and skills they need to succeed.

This study used diagnostic tests to identify students who might need extra support, a strategy that has proven effective in similar research. For example, Azizan and Shim (2021) found that pre-university students who scored well on math diagnostic tests generally performed just as strongly in their final exams, while those who struggled early on often continued to face challenges. These diagnostic insights helped instructors adjust their teaching strategies and materials to better support students, which is something this research also aims to do.

Diagnostic tests in mathematics are commonly used, especially in countries such as Ireland, where universities often assess first-year students' foundational math skills at the start of their studies. These tests evaluate key concepts that students should have learned in secondary school. Ní Fhloinn et al. (2014) examined student attitudes toward diagnostic testing and found that most students had a favourable view of the process. They understood the purpose behind the tests and valued the extra help offered based on their results. The study also highlighted that, students were informed about how consistently using support services could improve their grades and overall academic success. Following this approach, teaching strategies are tailored to assist struggling students, emphasizing early detection and prompt intervention.

The second initiative, clinic sessions, has also been emphasized in the literature for its effectiveness as a strategic approach to supporting students. One of the most relevant studies in this context is by Kamaruddin et al. (2022), which explored the use of virtual mathematics clinics to assist foundation students during the COVID-19 pandemic. Their virtual clinics utilized a variety of online platforms, including Google Meet, Unisel OWC, and Zoom, and incorporated additional tools such as online quizzes via Quizziz, one-on-one consultations through WhatsApp chat, and e-learning exercises. These sessions

were structured around a Problem-Based Learning model, supported by GeoGebra software. The study found that students demonstrated significant improvements in mathematical competency after participating in the online clinics. These findings underscore the critical role of academic support and guidance in enhancing students' mathematical skills and improving their likelihood of success in mathematics-related subjects.

In a recent study by Hisham et al. (2024), the majority of students reported that the Math Clinic significantly enhanced their understanding of Statistics and improved their academic performance. A key finding of the study was the high level of student satisfaction with the quality of tutoring and the overall learning environment. Additionally, students highlighted that the lecturers' openness during question-and-answer sessions contributed to the improvement of their mathematical skills. The study also emphasized that students highly valued the guidance and support provided by the Math Clinic, which played a crucial role in their academic development.

The third initiative, mentor-mentee peer support program, is also supported by existing literature as an effective strategy for enhancing student learning. Kiassat and ElKharboutly (2020) implemented a peer mentoring program in which first-year students selected senior students as their mentors. This initiative aimed to improve retention rates and assist underprepared first-year students in transitioning from school to college life. Similarly, Deshler et al. (2019) explored support mechanisms to help students adapt to university environments. A closely related study by Daud and Shahrill (2014) employed diagnostic test scores to categorize students as mentors or mentees. Mentees were allowed to choose their preferred mentors, with the focus placed on the topic of differentiation. Student mentors received training before being paired with mentees. The study recorded and compared diagnostic and post-test scores, revealing that all mentees demonstrated improvements in their post-test results.

To guide the implementation of early academic interventions, this study proposes a conceptual framework, illustrated in Figure 1, referred to as the Early Academic Support and Intervention (EASI) Framework. The EASI Framework is a structured approach designed to provide early academic support and intervention to students facing challenges in mathematics. Its primary objectives are to identify at-risk students, deliver targeted assistance, and enhance overall mathematical proficiency. The framework aligns with Curtin University's core values of Integrity, Respect, Courage, Excellence, and Impact, fostering a culture of inclusivity and academic excellence through the provision of tailored support and resources.

The EASI Framework is organized into three distinct levels. Level 1 focuses on early intervention, Level 2 represents the intervention phase, and Level 3 encompasses both the intervention and post-intervention phases. Each level plays a critical role in ensuring students' academic success by addressing their needs at different stages of their learning journey.

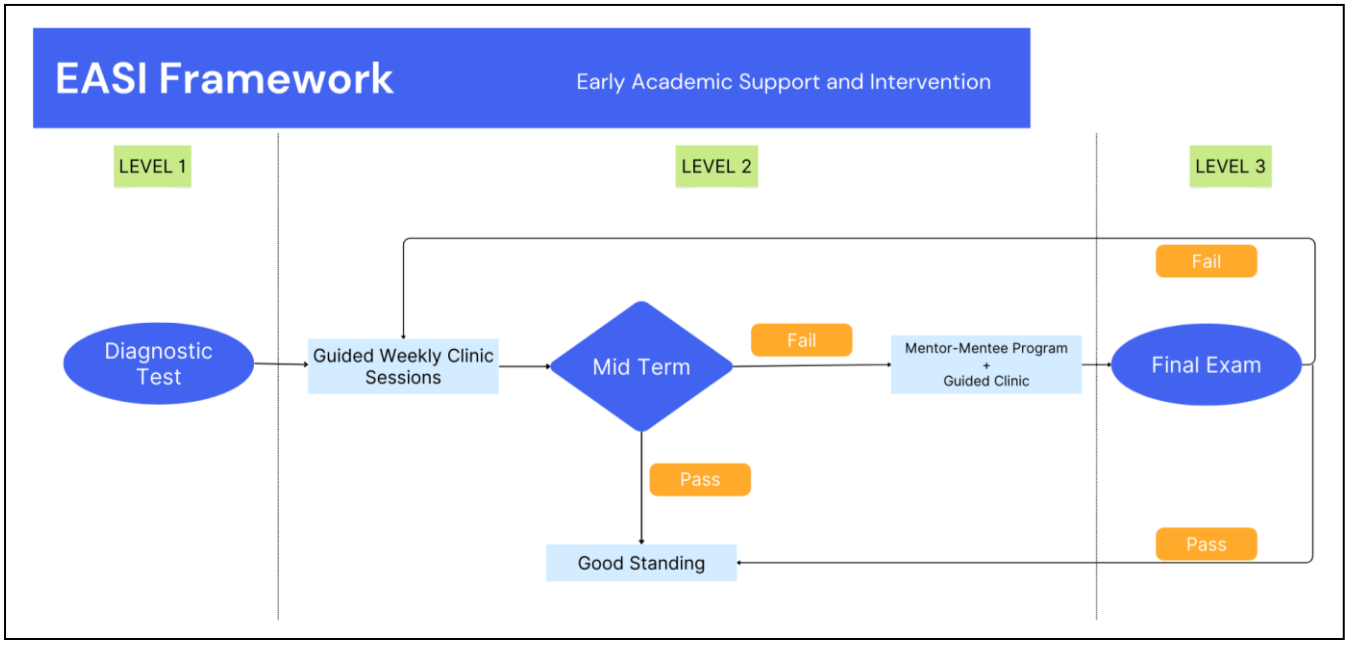


Figure 1: The structure of the EASI Framework

The EASI Framework is designed around a structured early intervention approach that combines diagnostic testing, guided support sessions, and peer mentorship to help students who are struggling with mathematics. By evaluating students' abilities early in the semester, lecturers can identify those in need of extra help and provide targeted support from the outset. Mid-term examination serves as an important checkpoint to track student progress, make timely adjustments, and refine learning strategies where necessary. The framework is guided by four core principles, represented by the acronym M-A-T-H: Motivate, Assist, Track, and Harness. Together, these pillars shape a holistic support system aimed at strengthening students' mathematical skills, increasing their motivation, and as a result improving their academic performance, especially in subjects that rely heavily on analytical thinking and problem-solving.

3 RESEARCH METHODS

This study also forms part of the action research initiative required of academic staff at the university, providing an opportunity for educators to reflect on their teaching strategies and identify areas for improvement (George, 2007). The population in this study were students taking CMFP0042 Mathematics 2 in Semester 2, 2024/2025 where there are a total of 255 students from different countries such as Malaysia, Brunei, Indonesia etc.

A set of fundamental mathematics questions aligned with the course content was created for a diagnostic test using Quizgecko one week before the semester began. During the first week of classes, all students were given 15 questions, comprising a mix of multiple-choice and short-answer formats. The test covered previously learned high school-level mathematics topics, including linear functions, quadratic functions, basic mathematical word problems, indices, matrices, right-angled triangle problems, simple statistics, inequalities, and percentages. This initial assessment serves as a crucial diagnostic tool to evaluate students' foundational knowledge and pinpoint those who may struggle with the course content. Based on the diagnostic results, students who scored below 50% of the overall marks were identified and advised to attend the clinic sessions for additional support. To address their learning needs, supplementary basic mathematics questions aligned with each week's topics were prepared and provided to students during clinic sessions. Identified students were required to complete these additional practice questions as well as their regular tutorial exercises. Throughout the clinic sessions, they received continuous support and guidance to help reinforce their understanding and improve their mathematical proficiency.

After the mid-term exam, students who did not pass were identified and encouraged to attend the clinic sessions. Additionally, a mentor-mentee peer support program was introduced as a further support initiative. High-achieving students were invited to volunteer as mentors to assist their peers struggling with mathematics. Participation in the mentor-mentee program was voluntary for both mentors and mentees to ensure genuine engagement rather than enforced participation.

At the end of the semester, students who attended the clinic sessions and participated in the mentor-mentee program were invited to complete an anonymous online survey to evaluate their experiences. The survey utilized a Likert scale ranging from "Strongly Disagree" to "Strongly Agree" and was divided into two main sections: gathering feedback on students' initial understanding of mathematics and experiences with the early detection and support program (Hisham et al., 2024). Additionally, the passing rates of the mid-term and final exams from previous and current semesters were compared to measure the effectiveness of these interventions.

4 RESULTS AND DISCUSSIONS

The results of this study can be categorized into quantitative findings, which include questionnaire responses and examination results, and qualitative findings, derived from open-ended questionnaire responses and reflections from teaching staff. While the qualitative data primarily originate from interactions and discussions with students and colleagues, personal reflective teaching experiences also offer valuable insights that can inform and guide future enhancements in teaching strategies.

4.1 Mathematics Clinics

Math Clinics, often conducted as extra classes or revision sessions, are essential for preparing students for examinations. They are particularly beneficial for topics where students face difficulties. Nieminen et al. (2024) reported that exam revision consolidated the material covered and provided clarity on the overarching structure of the course content. In this course, guided math clinics were held weekly, covering topics aligned with each week's lessons. Three lecturers teaching the course were involved in

facilitating these sessions. Revision sessions were also conducted during the clinic, focusing on the most critical topics and common problem areas to ensure that students received targeted support where it was most needed.

Each clinic began with an in-class exercise using Quizgecko. Afterward, students were encouraged to work through their tutorial exercises at their own pace. Recognizing that these students often struggle with mathematics, the sessions were designed to allow them to complete their exercises during class time, as many found it challenging to complete these tasks independently. This approach ensured that whenever they encountered difficulties, whether they were unsure how to start or became stuck in their calculations, they could simply raise their hands and ask for assistance. Any available lecturer would promptly attend to their queries. This support ensured students stayed on track with the week's topics and resolved any questions before new material was introduced in the following week. This method not only provided immediate support but also helped build students' confidence. With guidance, they were better equipped to tackle similar problems independently in the future.

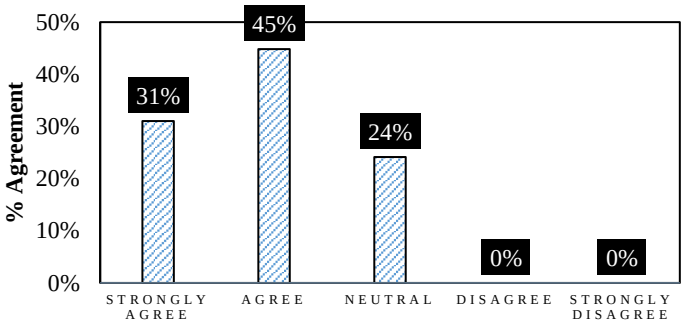


Figure 2: Responses on the effectiveness of clinic sessions in improving the students' understanding of the topics covered.

Figure 2 illustrates students' perceptions of the effectiveness of weekly clinic sessions in improving their understanding of mathematical topics. The majority of students indicated that the clinic sessions significantly enhanced their understanding. This finding is supported by qualitative feedback, in which students consistently highlighted the importance of lecturer support. They noted that accessible and patient lecturers were instrumental in clarifying doubts, particularly during the clinic sessions.

4.2 AI-Powered Platform

To enhance the learning experience and manage the high workload, Quizgecko, an AI-powered platform for generating, sharing, and analyzing customizable quizzes, was utilized as an instructional support tool. Quizgecko played a key role in creating questions for diagnostic tests and in-class practice, significantly reducing the workload for academic staff. Additionally, the platform allows for the inclusion of custom questions, providing flexibility in quiz design.

A notable feature of Quizgecko is its ability to generate questions based on uploaded notes, YouTube videos, or provided links. It can also create questions tailored to specific topics. The platform offers a variety of question formats, including multiple choice, true or false, and matching, ensuring that students remain engaged and do not become bored with a single type of question. Quizgecko allows control over the number of questions generated and can categorize them by difficulty levels—low, medium, or high. This makes it an excellent tool for setting diagnostic questions aimed at early intervention, as well as preparing weekly questions for clinic sessions.

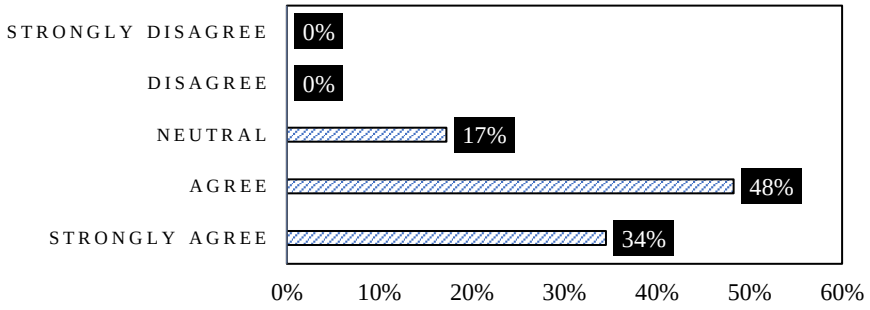


Figure 3: Responses on the use of Quizgecko in engaging the student.

Figure 3 shows that 82% of students who attended the clinic sessions agreed that Quizgecko made practicing mathematics more engaging. This is because each question, whether answered correctly or incorrectly, is accompanied by a detailed solution or explanation. If a student answers incorrectly, feedback is provided to help them understand their mistakes. This feature is convenient for both lecturers and students, especially when lecturers are unable to provide individual guidance at all times.

4.3 Mentor-Mentee Peer Support Program

In this program, high-achieving students from the mid-term exam were invited to register as mentors, while students who performed poorly were encouraged to sign up as mentees. The role of student mentors is crucial in supporting both the lecturer and the overall course, as they are able to meet with their mentees outside of regular class hours. During these sessions, mentors provided academic guidance and helped prepare mentees for upcoming assessments. The one-on-one or small-group format allowed mentees to receive more personalized support and attention. Although most students were initially reluctant to register for the program, 17 mentees eventually enrolled, and 12 of them successfully passed the course. This outcome aligns with the findings of Daud and Shahrill (2014), who demonstrated that pairing high-performing students with those who are struggling can improve mathematical achievement. Additionally, mentors were able to reinforce their own understanding of the subject, further enhancing their mastery of mathematical concepts. This peer support model also fosters cooperative learning, which has been shown to improve both mathematics achievement and students' attitudes toward the subject (Zakaria et al., 2010).

4.4 Passing Rates

An analysis of the mid-term exam results revealed that, out of 255 students, 170 passed, yielding a pass rate of 66.7%. This reflects a slight improvement compared to the previous semester's pass rate of 65.9%. The progress can be attributed to the implementation of a diagnostic test, which facilitated the early identification of at-risk students, combined with the promotion of regular attendance at weekly guided clinic sessions. Figure 4 illustrates student responses regarding the effectiveness of the diagnostic test in identifying students with weak mathematical skills and those at risk of underperforming.

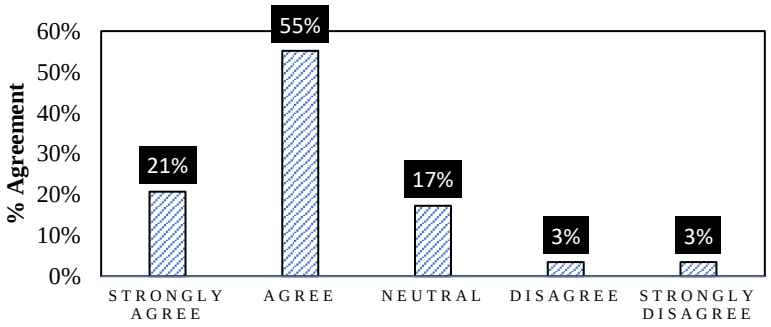


Figure 4: Responses on the effectiveness of diagnostic test in identifying students' weakness in Mathematics.

However, the fact that 85 students failed mid-term exam remains a significant concern. To further enhance academic outcomes, additional measures were introduced after the mid-term exam, including a mentor-mentee peer support program alongside the existing clinic sessions. These interventions contributed to a notable increase in the overall pass rate for the course, rising from 77.8% to 83.1%. These results highlight the effectiveness of early identification, targeted support, and mentorship in improving student performance.

4.5 Course Evaluation

Based on course evaluation through Insight, the satisfaction rates for all items have shown an increase. Table 1 displays the course evaluation for the Foundation Mathematics course of CMFP0042 Mathematics 2 in 2024.

Table 1: Course Evaluation Results in 2024.

Item	**Course Evaluation Results (2024)**		
	Evaluation Quantitative Items	**S1 (%)**	**S2 (%)**
1	I was engaged by the learning activities	84	95
2	The resources provided helped me to learn	86	95
3	My learning was supported	85	96
4	Assessments helped me to demonstrate my learning	85	95
5	I knew what was expected of me	80	89
6	Overall, this course was a worthwhile experience	78	93

The course evaluation results reflect the effectiveness of the early intervention and support provided. In Item 1, students reported feeling more engaged in class due to the integration of AI-powered platforms. Tools such as Quizgecko and Kahoot! have made lessons more interactive and engaging, reducing boredom and increasing students' motivation to learn. The use of these platforms has contributed to a more enjoyable mathematics learning experience.

Regarding Item 3, which focuses on supporting students' learning, the percentage of agreement has significantly increased from 85% to 96%. This indicates that the introduction of clinic sessions and the mentor-mentee peer support program has positively impacted students' learning experience.

The most significant improvement is observed in Item 6, where the agreement percentage rose from 78% to 93%. This suggests that the support and motivation provided throughout the course have been highly beneficial to students. It is particularly encouraging to note that even commerce stream students, who may not have a strong mathematical background, found the course valuable and worthwhile.

4.6 Top Six Students Issues in Mathematics

The observations from previous semesters from the years 2023 to 2024 reveal that some students who are mostly performed poorly in examinations lack the motivation to attend classes, particularly lectures. Informal conversations with these students have revealed that they often find mathematics too complex and struggle to see its relevance to their disciplines, leading to a lack of interest. This lack of engagement results in frequent absences, missed practice opportunities, and difficulties catching up as exams approach. Table 2 presents six key challenges commonly faced by students in learning mathematics, along with their possible causes and recommended interventions based on reflection and experience.

Table 2: The top 6 students' issues in Mathematics.

Top 6 Issues	Possible Causes	Recommended Interventions
Math anxiety	Finds math hard to understand	Social support from lecturers, friends, and family, technology-based approaches, mentor-mentee support program
Weak foundation in math	Online learning during school closures, no exposure to advanced math	Diagnostic testing, Math learning support modules
Difficulty understanding abstract concepts	Does not review before class, finds math too hard	Personalized support, one-to-one consultation
Struggles with problem-solving and application-based questions	Lack of practice	Clinic support session
Lack of motivation and engagement	Lack of interest	Mentor-mentee support program, social support from lecturers
Insufficient practice and poor time management	Cannot prioritize tasks/poor sleep habits	Academic mentor monitoring, clinic support session, counselling

The implementation of the early intervention framework and additional support mechanisms has shown promising results. Students who are willing to put in effort report feeling more supported by their lecturers and peers. The consistent guidance provided through the framework has also motivated them to engage in regular practice and adopt more effective study habits. These positive changes highlight the importance of structured support in addressing student challenges and fostering academic improvement.

5 CONCLUSIONS

Mathematics is a foundational discipline that plays a critical role in academic and professional success. However, many pre-university and diploma students struggle with the subject due to math anxiety, a lack of foundational knowledge, and the complexity of mathematical concepts. The EASI Framework proposed in this study provides a structured approach to identifying at-risk students, offering timely academic support, and enhancing their mathematical proficiency. By integrating diagnostic assessments, guided clinic sessions, mentor-mentee peer support programs, and AI-powered learning tools like Quizgecko, the framework delivers targeted interventions that help students build confidence, improve their problem-solving skills, and succeed in their mathematics courses. Grounded in the four pillars—M-A-T-H—the framework promotes a culture of inclusivity and supports a student-centered learning environment. Its flexible design allows for adaptation across various courses, particularly in STEM-related disciplines. It is believed that providing students with more support and engaging with them not only in classes but also through clinic sessions and consultations can enhance their awareness of the importance of studying and increase their interest in mathematics. The students themselves have also acknowledged their lecturers' efforts in supporting them, which motivated them to work harder to avoid disappointing their lecturers.

6 ACKNOWLEDGEMENTS

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Fostering Collaborative Learning through Gamification tools

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ABSTRACT

This abstract synthesizes existing literature on gamified quiz platforms and presents personal classroom observations to explore how tools such as Kahoot! And Padlet can enhance collaborative learning, engagement, and motivation. Research on Kahoot! demonstrates that its gamified format significantly improves concentration, enjoyment, and intrinsic motivation through real-time feedback, sound effects, and competitive dynamics. Similarly, studies on Padlet highlight its effectiveness in supporting group ideation, resource sharing, reflective dialogue, and cognitive flexibility within collaborative learning contexts. In my Chemical Engineering lectures, I implemented both tools: Kahoot! quizzes at the close of each chapter encouraged team-based conceptual discussions prior to submission, while Padlet served as a collaborative "idea wall" for collaborating to solve tutorial questions and promoting reflective dialogue. I observed measurable improvements in class dynamics—students showed higher participation rates, deeper peer-to-peer interaction, and enhanced problem-solving. Drawing on both literature and these classroom insights, this work suggests that carefully structured Kahoot! activities can serve as catalysts for collaborative knowledge construction and sustained motivation in higher education settings. It provides practical guidance for educators aiming to integrate technology-enhanced pedagogies to foster dynamic and inclusive learning ecosystems.

KEYWORDS: collaborative learning, student engagement, gamification, formative assessment, teamwork

1 INTRODUCTION

Collaborative Learning (CL), defined as groups working interdependently towards shared learning goals, is well-established for enhancing academic achievement, critical thinking, social skills, and psychological well-being (Warsah et al., 2021). Concurrently, gamification – integrating game design elements into non-game contexts – has gained traction in education for boosting motivation, engagement, and active participation (Swacha, 2021). This paper details a pedagogical strategy merging these two powerful approaches: using the gamification tool Kahoot! for group assessment and Padlet for collaborative solution sharing and repository building within an undergraduate course.

Gamification has emerged as a pivotal strategy in higher education, addressing persistent challenges in student motivation, engagement, and self-regulation. With today's learners accustomed to interactive, technology-rich environments, integrating game mechanics such as points, badges, leaderboards, and real-time feedback aligns educational experiences with their digital expectations. For instance, Bolat & Taş and Saleem et al. demonstrated that gamified assessments within blended learning environments significantly increase student satisfaction and participation, exceeding that found in traditional assessments (Bolat & Taş, 2023; Saleem et al., 2022).

Additionally, gamification addresses critical psychological needs such as competence, autonomy, and relatedness as described by Self-Determination Theory, thereby nurturing intrinsic motivation (Deci Edward L.and Ryan, 2016). Cortés-Pérez et al. emphasized that adaptive, gamified assessments foster not only satisfaction but also autonomy, resulting in more sustainable student motivation and enhanced academic achievement (Cortés-Pérez et al., 2023). By offering structured challenges that adapt to

individual progress, such systems keep learners in a productive "flow" state, both challenged and supported.

Beyond individual motivation, gamification fosters social learning through collaboration. Interactive tools like Kahoot! encourage shared dialogue and collective problem-solving, while mechanisms like team-based scoring promote accountability within peer groups. Effective gamification transcends novelty effects like initial excitement that fades quickly by incorporating meaningful storytelling, progressive challenges, and personalization. Gamification in higher education is not a mere educational novelty; it is a research-backed framework for enhancing engagement, motivation, self-regulation, and collaboration. By aligning with how modern students learn and socially interact, it transforms passive content delivery into active, student-centered experiences that improve educational outcomes and foster a dynamic, scalable learning ecosystem.

Digital tools like Kahoot!, a game-based quiz platform and Padlet, a collaborative online "bulletin board" extend these benefits by introducing real-time feedback, competitive dynamics, and multimodal content sharing. Literature indicates that Kahoot! boosts motivation and peer interaction, while Padlet fosters group ideation and reflective dialogue with the added advantage of asynchronous access to contributions (Laal & Ghodsi, 2012). Padlet, an online bulletin board tool, supports collaborative knowledge building through shared reflections and multimodal contributions. Research indicates Padlet fosters peer feedback, diverse idea generation, and longer-term access to posted content, enhancing both reflective dialogue and retention (Rath, 2025).

This paper presents an integrative case of using Kahoot! and Padlet in a Chemical Engineering cohort of over thirty students. Following each chapter, students worked in groups of five to complete a team-based Kahoot! quiz, followed by group problem-solving on tutorial exercises shared *via* Padlet. The instructor then reviewed and discussed solutions in tutorial sessions. Through observational insights and supported by the literature, this work demonstrates how combining these platforms promotes collaborative learning, motivation, teamwork, and accessible learning resources without requiring formal experiments. The observed results and their implications for teaching practice are discussed in subsequent sections.

2 LITERATURE REVIEW

2.1. Collaborative Learning: Benefits and Core Elements

CL moves beyond individualistic or competitive models, emphasizing interaction, shared responsibility, and mutual support. (Laal & Ghodsi, 2012) categorize CL benefits into four main areas:

i. **Social:** Developing social support systems, understanding diversity, practicing cooperation, and building learning communities.
ii. **Psychological:** Increasing self-esteem, reducing anxiety, and fostering positive attitudes towards learning and instructors.
iii. **Academic:** Promoting critical thinking, active involvement, improved classroom results, and personalized learning.
iv. **Assessment:** Enabling diverse assessment techniques and peer evaluation.

Effective CL requires positive interdependence, individual accountability, promotive interaction, social skills, and group processing (Johnson & Johnson, 2009). The described intervention inherently builds these: group Kahoot! scores foster interdependence; contributing to Padlet solutions ensures accountability; discussing answers promotes interaction; teamwork builds social skills; and tutorial discussions facilitate processing.

2.2 Kahoot! as a Catalyst for Engagement and Collaboration

Gamification enhances CL by introducing elements like points, leaderboards (often used cautiously), immediate feedback, challenges, and a sense of play. Kahoot!, a game-based response platform, exemplifies this. Its competitive quiz format, when used collaboratively within teams, transforms assessment into an engaging, low-stakes team challenge. Research indicates Kahoot! improves motivation, concentration, and knowledge retention (Ismail & Mohammad, 2017; Wang, 2015). Crucially, when students play Kahoot! in teams rather than individually, the focus shifts towards collaborative knowledge retrieval, discussion, and consensus-building before answering (Plump & LaRosa, 2017; Zainuddin, 2018). This aligns perfectly with CL principles, turning a potentially competitive tool into a collaborative exercise. Kahoot! is a game-based quiz platform popular for its competitive elements, real-time feedback, and social interaction. Research confirms it significantly boosts student motivation,

attention, and enjoyment of learning, especially when audio and point settings are enabled. Interactive quizzes in group settings have also been shown to support social learning (Singh et al., 2024).

2.3 Padlet in Collaborative Knowledge Construction

Padlet offers a multimedia "digital wall" for real-time or asynchronous contributions, enabling students to share text, images, and links collaboratively. A key challenge in large classes is ensuring all students benefit from group work and have access to diverse solutions. Padlet, a digital bulletin board, provides an ideal platform for asynchronous collaboration and knowledge sharing. Groups can post their solutions, diagrams, or explanations, creating a shared, persistent resource. This fosters peer learning as groups can review and learn from each other's approaches before and during class discussions (De Wever et al., 2015). It also promotes metacognition as students articulate their reasoning for sharing. Using Padlet for solution sharing after collaborative problem-solving (like the tutorial equations) extends the CL process beyond the immediate group to the whole class, democratizing access to learning resources.

3 IMPLEMENTATION OF GAMIFIED CL

The intervention was implemented in an undergraduate engineering course with over 30 students:

- Group Formation: Students were divided into heterogeneous teams of five members each, aiming for balanced skills.
- Post-Chapter Kahoot! Quizzes: After completing each chapter, a Kahoot! quiz was conducted in class. Teams huddled together, discussed each question collaboratively, and submitted one agreed-upon answer per question per team. This emphasized discussion and consensus over individual speed.
- Collaborative Tutorial Work: Based on the Kahoot! results and the chapter content, teams were assigned tutorial problems to solve collaboratively outside class.
- Padlet Solution Sharing: Each team uploaded their collaboratively derived solutions and key explanations for the tutorial problems onto a designated class Padlet board.
- Tutorial Discussion: During tutorial sessions, the instructor facilitated discussions based on the solutions shared on Padlet. Common errors, different approaches, and optimal solutions were explored collaboratively by the whole class, referencing the Padlet posts.
- Persistent Repository: The Padlet board remained accessible throughout the semester, providing students with a repository of peer-generated solutions for revision and practice.

4 LINKING PRACTICE TO THEORY AND SIMILAR EXAMPLES

This approach demonstrably leverages CL principles through gamification tools:

- Positive Interdependence & Accountability: The team Kahoot! score and the requirement to post a shared solution on Padlet created strong interdependence. Individual accountability was fostered through intra-team discussions and the expectation of contribution.
- Promotive Interaction: Both the Kahoot! huddle and the tutorial problem-solving required active discussion, explanation, and justification of ideas among team members. The Padlet review and class discussion further promoted interaction across groups.
- Academic Benefits - Critical Thinking & Knowledge Co-construction: Discussing Kahoot! answers forced teams to critically evaluate options and justify choices. Solving complex tutorial problems collaboratively required deeper reasoning and knowledge integration, leading to co-constructed understanding reflected in their Padlet. Reviewing diverse approaches on Padlet further stimulated critical analysis.
- Social Benefits & Psychological Safety: Working in consistent small teams fostered a supportive environment. The gamified Kahoot!, while challenging, was low stakes due to the team format, potentially reducing individual anxiety. Padlet provided a less intimidating platform for sharing group work than direct verbal presentation.
- Resource Accessibility & Metacognition: Padlet directly addressed the challenge of resource access in large classes, providing all students with a repository of peer-sourced solutions 24/7. Creating posts required teams to articulate their problem-solving process, enhancing metacognitive awareness.

Similar implementations support this model:

Zainuddin et al., found using Kahoot! in a team-based quiz format significantly improved student engagement and perceived learning in a science course compared to individual play, emphasizing the collaborative discussion it triggered (Zainuddin, 2018). Rath et al., reported that using Padlet for collaborative project documentation and peer feedback in an online course enhanced students' sense of community, peer learning, and access to shared knowledge, mirroring the repository function described here (Rath, 2025). Herrera-Pavo et. al., while focusing on higher virtual education, underscores the critical role of technological affordances (like Padlet's sharing) and careful task design (like the Kahoot!-to-tutorial sequence) for successful CL. The combination used here exemplifies integrating tools purposefully to support specific CL activities such as problem-solving, sharing and discussion (Herrera-Pavo, 2021).

5 CONCLUSION

Integrating gamification tools like Kahoot! and Padlet offers a powerful and practical strategy for fostering robust Collaborative Learning (CL) in higher education, particularly in larger classes. The described intervention of team-based Kahoot! quizzes followed by collaborative problem-solving and Padlet solution sharing effectively harnesses the engagement of gamification within a structured CL framework. It promotes essential CL elements like positive interdependence, individual accountability, and promotive interaction. This approach demonstrably enhances critical thinking through collaborative problem-solving and discussion, builds social skills and psychological safety within teams, and creates a valuable, persistent knowledge repository accessible to all students *via* Padlet. While this paper describes a specific implementation, the core principles of using gamified quizzing collaboratively and digital platforms for shared knowledge building are widely applicable across disciplines. Future research could quantitatively measure specific learning outcome gains and student perceptions of skill development (e.g., teamwork, critical thinking) resulting from this combined approach.

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SWIFTSPEAK: Bridging Communication Gaps for Non-Verbal Autistic Individuals Through 4IR Technology

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Abstract

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by difficulties in social communication and behavior. Individuals with severe autism often face challenges in expressing basic needs, which can lead to frustration and negatively impact their quality of life. This paper introduces SWIFTSPEAK, a user-friendly communication tool designed to help non-verbal individuals with severe autism convey essential needs such as eating, sleeping, and toileting. SWIFTSPEAK was developed using the ADDIE instructional design framework, which includes the Analysis, Design, Development, Implementation, and Evaluation phases. The tool features a color-coded button interface: blue for toileting, red for sleeping, and yellow for eating. This design aims to help users recognize and understand daily activities easily. When a button is pressed, notifications are sent to caregivers' smartphones, allowing for timely responses to the user's needs. The development process utilized advanced technologies, including Arduino microcontrollers, Internet of Things (IoT) integration, and 3D design patterns, to create a robust and intuitive user experience. A pilot study was conducted with a group of autistic person to assess their acceptance of the color-coded concept used in SWIFTSPEAK. During the study, participants were able to connect colours with specific activities, indicating that SWIFTSPEAK is an intuitive and effective communication aid. These findings highlight the potential of colour-based learning in augmentative communication tools. Future development plans include enhancing the device's durability, expanding its features, and exploring broader applications in educational settings. The successful implementation of SWIFTSPEAK demonstrates the potential for technology-driven solutions to significantly improve the quality of life for individuals with severe autism.

KEYWORDS: autism communication tool, ADDIE, Internet of Things

1 INTRODUCTION

Autism is a complex neurological disorder characterised by significant self-isolation, withdrawal from reality, and limited emotional expression. Individuals with autism typically face challenges in responding to their environment and engaging in social interaction, with the condition usually identified within the first three years of life (Rea et al., 2019; Anderson-Chavarria, 2022). Research in visuospatial functioning has highlighted cognitive challenges for children with autism spectrum disorder (ASD),

nonverbal learning disability (NLD), and attention deficit hyperactivity disorder (ADHD), all of which share overlapping symptoms that complicate diagnosis (Cardillo et al., 2020). Due to these diagnostic challenges, the Department of Social Welfare, in its 2022 statistical report, categorised all these conditions under the broad umbrella of learning disabilities (Jabatan Kebajikan Masyarakat, 2023). Although this broad classification is not entirely accurate, it provides a rough estimate of the distribution of autistic individuals in Malaysia. Table 1 below shows the registration of persons with learning disabilities by age group and gender in Malaysia.

Table 8: Registration of Person with Learning Disabilities in Malaysia (Jabatan Kebajikan Masyarakat, 2023)

Age Group	**Learning Disabilities**		
	Male	**Female**	**Total**
Below 6 years	3, 927	2,148	6,075
6-12 years	40,250	14,352	54,602
13-18 years	39.426	15,477	54,903
19-21 years	15,907	7,161	23,068
22-35 years	41,536	22,000	63,535
36-45 years	8,776	7,101	15,877
46-59 years	5,636	5,020	10,656
60 years and above	1,806	1,876	3,682
Total	157,263	75,135	232,398

Based on Table 1, there is a significant gender disparity across all age groups, with the number of males registered with learning disabilities significantly exceeding the number of females. This trend is especially pronounced in the 6-12 and 13-18 age groups. The combined total for children and adolescents (below 18 years) is 115,580, constituting nearly half of the total registrations, underscoring the importance of early intervention and educational support during these formative years. Additionally, there are 6,075 children below 6 years registered with learning disabilities, highlighting the need for early diagnosis and intervention programs to support developmental milestones.

The urgency of this issue is highlighted by recent reports indicating a sharp rise in autism diagnoses in Malaysia. Nancy Shukri, Minister of Women, Family and Community Development, reported that the number of children diagnosed with autism registered with the Department of Social Welfare (JKM) has risen steadily, from 6,991 children in 2013 to 53,323 children in 2023, a 663% increase (OVA, 2024). This steeply increases the pressing need to expand resources allocated to this cause. Currently, JKM operates 10 institutions for people with disabilities nationwide, including seven Taman Sinar Harapan centres, which offer care, protection, and rehabilitation to children with learning disabilities, including autism. However, this number of centres is insufficient to meet the rapidly growing population of individuals with autism, suggesting that many families are left to manage the intensive care needs of autistic children on their own.

Thus, in response to this matter, we propose SWIFTSPEAK as a user-friendly communication tool specifically designed for individuals with severe autism. Its primary aim is to assist families and care centres effectively communicate with autistic individuals, particularly those with significant communication challenges. SWIFTSPEAK is an innovative solution that enables severely autistic individuals to express their basic needs, such as sleeping, eating, and using the bathroom, allowing caregivers to respond promptly.

The development process of SWIFTSPEAK is based on ADDIE, a product development paradigm, which is an acronym for **A**nalyze, **D**esign, **D**evelop, **I**mplement, and **E**valuate. ADDIE offers a method for overcoming the challenges involved in creating modules for use in a purposeful learning environment (Branch, 2009). The development process of ADDIE is summarised in Table 2 below:

Table 9: ADDIE Product Development Paradigm (Branch, 2009)

	Analyze	**Design**	**Develop**	**Implement**	**Evaluate**
Concept	Identify the probable cause for a performance gap.	Verify the desired performances and appropriate testing methods.	Generate and validate the learning resources.	Prepare the learning environment and engage the students.	Assess the quality of instructional products and processes, both before and after implementation.
Common procedure	Validate the probable causes for a performance gap. Determine instructional goal. Confirm the intended audience. Identify required resources. Determine potential delivery system (include cost estimate). Compose a project management plan	Conduct a task inventory. Compose performance objective. Generate testing strategies. Calculate return on investment.	Generate content. Select or develop supporting material. Develop guidance for the student. Develop guidance for the teacher. Conduct formative revisions. Conduct a pilot test.	Prepare the teacher. Prepare the student.	Determine the evaluation criteria. Select evaluation tools Conduct evaluation.
	Analysis Summary	***Design Brief***	***Learning Resources***	***Implementation Strategy***	***Evaluation Plan***

Table 2 shows a comprehensive ADDIE model that provides an end-to-end framework for instructional design, from analysis, design, development, and implementation to the evaluation phase. However, this research focuses on developing the prototype SWIFTSPEAK, particularly with an emphasis on creating and validating initial learning tools for severely autistic persons. For that matter, we are concentrating on creating and validating an initial prototype of SWIFTSPEAK, aiming to establish a solid foundation to inform future work on implementation and full-scale evaluation. This approach allows for an in-depth examination of the early-stage design and development process, which are critical for addressing the unique needs of our target user group. To better understand the current landscape of communication interventions for individuals with severe autism, this paper will begin with a review of existing augmentative and alternative communication (AAC) systems, with a particular focus on Picture Exchange Communication System (PECS) and the potential for integrating Internet of Things (IoT) technology.

2 LITERATURE REVIEW

The communication barriers faced by adolescents with severe autism necessitate specialized interventions that cater to their unique needs. This research aims to contribute to this area by exploring and developing effective augmentative and alternative communication (AAC) strategies, specifically through the creation of SWIFTSPEAK, a user-friendly tool designed for nonverbal individuals. This literature review will begin by examining the core communication challenges associated with severe autism, followed by an analysis of the existing AAC system primarily the Picture Exchange Communication System (PECS), and conclude with an exploration of how IoT technology can be integrated to improve communication outcomes, by synthesizing these areas, we intended to establish a foundation for the development and evaluation of innovative communication tools like SWIFTSPEAK.

2.1 Autism Spectrum Disorder (ASD) and the Communication Challenges

Autism Spectrum Disorder (ASD) is characterised by difficulties in initiating or responding to social and emotional exchanges, irregularities in nonverbal communication behaviours, and challenges in forming and maintaining relationships. These traits often set back effective communication, a core aspect of human interaction. Rea et al., (2019) further note that restricted interests and repetitive behaviours in ASD are characterised, including by at least two or more of rigidly committed to a routine, unusual intensity or focus on specific interests, atypical reactions to sensory input, and stereotyped of repetitive movement or speech. These characteristics not only define autism but also present significant challenges in communication and interaction, highlighting the need for effective interventions. Interventions targeting communication difficulties are critical for improving the quality of life for individuals with ASD. Lord et al., (2020) suggest that the key to addressing common communication issues in children with autism is early intervention, such as school-based strategies, parent-mediated approaches, and therapies-led therapies, to address the communication challenges. However, Slušná et al., (2021) finds that in case of communication difficulties comes with intellectual disabilities (ID), its often lead to severe limitations of speech production. The finding confirms Maljaars et al. (2011) earlier research that emphasized the importance of exploring the communication abilities of non-verbal and low-functioning ASD persons in order to develop effective, tailored interventions.

One promising approach to lessen these communication challenges is by using augmentative and alternative communication (AAC) systems. AAC is a methods and tools designed to enhanced or replace spoken and written language for individual with complex communication needs. The system can generally be categorized into an unaided communication system, which relies on gestures or sign language, and an aided communication system, which involves the use of devices or tools, such as speech-generating devices (Mohammad & Abu-Amara, 2019). Given the diversity of needs for ASD persons, the choice of AAC intervention is crucial. For those with severe communication impairment, aided AAC systems offer significant potential for improving interaction and independence. Furthermore, recent research highlights the link between motor skill deficits and communication challenges in individuals with ASD. Ohara et al., (2020) propose that motor dysfunction may contribute to social and communication deficits, underscoring the need for tools that address physical and communicative limitations.

While language development plays a pivotal role in social interaction, many individuals with severe autism remain non-verbal, facing profound challenges in expressing basic needs such as eating, sleeping, and toileting. To address these needs, our research focuses on developing SWIFTSPEAK, a user-friendly communication tool designed for severely autistic individuals. Using an AAC-aided approach, SWIFTSPEAK employs colour-coded buttons to represent basic needs. When pressed, the tool sends notifications to a caregiver's smartphone, facilitating effective communication and reducing frustration. Despite the advancement in AAC, the gap in accessible, affordable, and contextually appropriate communication tools remains significant. This underscores the importance of evaluating existing AAC tools and interventions to identify best practices and areas for innovation. The next section will explore existing communicating tools and interventions using AAC, providing an overview of the current landscape and informing the development of SWIFTSPEAK.

2.2 Picture Exchange Communication System (PECS)

Picture Exchange Communication System (PECS) and more sophisticated speech-generating devices benefited from the use of augmentative communication systems.



Figure 16: Visual Support Material Sold by National Autism Resources at https://nationalautismresources.com/

Individuals who utilize the Picture Exchange Communication System (PECS) are trained to approach others and offer a picture of a desired item in exchange for that item. This method enables autistic individuals to effectively communicate requests, thoughts, or any concepts that can be represented visually on picture cards. PECS can be employed in both home environments and educational settings (National Autism Resources, n.d.)

Increasingly, interventions for school-age children and young people with autism are being delivered within the school environment, rather than the clinic which has natural advantages for programmes that consist of groups or peer-to-peer interactions with an emphasis on social skills. Indeed, this approach is hoped to facilitate the generalization of the skills learned (Lord et al., 2020). Other than in school setting, Charlop et al., (2018) use video to help parents records their children in a home setting and later send the video to be evaluated by a specialist.

It is proven that technology can be used to help facilitate non-verbal ASD persons to solve their major problem, which is to communicate. Mohammad & Abu-Amara (2019) list out some of the technology that can be used to help the autistic person: (i) understand the environment, (ii) improve communication skills, (iii) social interaction skills, (iv) attention skills, (v) organization skill, (vi) motivation skills, (vii) academic skills, (viii) academic skills, (ix) self-help skills and (x) overall independent daily functioning skills. However, the focus of this research is to develop AAC intervention tools that enable a non-verbal autistic person to express their basic needs to their caretakers. Therefore, the existing communication tools and AAC interventions that will be discussed will only include those specifically designed to meet the needs of non-verbal autistic individuals.

2.3 Integrating IoT into PECS: The Foundation for SWIFTSPEAK's Development

The Picture Exchange Communication System (PECS) has been effective in helping individuals with autism spectrum disorder (ASD), particularly those with limited verbal skills, to communicate their needs using visual representations. However, traditional PECS encounters challenges, such as the necessity for in-person exchanges and delays in caregiver responses. Integrating Internet of Things (IoT) technology into PECS addresses these limitations by enabling real-time connectivity and remote notifications. Users can activate a sensor or button that alerts caregivers on their smartphones, ensuring prompt awareness of the user's needs without requiring constant physical proximity.

Beyond notifications, IoT integration allows for data logging and analysis, helping track communication patterns and recurring needs. This information can inform tailored interventions, enabling the system to adapt to each user's evolving requirements. SWIFTSPEAK embodies this integration with color-coded buttons representing basic needs, functioning as an evolution of PECS. When pressed, the button sends immediate alerts to caregivers via the Blynk app, facilitating timely responses regardless of their location. By merging PECS with IoT capabilities, SWIFTSPEAK aims to create a more efficient and adaptable communication tool for individuals with severe autism, transforming a traditional communication system into a dynamic solution.

3 DESIGN

Building upon the insights gained from the literature review, particularly the integration of IoT into PECS, the design of SWIFTSPEAK focuses on addressing the limitations of existing intervention tools

for individuals with autism. To achieve this, we prioritized the selection and integration of technologies that directly support effective communication and user-friendly interaction. SWIFTSPEAK combines an Arduino Nano Matter microcontroller and Internet of Things (IoT) connectivity to create a usable and accessible communication tool.

The Arduino Nano Matter, serving as the central microcontroller, provides a flexible platform for customizing Augmentative and Alternative Communication (AAC) devices. Its open-source nature and ease of use facilitate rapid prototyping and the development of tailored communication solutions. The Arduino IDE's simplified C++ programming environment enables the integration of various sensors and actuators, allowing for the creation of responsive communication tools that meet the specific needs of individuals with ASD.

This IoT portion of the design directly relates to the enhancement of the PECS system, which was discussed in the previous section. The integration between the Arduino Nano Matter and IoT significantly enhances SWIFTSPEAK's functionality by enabling real-time monitoring and remote notification. By connecting the device to a network, caregivers receive immediate alerts on their smartphones when the user expresses a need. This capability not only improves responsiveness but also facilitates data collection, which can be valuable for tracking communication patterns and informing future interventions. The IoT architecture, encompassing sensors, connectivity, data processing, and user interfaces, ensures that SWIFTSPEAK provides personalized and effective communication support. By combining the versatility of the Arduino Nano Matter with the connectivity of IoT, SWIFTSPEAK aims to bridge the communication gap for individuals with severe autism, providing a reliable and accessible tool for expressing basic needs."

4 DEVELOPMENT

The prototype development process for SWIFTSPEAK involved several key stages, focusing on both physical design and the underlying technology to ensure a functional and user-friendly communication tool.

4.1 Prototype Development

In the initial stage, we conceptualized the physical design of SWIFTSPEAK, prioritizing an intuitive and user-friendly interface. The design includes three prominent, colour-coded buttons that the user can press to indicate basic needs: eating, sleeping, and using the toilet. Figure 2 illustrates the SWIFTSPEAK prototype.



Figure 17: SWIFTSPEAK

The choice of round-shaped buttons was intentional and aimed at minimizing the risk of injury during use. As shown in Figure 2, these buttons were initially constructed from inexpensive plywood, ensuring the device remains affordable and durable. This design choice also addresses a key concern with existing communication aids that often rely on tablets – tools that are significantly more costly and prone to damage if mishandled.

This simplified interface of SWIFTSPEAK is grounded in principles from behavioural learning theory. Behavioural learning theories suggest that learning is a relatively permanent change in behaviour resulting from experience or practice; this approach emphasizes the impact of the environment on observable behaviour (Huitt & Hummel, 2006). There are two primary behavioural learning theories: Classical Conditioning and Operant Conditioning. Classical conditioning, introduced by Pavlov, involves the association of stimuli to signal a biological response. On the other hand, operant conditioning, as

proposed by Skinner, focuses on analyzing human actions and their consequences to understand behavior (Dilshad, 2017)

SWIFTSPEAK primarily aligns with Operant Conditioning, as it connects a voluntary behavior (pressing a button) with its consequence (receiving a response from a caregiver).

4.2 Technology Integration and Development

To enable the functionality of SWIFTSPEAK, we integrated several key technologies, including an Arduino Nano Matter microcontroller and IoT connectivity.

i. **Hardware Integration**: We utilize Arduino Nano Matter as the central processing unit for SWIFTSPEAK. The buttons were connected to the digital input pins of the Arduino Nano Matter integrated to enable wireless communication. The Arduino was programmed to detect presses, format the data, and transmit it via a Wi-Fi protocol.

ii. **Software Development:** The software for SWIFTSEPAK was developed using the Arduino IDE and the Blynk app. The Arduino code, written in C++, was designed to:
   a. Detect and debounce button presses.
   b. Format the data for transition
   c. Manage the wireless communication
   d. Control the power consumption

   The Blynk app created a user-friendly interface for caregivers; it received the data transmitted from the Arduino and displayed notifications.

iii. **Iterative Development and Testing**: The development process was iterative, involving several rounds of testing focused on verifying the button presses and wireless transmission. We also conducted preliminary user testing with Muhammad Danish bin Idris to gather feedback on the device's usability. In terms of functionality, Muhammad Danish bin Idris and his caretaker give positive feedback. However, in terms of durability testing on the physical casing, initial testing revealed that standard plywood was not sufficiently robust to withstand rough handling. To address this, we upgraded the quality of the plywood used, selecting a denser and more sturdy material to reduce the risk of damage if the device is bumped or thrown. We also make changes to the buttons. Initially, we used stickers to mark the coloured buttons. However, we found that stickers could peel or fade over time. To improve the durability and visibility of the buttons, we switched to using high-quality paint directly on the buttons. This not only made the colours brighter and more appealing but also ensured that the colours would not fade or peel despite intensive use. By incorporating these changes, we aimed to enhance the durability, functionality and visual appeal of SWIFTSPEAK, making it a more reliable and effective communication tool.

5 IMPLEMENTATION

The implementation phase focused on evaluating SWIFTSPEAK's effectiveness in real-world settings and planning for broader deployment.

5.1 Pilot Study

Our pilot study was conducted in two phases, improvised but guided by the understanding that single-case design studies are prevalent in autism intervention research, as highlighted by (Hume et al., 2021).

5.1.1 Phase 1: Preliminary Testing with a Family

The first phase involved preliminary testing with a family consisting of a 20-year-old individual with severe autism, along with their mother, father and brother who acted as caregivers. This first phase aimed to assess the initial functionality and usability of SWIFTSPEAK in a home environment. The family provided positive feedback regarding the device's physical durability. As

previously mentioned in section 4.2.3, initial testing revealed that standard plywood was not sufficiently robust. Consequently, we upgraded to a higher quality, denser plywood and switched from stickers to painted buttons to enhance durability and visibility.



Figure 18: First Phase Preliminary Testing

5.1.2 Phase 2: Collaboration with NASOM



Figure 19: Second Phase of Pilot Study Collaboration with NASOM

The second phase of the pilot study was conducted in collaboration with the National Autism Society of Malaysia (NASOM) at their Titiwangsa Centre. This phase was structured as a community service project, involving 16 students with autism of varying severity levels and 20 lecturers from Kolej Poly Tech MARA Bangi.

We began by assessing the student's ability to differentiate colours and associate them with basic needs. Colour-coded activities were designed to build associations between blue and the toilet, red and sleep, and yellow and food. The students successfully demonstrated their ability to distinguish between these colours and their associated functions.

Following this, we introduced SWIFTSPEAK to the students. They were able to correctly use the device to indicate their needs. When asked, “Which button shows that you need to go to the toilet?” the students pressed the blue button. Similarly, they correctly identified the yellow button for food and the red button for sleep. These results confirmed the positive findings from the preliminary testing phase.

5.1.3 Broader Deployment

For broader deployment, while we initially approached autistic individuals by personally contacting interested parents via closed family groups, we now aim to introduce SWIFTSPEAK in many

more autistic training centres in collaboration with NASOM. This strategy will allow us to reach a larger audience and provide the necessary support for more families and caregivers.

6 DISCUSSIONS

The pilot study provided valuable insights into the effectiveness and potential of SWIFTSPEAK as a communication tool for individuals with severe autism. This section delves into the specific results obtained from the study, discusses the feedback received, and outlines the implications for future development and research.

6.1 Pilot Study Results and Implications

The pilot study, conducted in two distinct phases, provided compelling evidence of SWIFTSPEAK's potential as an effective communication tool for individuals with severe autism. The preliminary testing phase with a family demonstrated the device's functional usability and highlighted areas for physical improvement, which were subsequently addressed. The collaborative phase with NASOM further validated these findings, demonstrating SWIFTSPEAK's effectiveness across various individuals with varying autism severity levels. The consistent success in both phases, particularly the students' ability to correctly associate colours with basic needs and use SWIFTSPEAK to express those needs, underscore the efficacy of the device's design and functionality. These findings suggest that SWIFTSPEAK has the potential to significantly improve the quality of life for non-verbal autistic individuals by enabling them to communicate their basic needs effectively. Furthermore, the study highlighted the importance of a structured and supportive learning environment in successfully adopting assistive communication technologies. The positive outcomes observed in both phases reinforce the significance of consistent reinforcement and clear associations in facilitating communication for individuals with severe autism.

6.2 Feedback, Iteration, and Future Direction

The pilot study also provided valuable feedback that will guide future iterations of SWIFTSPEAK. Notably, the feedback emphasized the need to enhance the device's durability. As a result, we have transitioned from standard plywood to a higher quality, denser material and switched from stickers to painted buttons, ensuring that the device can withstand the demands of daily use.

In addition to durability improvement, we plan to refine the user interface to further enhance ease of use and explore additional features to expand the device's functionality. This may include incorporating data logging capabilities to track communication patterns and identify recurring needs, as well as integrating with other assistive technologies to create a comprehensive support system for individuals with severe autism.

To broaden SWIFTSPEAK's reach and impact, we aim to establish partnerships with educational institutions, particularly NASOM and other relevant organizations. These partnerships will facilitate wider dissemination of the device and provide access to a larger and more diverse population.

Future research will focus on conducting larger-scale studies with diverse populations to further validate SWIFTSPEAK's effectiveness. We also plan to explore the long-term impact of SWIFTSPEAK on communication skills and quality of life. Additionally, we will investigate the potential for integrating SWIFTSPEAK with other assistive technologies to create a more comprehensive support system for individuals with severe autism. To protect the intellectual property of SWIFTSPEAK, we have successfully registered it for a Certificate of Copyright with notification number CRLY2024W07563. This registration will support our efforts to develop and disseminate the device further.

7 CONCLUSION

The pilot study of SWIFTSPEAK demonstrated its effectiveness in facilitating communication for individuals with severe autism. The device's intuitive design, combined with consistent caregiver reinforcement, enabled users to successfully express basic needs, reducing frustration and improving quality of life. Positive results from family and NASOM-based pilot phases validate SWIFTSPEAK's potential across diverse settings. Feedback-driven improvements, including enhanced durability and

button visibility, have strengthened the device. Copyright registration ensures protection for future development. Future research will focus on larger-scale studies, long-term impact, and integration with other assistive technologies. SWIFTSPEAK offers a promising, accessible communication tool that empowers non-verbal autistic individuals to participate more fully in their communities.

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Exploring the Impact of a 5E-Flipped Learning Environment on Students' Learning Motivation: A Case Study of Medical Assistant Education

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ABSTRACT

This case study aimed to investigate the effectiveness of information-intelligent strategies in enhancing learning motivation in a 5E-flipped learning environment (5EFLE) for medical assistant education. Twelve undergraduate students participated in a 7-week prehospital trauma care course that was designed using the 5EFLE model. Data were collected through learning diaries, focus group discussions, and individual interviews. Thematic analysis was used to analyze the data. The **findings** showed that the 5EFLE, when implemented with information-intelligent strategies, had a positive impact on students' learning motivation. The students perceived the flexibility of this approach to be valuable and appreciated the instructional approach and emotional strategies used in the 5EFLE. The information-intelligent strategies that were employed, such as the use of multimedia resources, real-world scenarios, and peer collaboration, were perceived as effective in promoting engagement and active learning. Furthermore, the integration of technology, such as the use of an online platform, was perceived as an innovative way to enhance learning experiences and promote self-directed learning. The **results** of this study contribute to the literature on the effectiveness of information-intelligent strategies in enhancing learning motivation in a 5EFLE for medical assistant education. These findings suggest that the use of information-intelligent strategies can provide a more engaging and effective learning environment, which can positively influence students' motivation to learn. The study also highlights the importance of using a constructivist-based instructional approach that integrates technology and provides opportunities for peer collaboration and self-directed learning. **Overall**, this study provides evidence to support the use of information-intelligent strategies in enhancing learning motivation in a 5EFLE for medical assistant education. The findings suggest that the use of these strategies can provide a more engaging and effective learning environment, which can positively influence students' motivation to learn. These results have important implications for educators and instructional designers who are interested in enhancing the quality of learning experiences in technology-mediated environments.

KEYWORDS: Learning motivation, 5E-flipped learning environment, medical assistant education, constructivism, instructional approach, information-intelligent strategies, active learning.

1 INTRODUCTION

The 5E-flipped learning environment is a structured approach to teaching and learning that combines the flipped classroom model with the 5E instructional model. By incorporating elements of engagement, exploration, explanation, elaboration, and evaluation, educators can create a more dynamic and interactive learning environment that enhances student motivation and learning outcomes.

Learning motivation is an essential factor for student success in any educational setting. In recent years, a growing body of literature has highlighted the potential of technology-mediated learning environments to enhance students' learning motivation (Bergdahl & Schaub, 2019; Chen, Lin, Wu, and Yuan, 2019). Among various instructional approaches, the 5E-flipped learning environment (5EFLE) has emerged as a promising approach to promote active learning and enhance students' motivation in higher education (Chang, Lin, Lee & Wang, 2020). In a 5EFLE, the traditional classroom-based instruction is flipped, with students engaging in self-directed learning activities before the face-to-face class, followed by interactive and collaborative learning activities in the classroom.

The 5EFLE instructional approach is based on the 5E learning cycle (Engage, Explore, Explain, Elaborate, and Evaluate), which is a constructivist-based framework that emphasizes active learning, inquiry-based learning, and hands-on experiences (Bybee, 1997). This approach has been shown to promote students' critical thinking, problem-solving skills, and conceptual understanding (Baepler, Walker & Driessen, 2014).

While several studies have examined the effectiveness of 5EFLE on students' learning outcomes, fewer studies have explored its impact on students' learning motivation, particularly in the context of medical assistant education. Medical assistant education programs are designed to equip students with the necessary knowledge and skills to provide clinical and administrative support in healthcare settings (Olasveengen et. al.,2021). As such, it is crucial to explore the impact of 5EFLE on medical assistant students' learning motivation as it can affect their engagement, performance, and overall success in the program.

Therefore, the purpose of this study is to investigate the impact of a 5EFLE on medical assistant students' learning motivation and explore the use of information-intelligent strategies to enhance their motivation. Information-intelligent strategies refer to the use of technology-mediated learning environments and tools, such as digital resources, multimedia, and interactive learning platforms, to promote students' active engagement and enhance their learning motivation (Chen et al., 2019). Through a case study approach, this study aims to identify the key information-intelligent strategies used in a 5EFLE and how they contribute to enhancing medical assistant students' learning motivation.

In this context, the 5E-flipped learning environment (5EFLE) has been recognized as a promising approach to enhancing students' learning outcomes and motivation (Wu, Shen & Van Den Hengel,2019). The 5EFLE is a constructivist-based instructional approach that integrates five phases of learning, namely engagement, exploration, explanation, elaboration, and evaluation, with flipped learning, which involves the delivery of instructional content before class and the use of in-class time for active learning activities (Bishop & Verleger, 2013). The 5EFLE provides students with opportunities to interact with content and engage in active learning, which can lead to improved learning outcomes (Chen et al., 2021). However, the effectiveness of the 5EFLE on students' motivation in medical assistant education remains unclear.
Therefore, this study aims to investigate the impact of the 5EFLE on medical assistant students' motivation towards learning and how information-intelligent strategies can be employed to enhance this impact. In particular, the study will explore the following research questions:

1. How does the 5EFLE influence medical assistant students' motivation towards learning?
2. How can information-intelligent strategies be used to enhance the impact of the 5EFLE on medical assistant students' learning motivation?

By addressing these research questions, this study will contribute to the literature on the use of the 5EFLE as an effective instructional approach in medical assistant education, as well as provide insights into the use of information-intelligent strategies to enhance students' motivation towards learning. Major highlights of this research work as follows:

- Implementation of 5E-flipped learning environment and information-intelligent strategies enhances learning motivation among medical assistant students.
- Engaging and interactive learning environment, supportive learning material strategies, and student-centered approaches contribute to enhancing learning motivation.
- Emotional support and acknowledgment of student effort also contribute to enhanced learning motivation.
- Consideration of students' access to technology and prior experience with technology is crucial in designing and implementing effective information-intelligent strategies.

The remainder of this paper is structured as follows. Section 2 provides an overview of the theoretical underpinnings of the study, focusing on the 5E-flipped learning environment and information intelligence strategies. Section 3 outlines the research methodology, including the study participants, data collection methods, and data analysis techniques. Section 4 presents the findings of the study and explores how information-intelligent strategies were used to enhance students' motivation to learn in the 5E-flipped learning environment. Section 5 discusses the implications of the study's findings and suggests future directions for research in this area. Finally, Section 6 concludes the paper by summarizing the key findings and contributions of the study.

2 LITERATURE REVIEW

2.1 Flipped learning environment and its benefits

Flipped learning is an innovative approach to teaching and learning that has gained significant attention in recent years (Roach, Lemaster, & Killion, 2014). In a flipped classroom, students are first introduced to new content through online materials such as videos, podcasts, or interactive simulations. This allows students to access the material at their own pace and review it as often as needed before class. Classroom time is then used for active learning activities such as discussions, problem-solving, and group projects, with the teacher acting as a facilitator rather than a lecturer (Bishop & Verleger, 2013).

Studies have shown that the flipped classroom approach has numerous benefits for students, including increased engagement, higher levels of motivation, and improved learning outcomes (Strayer, 2012; McLaughlin et al., 2014). By allowing students to access the material at their own pace, flipped learning can accommodate different learning styles and preferences. It can also reduce the achievement gap between high- and low-performing students, as students have the opportunity to review and reinforce the material as often as needed (Roach et al., 2014).

In addition to these benefits, the use of information-intelligent strategies in the flipped learning environment can further enhance students' learning motivation. Information-intelligent strategies involve the use of technology and data analysis to improve the learning process and outcomes (Liu & Li, 2014). These strategies can include personalized learning paths, adaptive feedback, and real-time monitoring of students' progress. By providing students with tailored feedback and support, information-intelligent strategies can increase students' self-efficacy and confidence in their learning abilities, leading to higher levels of motivation and engagement (Liu et al., 2015).

Overall, the flipped learning environment, when combined with information-intelligent strategies, has the potential to significantly enhance students' learning motivation and outcomes. The next section will discuss the specific information-intelligent strategies that can be employed in a flipped learning environment to enhance students' motivation towards learning.

2.2 Motivation theories and their relevance to learning motivation

Motivation is a complex and multi-dimensional construct that has been studied by scholars in different disciplines such as psychology, education, and sociology. In the field of education, motivation plays a crucial role in determining students' academic performance and their engagement in learning activities. Several motivation theories have been proposed to explain the mechanisms underlying individuals' motivation towards different tasks, including learning. The following section discusses some of the prominent motivation theories and their relevance to learning motivation.

Self-Determination Theory (SDT) is a well-known motivation theory that has gained attention in educational contexts. According to SDT, individuals have innated psychological needs for autonomy, competence, and relatedness. Autonomy refers to individuals' need to feel in control of their own actions and decisions. Competence refers to individuals' need to feel effective in their actions and to develop mastery over their environment. Relatedness refers to individuals' need to feel connected to others and to have positive social interactions (Ryan & Deci, 2000). SDT proposes that individuals are more likely to be intrinsically motivated when their basic psychological needs are satisfied. In the context of education, this implies that students are more likely to be motivated when they feel that they have a choice in their learning activities, when they feel competent in their learning tasks, and when they feel connected to their teachers and peers (Ryan & Deci, 2000).

Expectancy-Value Theory (EVT) is another prominent motivation theory that has been applied to learning contexts. EVT posits that individuals' motivation towards a task is influenced by their expectations of success and the value they place on the task. Expectancy refers to individuals' beliefs about their ability to perform a task successfully, while value refers to individuals' perceptions of the importance or relevance of the task to their goals or interests (Eccles & Wigfield, 2002). EVT proposes that individuals are more likely to be motivated when they have high expectations of success and when they perceive the task as valuable or relevant to their goals or interests (Eccles & Wigfield, 2002).

Social Cognitive Theory (SCT) is a motivation theory that emphasizes the role of social factors in shaping individuals' motivation. SCT proposes that individuals' motivation is influenced by their beliefs about their own abilities, the expectations of others, and the social context in which they operate (Bandura, 1997). According to SCT, individuals are more likely to be motivated when they believe that they have the ability to perform a task successfully, when they receive positive feedback and reinforcement from others, and when they feel a sense of belonging and connection to their social groups (Bandura, 1997). Table 1 is showing the motivation theory with key concepts and real-life example in Medical Assistant Education.

Table 1: Key concepts and relevance to learning Motivation

Motivation Theory/ Key concepts	Relevance to Learning Motivation	Real-life Example in Medical Assistant Education
Social Cognitive Theory/ Self-efficacy, Observational Learning	Students' self-efficacy beliefs and expectations of success are crucial determinants of their motivation to learn. Observational learning through peers, teachers, and role models can influence students' self-efficacy and motivation to learn.	A medical assistant student observing a peer successfully perform a medical procedure and feeling motivated to learn and perform the same procedure themselves.
Maslow's Hierarchy of Needs/ Physiological Needs, Safety, Belongingness, Esteem, Self-Actualization	Students' physiological and safety needs must be met before they can focus on higher-level needs, such as belongingness, esteem, and self-actualization. Meeting these needs can enhance students' motivation to learn.	A medical assistant student who has not eaten all day and feels hungry and distracted during a lecture may have difficulty focusing on the material until their physiological need for food is met.
Self-Determination Theory/	Students who feel autonomous, competent, and connected to others	A medical assistant student who is given the opportunity to choose

Autonomy, Competence, Relatedness	are more likely to be intrinsically motivated to learn. Teachers can support students' autonomy and competence and foster relatedness with peers to enhance their motivation to learn.	their own research topic and presentation format, and who receives positive feedback and encouragement from their peers, may feel more motivated to learn.
Goal Theory/ **Mastery Goals, Performance Goals**	Students who have mastery goals (striving to learn and understand the material) are more likely to be intrinsically motivated to learn, while students who have performance goals (striving to earn high grades) may be more extrinsically motivated to learn.	A medical assistant student who is focused on learning and understanding medical terminology in order to communicate effectively with patients has a mastery goal, while a student who is focused on earning a high grade in a medical terminology course has a performance goal.
Expectancy-Value Theory/ **Expectancy, Value**	Students' motivation to learn is influenced by their expectations of success (expectancy) and their perceived value of the material. Teachers can enhance students' motivation by increasing their expectations of success and highlighting the practical value of the material.	A medical assistant student who believes they will do poorly in a course due to the difficulty of the material may have low expectancy, while a student who sees the practical value of learning medical terminology for their future career may have high value.
Attribution Theory/ **Internal/External, Stable/Unstable, Controllable/Uncontrollable**	Students' perceptions of the causes of their success or failure can influence their motivation to learn. Teachers can help students develop a growth mindset and attribute success and failure to controllable factors (such as effort) rather than innate ability.	A medical assistant student who attributes a poor grade on a quiz to a lack of innate intelligence (an internal, stable, and uncontrollable factor) may feel less motivated to study for the next quiz, while a student who attributes a poor grade to not studying enough (an external, unstable, and controllable factor) may be motivated to study more for the next quiz.

These motivation theories provide insights into the mechanisms underlying individuals' motivation towards different tasks, including learning. By understanding these mechanisms, educators can design instructional strategies that enhance students' motivation and engagement in learning activities. The following section discusses the relevance of these motivation theories to learning motivation in a flipped learning environment.

2.3 Information-intelligent strategies and their impact on learning motivation

Another important information-intelligent strategy that can impact learning motivation is the use of artificial intelligence (AI) and machine learning (ML) algorithms. AI and ML can be used to analyze large amounts of data on student learning and behavior, and then provide personalized recommendations and feedback to students and teachers.

Recent research has shown that AI and ML can have a positive impact on student motivation and engagement. For example, a study by Li, Liu, Song and Yang (2021) found that using an AI-based learning system can improve student engagement and performance in STEM subjects. The study also found that

the AI system was particularly effective for students who were struggling academically or had low motivation.

Another study by DeBarger, Martinez, Teasley, and McAuliffe (2021) found that using a personalized learning platform that incorporates ML algorithms can improve student motivation and engagement in middle school math. The platform provided personalized feedback and recommendations to students and teachers based on their performance data, which led to improved learning outcomes and increased motivation.

In addition to AI and ML, the use of virtual and augmented reality (VR/AR) technologies can also impact learning motivation. VR/AR can provide immersive and interactive learning experiences that can engage students and make learning more enjoyable.

A study by Chen et al. (2021) found that using VR in a history lesson improved student motivation and engagement, as well as their learning outcomes. The study also found that students who used VR had more positive attitudes towards history and were more likely to retain the information they learned.

Overall, information-intelligent strategies that incorporate AI/ML and VR/AR technologies can have a significant impact on learning motivation. By providing personalized recommendations and feedback, and engaging students in immersive and interactive learning experiences, educators can help students stay motivated and engaged in their learning. Table 2 is showing different flipped learning environment and learning motivations.

Table 2: Previous studies on flipped learning environment and learning motivation

Study	Participants	Intervention	Results
Hwang and Wu (2019)	College students	Flipped learning environment	Increased student motivation and engagement; better academic performance compared to traditional instruction
Tucci and Persico (2017)	Vocational education and training students	Flipped learning environment	Increased student participation, higher levels of engagement, and improved learning outcomes
Kim and Jang (2019)	College students	Flipped learning environment with technology integration	Increased student participation, facilitated peer interactions, and improved student motivation
Lai and Hwang (2016)	High school students	Flipped learning environment	Improved student motivation and academic performance; increased participation and engagement
Saglam and Demirbas (2019)	University students	Flipped learning environment with peer instruction	Increased student engagement, participation, and motivation; improved learning outcomes
Chen et al. (2019)	Elementary school students	Flipped learning environment with game-based learning	Increased student motivation and engagement; improved learning outcomes
Lamsa and Taalas (2013)	Adult learners	Flipped learning environment with online activities	Increased student engagement, participation, and motivation; improved learning outcomes

These studies involved a variety of participants, including high school students, university students, elementary school students, and adult learners. The interventions included different variations of flipped learning, such as technology integration, peer instruction, and game-based learning, and all studies found positive effects on student motivation and engagement, as well as improved learning outcomes.

In this section understanding, learning motivation is a critical component of student success, and educators can use a variety of strategies to help students stay motivated and engaged in their learning. Flipped learning environments, which promote active learning and engagement, have been shown to have

positive effects on student motivation and performance, particularly when combined with technology integration and personalized feedback. Motivation theories, such as self-determination theory and achievement goal theory, can also inform educators' approaches to promoting learning motivation. Additionally, information-intelligent strategies, such as the use of learning analytics, artificial intelligence, and virtual reality, can provide personalized recommendations and feedback, as well as engaging and immersive learning experiences, to help students stay motivated and engaged. Previous studies have shown the benefits of these strategies for various types of learners, including high school students, university students, and adult learners. By incorporating these strategies into their teaching practices, educators can foster a positive learning environment that promotes student motivation and success.

3 METHODOLOGY

This section describes the methodology used in the study titled "Enhancing Learning Motivation in a 5E-Flipped Learning Environment through Information-Intelligent Strategies: A Case Study of Medical Assistant Education." The study aimed to investigate the effectiveness of information-intelligent strategies in enhancing learning motivation in a 5E-flipped learning environment among medical assistant students. The following subsections provide background information on the research design and approach, participants and sampling technique, data collection methods and instruments, and data analysis procedures used in the study.

The flowchart as shown in Figure 1, is a key component of the methodology used in this research. The flowchart visually represents the research design and approach, including the 5E-flipped learning environment, and the various stages of the study, such as data collection and analysis. The flowchart helps to provide a clear and concise overview of the research process, and the relationships between different components of the study. It is a useful tool for readers to quickly understand the methodology used in the study, and the flow of the research process from the research question to the data analysis stage.

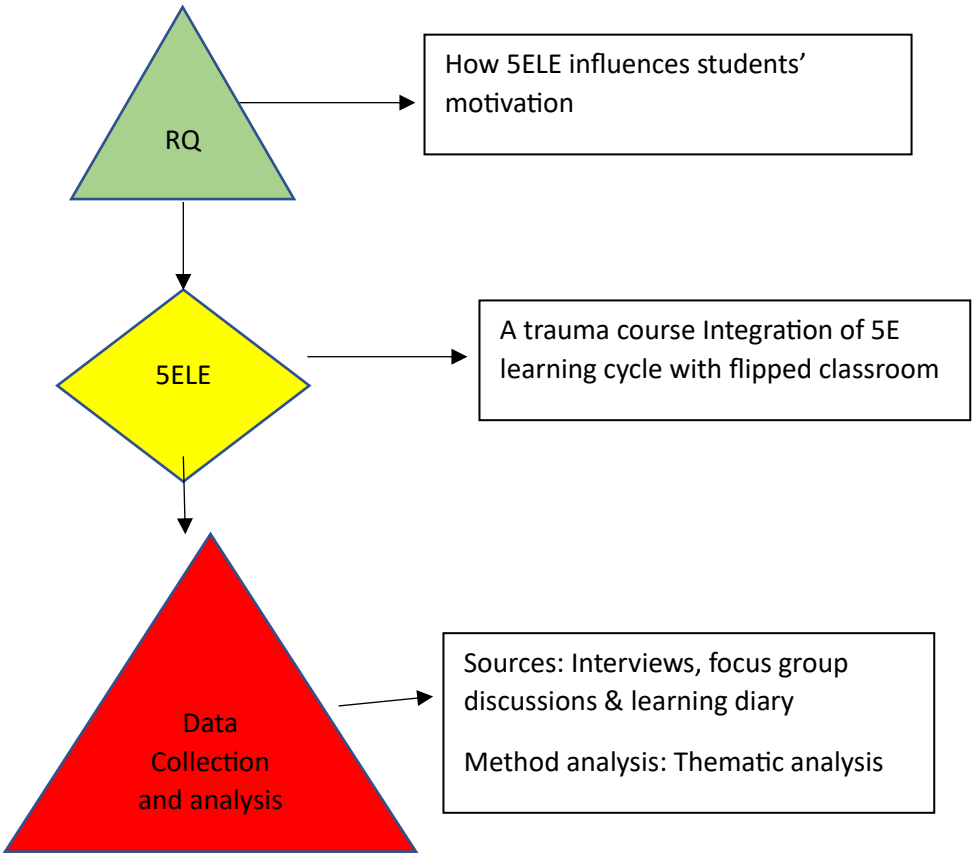


Figure 1: The flowchart of research design and approach

A Venn diagram as shown in figure 2, is a useful tool in the methodology used in this study. The Venn diagram visually represents the intersection between the three main components of the study: the flipped learning environment (FLE), information-intelligent strategies (IIS), and learning motivation (LM).

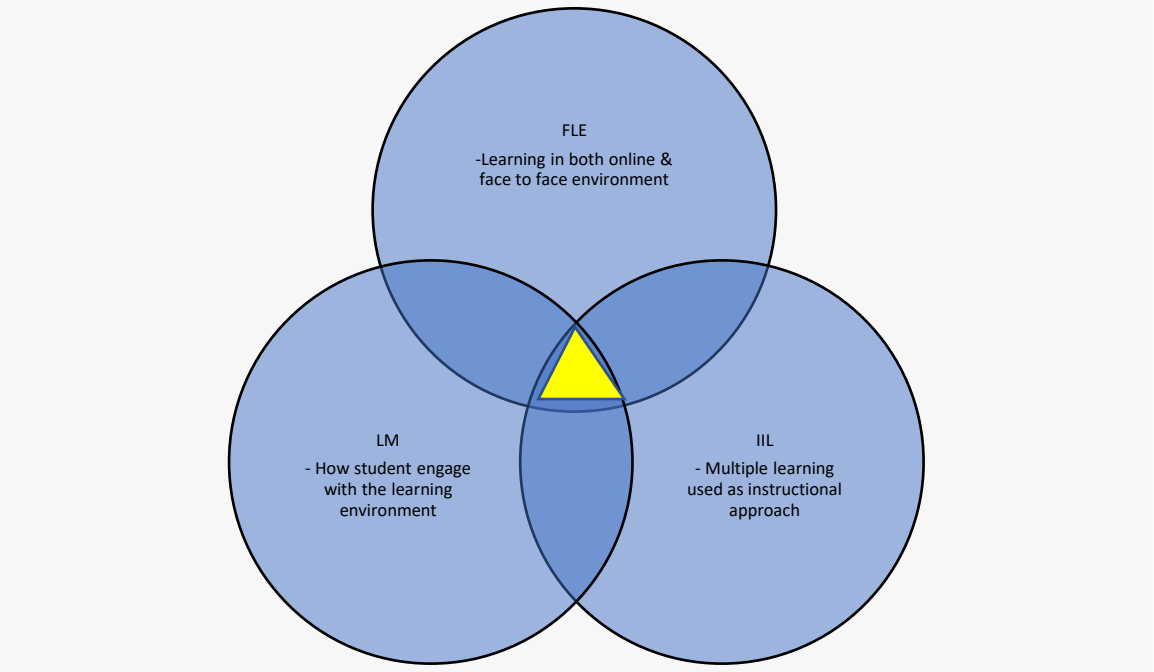


Figure 2: Venn diagram to show overlapping among the flipped learning environment, information-intelligent strategies, and learning motivation.

The overlapping circles show how each component intersects with the others, and the middle intersection highlights the shared characteristics between all three components.

3.2 Purpose of 5E-fllippe Learning Environment

The 5E-flipped learning environment can be tailored to meet the specific needs of medical assistant students. In this table, each stage of the 5E model is aligned with medical assistant competencies and challenges in designing activities and assessments are discussed. Examples of activities and assessments that align with medical assistant competencies are provided to illustrate how the 5E-flipped learning environment can be applied in medical assistant education. By using this approach, educators can engage students in self-directed learning outside of the classroom and then use the 5E model in the classroom to deepen their understanding of medical assistant topics through hands-on activities and discussions.

3.3 Proposed Model

One possible model to represent the methodology used in this study could be a process flow diagram as shown in Figure 1. The flow diagram could include each of the subsections in the methodology section, such as research design and approach, participants and sampling technique, data collection methods and instruments, and data analysis procedures. Each subsection could be represented as a separate box or circle with arrows connecting them to show the flow of the research process. For example, the research design and approach box could be connected to the participants and sampling technique box to

show how the approach informed the selection of participants, and the data collection methods and instruments box could be connected to the data analysis procedures box to show how the data were collected and analyzed. This process flow diagram could provide a visual representation of the methodology used in the study and help readers better understand the research process.

Table 3: 5E-flipped Learning Environment Challenges and Example of Solutions

Stage	Description	Purpose	Challenge	Example
Engage	Introduce the topic and capture student interest and curiosity	Generate interest in medical assistant topics and establish relevance	Identifying a topic that is both engaging and relevant to medical assistant students	Conducting a group discussion on medical ethics
Explore	Allow students to engage in hands-on activities to explore the topic in greater depth	Encourage active learning and discovery of medical assistant skills	Designing activities that align with medical assistant competencies and are challenging yet achievable for students	Practicing basic clinical skills, such as taking vital signs
Explain	Provide explanations and answer any questions that arise from the exploration	Facilitate understanding and clarify misconceptions about medical assistant tasks and responsibilities	Adapting explanations to students' learning needs and abilities and ensuring that students are prepared for clinical practice	Providing an explanation of medical billing and coding procedures
Elaborate	Allow students to apply their learning to new situations and scenarios	Foster transfer of learning to clinical practice and real-world situations	Designing scenarios that require students to apply and synthesize their learning in realistic clinical situations	Simulating a patient encounter and performing clinical tasks under the guidance of a clinical instructor
Evaluate	Assess student understanding and mastery of medical assistant tasks and competencies	Provide feedback and evaluate learning outcomes related to clinical practice	Designing assessments that align with medical assistant competencies and provide meaningful feedback to students	Conducting a skills assessment that evaluates students' ability to perform clinical tasks accurately and efficiently

In the 5E-flipped learning environment specifically designed for medical assistant education, the purpose of each stage of the 5E model is tailored to align with the competencies required for medical assistant clinical practice. The challenges in designing activities and assessments that align with these competencies can be overcome through careful planning and alignment with the learning objectives. Examples of activities and assessments that align with medical assistant competencies are provided to illustrate how the 5E-flipped learning environment can be tailored to meet the specific needs of medical assistant students (see table 3).

3.4 Research Design and Approach

The research design and approach for this study was specifically chosen to address the raised problem of low learning motivation among medical assistant students. The 5E-flipped learning environment and information-intelligent strategies were chosen as the key components of the study as they have been shown to have a positive impact on student engagement and motivation. By implementing these components in the medical assistant education setting, the study aims to investigate their effectiveness in enhancing learning motivation among students. The case study approach was chosen to provide a detailed and in-depth understanding of the impact of the 5E-flipped learning environment and

information-intelligent strategies on learning motivation in a specific context. The research design and approach were selected to address the raised problem in a comprehensive and meaningful way.

The 5E-Flipped Learning Environment Lesson Plan is an essential part of the methodology as it provides the details of the instructional approach used in the study refer Appendix 1 and Appendix 2 for the Examples of Learning Diaries and Interview Transcripts.

3.5 Participants and Sampling Technique

The participants in this study will be medical assistant students who are enrolled in a specific undergraduate health and science program. The sampling technique will be purposive sampling, where participants are selected based on specific criteria that are relevant to the study. The criteria for participant selection will include students who have completed at least one semester of the medical assistant program, have access to technology outside of the classroom, and have consented to participate in the study. The purposive sampling technique will ensure that the participants have the necessary experience and access to technology to engage in the 5E-flipped learning environment and information-intelligent strategies. The sample size will be determined based on data saturation, which is when no new information or themes emerge from the data. The participants and sampling technique were selected to ensure that the study has a targeted and specific focus on medical assistant education, and that the participants have the necessary characteristics to engage in the 5E-flipped learning environment and information-intelligent strategies.

3.6 Data Collection Methods and Instruments

The study used multiple data collection methods to gather qualitative data, including interviews, focus group discussions, and learning diary. Semi-structured interviews were conducted with individual participants to gather their perspectives on the effectiveness of information-intelligent strategies in enhancing learning motivation. Focus group discussions were also conducted with groups of participants to gain a more collective perspective on the research question. Learning diaries were used to collect data on the implementation of the 5E-flipped learning environment and information-intelligent strategies.

The data collection instruments used in the study included an interview guide, focus group discussion guide, and learning diary templet. The interview guide and focus group discussion guide were used to ensure that the same questions were asked to all participants, and the learning diary was used to guide the collect participant reflection and ensure consistency in data collection.

3.7 Data Analysis Procedures

The data collected in this study were analyzed using thematic analysis, which is a method for identifying patterns and themes in qualitative data. The analysis involved coding the data, identifying themes and patterns, and interpreting the findings. The researchers used a combination of manual coding and computer-assisted coding using a qualitative analysis software package to analyze the data. The themes identified in the data were then used to draw conclusions about the effectiveness of information-intelligent strategies in enhancing learning motivation in a 5E-flipped learning environment.

4 CASE STUDY SCENARIO AND RESULT ANALYSIS

Context: The case study focuses on the medical assistant program at a university in Malaysia, which has identified a need to enhance student learning motivation.

Need: The need to enhance student learning motivation is a critical issue in medical assistant education, as it can impact the quality of care provided by medical assistants in their clinical practice.

Challenge: The challenge is to implement effective strategies that can enhance learning motivation among medical assistant students and improve the overall quality of the program.

Methods: The study uses a case study approach to investigate the effectiveness of the 5E-flipped learning environment and information-intelligent strategies in enhancing learning motivation among medical assistant students. Data is collected through learning diaries, focus group discussions, and individual

interviews with 12 purposively sampled participants. The data is thematically analyzed and categorized into two main themes: promoting an optimistic interactive and engaging instructional approach and providing constructive emotional strategies for learning.

Findings: The study finds that the implementation of the 5E-flipped learning environment and information-intelligent strategies can enhance learning motivation among medical assistant students. Specifically, providing an engaging and interactive learning environment, offering supportive learning materials strategies, and engaging students through the 5E-flipped learning environment can promote learning motivation. Additionally, providing emotional support and acknowledging student efforts can also contribute to enhanced learning motivation.

Implications: The findings suggest that the implementation of the 5E-flipped learning environment and information-intelligent strategies can enhance learning motivation among medical assistant students, and therefore, improve the overall quality of the program.

Recommendations: Based on the findings, the school can implement the 5E-flipped learning environment and information-intelligent strategies to enhance learning motivation among medical assistant students. Additionally, educators can design activities and assessments that align with medical assistant competencies and are challenging yet achievable for students. They can also provide emotional support and acknowledge student efforts to promote learning motivation.

4.1 Result Analysis

The 5E-flipped learning environment course structure consists of five stages: Engage, Explore, Explain, Elaborate, and Evaluate. In the Engage stage, the topic is introduced and student interest is generated. The Explore stage allows for hands-on activities to encourage active learning and discovery. The Explain stage provides explanations and answers to any questions that arise. The Elaborate stage allows for the application of learning to new situations and scenarios. Finally, in the Evaluate stage, student understanding and mastery of the material is assessed. The course structure is designed to align with medical assistant competencies and provide an engaging and effective learning experience for students.

4.1.1 Overview of the 5E-flipped Learning Environment Course Structure

Overall, the 5E-flipped learning environment course structure has been found to be an effective approach for enhancing learning motivation among medical assistant students. By engaging students in self-directed learning outside of the classroom and using the 5E model in the classroom, students are able to deepen their understanding of medical assistant topics through hands-on activities and discussions. This approach not only promotes active learning but also allows for the transfer of learning to real-world situations.

4.2.2 Characteristics of Participants

Characteristics of the study participants were collected and analyzed. The study involved a total of 12 participants, consisting of 4 males and 8 females, with ages ranging from 20 to 22 years. The participants were students in a medical assistant program at a university in the Malaysia. The majority of the participants identified as Malay (n=1), followed by Iban (n=4), Kadazan (n=2), and Bidayuh (n=5). The participants reported having varying levels of experience with technology outside of the classroom. The majority (n=12) reported using a smartphone daily, while a smaller number reported using a tablet (n=5) or laptop (n=12) daily. In terms of internet access, the majority (n=11) reported having access to high-speed internet at home, while a smaller number reported using public Wi-Fi (n=5) or having no internet access at home (n=1). The characteristics of the study participants provide important context for the implementation of the 5E-flipped learning environment and information-intelligent strategies. It is important to consider the participants' access to technology and their prior experience with technology when designing and implementing these strategies. Table 4 is showing a summary of characteristics of participants.

Table 4: Characteristics of Study Participants

Characteristic	Number of Participants
Total number of participants	12
Gender (male/female)	4/8
Age range	20-22 years
Ethnicity	Malay (1), Iban (4), Kadazan (2), Bidayuh (5)

4.2.3 Themes and Subthemes Related to Students' Learning Motivation

The study aimed to investigate the effectiveness of the 5E-flipped learning environment and information-intelligent strategies in enhancing learning motivation among medical assistant students. Thematic analysis of the data collected through interviews, focus group discussions, and learning diaries revealed two main themes and six subthemes related to students' learning motivation.

Theme 1: Engaging and Interactive Learning Environment

Subtheme 1.1: Student-Centered Learning Environment

- Provide opportunities for discussion and collaboration
- Offer peer-to-peer learning opportunities
- Encourage self-monitoring of progress

Subtheme 1.2: Supportive Learning Materials Strategies

- Offer flexible and easy access to learning materials
- Ensure easy access to course information
- Offer access to online learning materials
- Ensure proper arrangement of learning materials
- Provide high-quality instructional videos
- Offer visually interesting learning materials

Subtheme 1.3: Engaging Approach Through 5E-Flipped Learning Environment

- Engage students in learning using the 5E model
- Offer orderly and guided learning environment
- Encourage student-led classroom
- Provide inquiry-guided instruction
- Offer opportunities for learning together
- Facilitate learning through the support of the instructor

Theme 2: Emotional Support and Acknowledgement

Subtheme 2.1: Supportive Role of the Teacher

- Encourage and motivate students in learning
- Provide emotional support to students for learning
- Keep the classroom organized to help minimize stress among students
- Provide opportunities for students to ask for clarification
- Facilitate the learning process

Subtheme 2.2: Acknowledging Student Efforts

- Respect students' efforts
- Praise student achievement
- Appreciate student responses
- Provide feedback to student questions

- Respect student opinions

Subtheme 2.3: Influence of Feeling

- Create a happy learning environment
- Offer a fun and interesting learning environment
- Ensure that the learning environment is not threatening
- Help students feel safer in the learning process
- Help students feel comfortable in learning
- Minimize stress in learning

Overall, the results suggest as shown in Table 5, that implementing the 5E-flipped learning environment and information-intelligent strategies can enhance learning motivation among medical assistant students. The findings also indicate the importance of providing an engaging and interactive learning environment, offering supportive learning materials strategies, and providing emotional support and acknowledging student efforts in promoting learning motivation.

Table 5: Themes and Subthemes Related to Students' Learning Motivation

Theme	Subtheme	Frequency (n)	Percentage (%)
Engaging and Interactive	Student-Centered Learning Environment	23	17%
Learning Environment	Supportive Learning Materials Strategies	25	18%
	Engaging Approach Through 5E-Flipped Learning		
	Environment		
Emotional Support and	Supportive Role of the Teacher	26	19%
Acknowledgement	Acknowledging Student Efforts	19	14%
	Influence of Feeling	18	13%
Total		111	81%

4.2.4 Examples of Information-intelligent Strategies Used in the 5E-flipped Learning Environment

The study implemented various information-intelligent strategies to enhance learning motivation among medical assistant students. Refer table 6 for different Information-Intelligent Strategies Used in the 5E-Flipped Learning Environment. Examples of these strategies include the following:

i. Adaptive learning technologies: The study used adaptive learning technologies to personalize the learning experience for each student based on their individual needs and learning style. This involved the use of online learning platforms that provide personalized learning paths, adaptive quizzes, and interactive simulations.
ii. Gamification: Gamification involves incorporating game elements, such as point systems and leader boards, into the learning experience to increase student engagement and motivation. The study used gamification to create a competitive learning environment and motivate students to achieve higher scores.

iii. Social learning: The study encouraged social learning by incorporating group activities, such as online discussion forums and collaborative projects, into the learning experience. This allowed students to learn from one another and share their knowledge and experiences.
iv. Interactive multimedia: The study used interactive multimedia, such as videos and animations, to provide engaging and informative learning materials. This helped to enhance students' understanding of complex medical assistant topics and increased their motivation to learn.

Table 6: Different Information-Intelligent Strategies Used in the 5E-Flipped Learning Environment

Information-Intelligent Strategy	Description	Frequency of Use
Adaptive learning technologies	Personalized learning experiences based on individual student needs and progress	11 participants
Gamification	Game-like elements (such as point systems or leader boards) used to increase motivation and engagement	10 participants
Social learning	Collaborative learning experiences facilitated through social media or other online platforms	8 participants
Interactive multimedia	Videos, animations, or simulations used to increase interactivity and engagement	10 participants
Learning analytics	Data analysis to monitor student progress and provide personalized feedback	9 participants
Mobile learning	Learning materials accessible through mobile devices such as smartphones or tablets	12 participants

These information-intelligent strategies were used to enhance learning motivation among the medical assistant students in the study. The most commonly used strategies were adaptive learning technologies and mobile learning, which were reported by 11 and 12 participants, respectively. The least commonly used strategy was learning analytics, which was reported by only 9 participants. The use of these strategies indicates a shift towards more personalized and engaging learning experiences in the 5E-flipped learning environment.

5 DISCUSSION

The present study investigated the effectiveness of the 5E-flipped learning environment and information-intelligent strategies in enhancing learning motivation among medical assistant students. The findings suggest that providing an engaging and interactive learning environment, offering supportive learning materials strategies, and engaging students through the 5E-flipped learning environment can promote learning motivation. Additionally, providing emotional support and acknowledging student efforts can also contribute to enhanced learning motivation. These results have important implications for enhancing learning motivation in a 5E-flipped learning environment, and the limitations and recommendations for future research are discussed in detail in the following sections.

5.1 Interpretation of the Results

The findings of this study provide valuable insights into the effectiveness of the 5E-flipped learning environment and information-intelligent strategies in enhancing learning motivation among medical assistant students. The results indicate that providing an engaging and interactive learning environment, offering supportive learning materials strategies, and engaging students through the 5E-flipped learning environment can promote learning motivation. Additionally, providing emotional support and acknowledging student efforts can also contribute to enhanced learning motivation.

The findings of this study are consistent with previous research that has highlighted the importance of active learning and student-centered approaches in promoting learning motivation (Deci & Ryan, 1985; Pintrich & Schunk, 2002). The results also suggest that the use of information-intelligent

strategies, such as gamification and adaptive learning technologies, can be effective in enhancing learning motivation among students.

Overall, the findings have important implications for enhancing learning motivation in a 5E-flipped learning environment. By providing an engaging and interactive learning environment and using information-intelligent strategies, educators can enhance learning motivation among students and improve the overall quality of the program.

5.2 Implications

The findings of this study have significant implications for enhancing learning motivation in a 5E-flipped learning environment. The study revealed that providing an engaging and interactive learning environment, offering supportive learning materials strategies, and engaging students through the 5E-flipped learning environment can promote learning motivation. In addition, providing emotional support and acknowledging student efforts can also contribute to enhanced learning motivation.

To create an engaging and interactive learning environment, educators can implement strategies such as active learning, collaborative learning, and experiential learning. Supportive learning materials strategies, such as flexible and easy access to course materials and appropriate arrangement of learning materials, can help students access and engage with the course content more effectively. The 5E-flipped learning environment can also be used to deepen student understanding of medical assistant topics through hands-on activities and discussions. Additionally, providing emotional support and acknowledging student efforts can enhance student motivation and self-efficacy.

Overall, the findings of this study suggest that educators can enhance learning motivation in a 5E-flipped learning environment by implementing a combination of engaging instructional strategies, supportive learning materials strategies, and emotional support strategies. By doing so, educators can create a more effective and engaging learning experience for medical assistant students.

5.3 Limitations & Recommendations

Limitations of the current study include the relatively small sample size and the specific context in which the study was conducted. The findings may not generalize to other settings or populations. Additionally, self-reported data from participants may be subject to social desirability bias, which could affect the accuracy of the results.

Future research should focus on replicating this study in larger and more diverse samples, as well as in different educational contexts. It may also be beneficial to incorporate objective measures of learning motivation, such as behavioral observations or physiological measures. Finally, exploring the potential long-term effects of the 5E-flipped learning environment and information-intelligent strategies on students' learning motivation and academic outcomes could provide valuable insights into the sustainability of these approaches.

6 CONCLUSION

This study aimed to investigate the effectiveness of the 5E-flipped learning environment and information-intelligent strategies in enhancing learning motivation among medical assistant students. The study found that the implementation of these strategies can enhance learning motivation among students, with themes and subthemes related to promoting an optimistic interactive and engaging instructional approach and providing constructive emotional strategies for learning.

Contributions to the literature include the identification of effective strategies for enhancing learning motivation in a 5E-flipped learning environment, which can inform future research and implementation of similar strategies in medical assistant education.

Practical implications for educators include the implementation of an engaging and interactive learning environment, offering supportive learning materials strategies, and engaging students through

the 5E-flipped learning environment. Additionally, providing emotional support and acknowledging student efforts can also contribute to enhanced learning motivation. Educators should also consider students' access to technology and their prior experience with technology when designing and implementing these strategies.

Recommendations for future research include the exploration of additional strategies for enhancing learning motivation in a 5E-flipped learning environment, as well as the investigation of the long-term effects of these strategies on students' academic performance and career success.

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Appendix-1: 5E-Flipped Learning Environment Lesson Plan

Lesson Title:	**Introduction to Medical Terminology**
Duration:	2 weeks
Grade Level:	Diploma
Subject:	Medical Assistant Program
Instructor:	Mr Siva
Technology:	Learning Management System (LMS)
	Video Recording Software
	Online Medical Terminology Database
Learning Goals	Students will be able to:
	1. Understand basic medical terms
	2. Identify medical prefixes,
	suffixes and root words
	3. Use medical terminology correctly
Lesson Plan	
Phase 1: Engage	- Students watch a video lecture on
	medical terminology and take a
	pre-assessment quiz.
Phase 2: Explore	- Students read assigned textbook
	chapters and complete online
	medical terminology exercises.
Phase 3: Explain	- Instructor provides feedback on
	student performance and reviews
	key medical terms and concepts.
Phase 4: Elaborate	- Students work in small groups
	to create medical terminology
	flashcards and quiz each other.
Phase 5: Evaluate	- Students take a post-assessment
	quiz to demonstrate mastery of
	medical terminology.
Resources:	- Medical Terminology Textbook

	- Online Medical Terminology Database
	- Video Recording Software
	- Learning Management System (LMS)

Appendix 2: Examples of Learning Diaries and Interview Transcripts

This appendix provides examples of learning diaries and interview transcripts used in the study. The learning diaries were collected on a weekly basis and the interview transcripts were conducted at the end of the study.

Learning Diary Example:

Week 1: This week, we were introduced to the concept of medical terminology. I found it difficult to remember all the new terms and their meanings. However, I tried to review the terms every day and created flashcards to help me remember. I also found the online resources provided by the teacher to be very helpful.

Week 2: This week, we learned about different medical procedures. I found it interesting to learn about the different techniques used in medical procedures. However, I struggled with understanding some of the more complex procedures. I plan to ask my classmates and teacher for clarification during our next class.

Interview Transcript Example:

Interviewer: Can you tell me about your experience with the 5E-flipped learning environment?

Participant: Sure. I found the flipped learning approach to be very engaging. It allowed me to learn at my own pace and review the materials as many times as I needed to fully understand the concepts.

Interviewer: Were there any specific information-intelligent strategies that you found particularly helpful?

Participant: Yes, I really enjoyed the use of gamification in our learning activities. It made learning more fun and motivated me to engage with the materials. I also appreciated the use of adaptive learning technologies, which allowed me to focus on the areas where I needed the most help.

This appendix provides insight into the experiences and perspectives of the participants in the study, as documented in their learning diaries and interview transcripts. These examples can help to further illustrate the themes and subthemes related to learning motivation identified in the study.

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The Evaluation of User Experience (UX) About an Interactive Animated Comic of Pedophile Awareness for Children (i-ComPedo)

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ABSTRACT

The issue of pedophile can be a nightmare for children who fall victim to it. To address this, the researcher developed the i-ComPedo app, a digital comic designed to provide interactive content by utilizing animated comic elements to create awareness among children. However, despite children using i-ComPedo, it is unclear whether the digital comic effectively raises awareness about pedophile among them. Therefore, this study evaluates children's experiences with the i-ComPedo app. To evaluate the children's experience with i-ComPedo, the Attrakdiff questionnaire was used to evaluate four dimensions of user experience (UX): Pragmatic Quality (PQ), Hedonic Quality Identification (HQ-I), Hedonic Quality Stimulation (HQ-S), and Attractiveness (ATT). The results revealed that primary school children users gave a positive evaluation; (ATT) was the highest score, followed by (HQ-I). In addition to this, the researcher also used the Smiley-o-meter scale to determine children's emotions and perceptions using the i-ComPedo app. The result gathered from the analysis of the Smiley-o-meter also shows that most participants gave positive feedback, with the average scoring "Really Good" and "Brilliant". Overall, the results indicated that users were familiar with the technology, understood well, and felt in control while using the product. Thus, users felt motivated and found i-ComPedo useful in raising awareness about pedophiles. Future research directions include expanding the scope of the study, further improving the UX, and incorporating qualitative methods to address the limitations of the Attractive Questionnaire Framework.

KEYWORDS: User Experience (UX), Attractive Questionnaire, Smiley-o-meter, i-ComPedo application, children

1. INTRODUCTION

Pedophile awareness among children requires extensive and raises worldwide attention because the longer people keep silent about this issue, the more widespread it would happen. The pedophile was a sexual preference, sexual excitement, and object to gratification for young children, boys, girls, or both. It also concerns many disciplines, including psychology, psychiatry, and criminology (Moen, 2015). Children need to be aware of pedophiles, which might be harmful to them. Besides, one of the approaches to increase awareness of pedophiles among children in the early stage was by introducing digital comics that spread a specific message using storytelling and interactive multimedia elements.

The digital comic, the i-ComPedo application (Ahmad, S., Mohd Nor, N., & Maesin, A., 2020), was developed to provide interactive content by utilizing animated comic elements to create awareness pedophile threats towards children. The application can be a supportive tool for the children's learning and teaching aid and create awareness. According to previous literature, there was still limited research regarding the awareness of pedophiles by using animated comics in terms of user experience.

Unfortunately, there was scarce research on the animated comic and awareness of pedophiles among children in the Malaysian context. It was crucial to gather information from children's points of view and perception to know their level of awareness of pedophile issues by evaluating the user experience. So that children can be motivated more carefully and learn how to take care of their bodies from strangers, therefore, this research aims to evaluate the user experience (UX) of the i- ComPedo application for children to gather their perception of whether this app can increase awareness about a pedophile or otherwise.

1.1 Research Questions

There were two (2) research questions conducted based on the issues discussed in the above sections of this thesis:

a) What is user experience (UX) of using i-ComPedo application?
b) How can we improve user experience (UX) of i-ComPedo application?

1.2 Research Objectives

The objectives were developed based on the above problem statement to achieve the best possible outcomes. The research objectives were:

a) To evaluate the user experience (UX) of the i-ComPedo application.
b) To suggest user experience (UX) improvement for the i-ComPedo application.

1.3 Research Scope

The research mainly evaluates the UX of children from 9 to 12 years old, Sekolah Kebangsaan Besut, Terengganu. That was because, at this age, children were quickly exploited by cybercriminals because of their age, and the majority heavily relied on networking sites to interact with the public (Quayle, E., 2020). However, recently, children's widespread use of social networking sites and technological tools has significantly reconfigured how they communicate, with whom, and consequences (Abbas, 2019).

2. LITERATURE REVIEW

According to Child-National help's Child Abuse Hotline (2016) and Giulio, P. (2020), child sexual abuse or pedophilia were any inability of parents, other protectors, or public officials to intervene that results in an actual or potential crisis for a child. It can occur in the children's family, our relationships, schools, or the networks in which the child works and encompasses all forms of physical abuse, sexual abuse, emotional abuse, or disregard (Cheah, I. et al., 2016; Ahmad, S., Mohd Nor, N., & Maesin, A., 2020). The i-ComPedo application (Ahmad, S., Mohd Nor, N., & Maesin, A., 2020) was designed as stand-alone courseware using multimedia and animated comics. The application utilizes animated comic elements to increase awareness about pedophile risks to children. The i-ComPedo application was divided into three (3) primary modules, each of which features two distinct situations (Cerita 1 and Cerita 2) with engaging storylines involving a girl and a guy as the victims in the first module.

Research conducted by Othman, A. et al. (2015), a "Multimedia Learning Application to raise children's awareness of child sexual abuse," was built using 2D animation and a multimedia learning application. The report discusses the findings of a pilot study on interactive media applications, cyber-bullying, and how to increase young awareness and perspective. Manaf et al. investigate using "ToonDoo" as a media technology for teaching English short stories. The proposed development of an animated cartoon as interactive multimedia was intended to entice children to learn. A short tale can

significantly boost and develop all four skills: cultural awareness, linguistic awareness, and motivation.

Therefore, the Smiley-o-meter has a long history in "pediatrics" as a subjective indicator of children's medical conditions (Hall, L. et al., 2016). Recently, it has been used to gauge children's preferences for lighter foods, more practical experiences, and interactive products. The measurement methods were designed and verified using facial data collected from children while viewing i- ComPedo apps. "This or That" and "Smiley-o-meter" are useful for assessing the engagement of children with digital media degrees. Huan's (2017) research focuses on this concept of the child's involvement in subjects such as the Manchester Child Attachment Task (MCAST). The findings indicated that facial data analysis, utilizing eye-tracking and face-to-face recognition, might be used to determine children's involvement rates. This research also described several past research on evaluating UX for children.

The Attrakdiff was adapted and chosen for this research because the primary objective was to provide users with a quick, immediate, and effective tool for self-assessment of the usability and design of a collaborative product to evaluate user experience (Schrepp, M. et al., 2017; Hassenzahl, M., 2008). Attrakdiff consists of "28 seven-step items with poles and opposing adjectives" (for example, confusing-clear, unusual-ordinary, good-bad), which were classified into four major categories in the current version: Pragmatic Quality (PQ), Hedonic Quality-identification (HQ-I), Hedonic Quality-stimulation (HQ-S), and Attractiveness (ATT).

3. RESEARCH METHODOLOGY

The Figure 3.1 shows that this research was divided into four (4) phases for the research framework bbased on quantitative research which was planning and preparation, data collection, data analysis, and documentation.

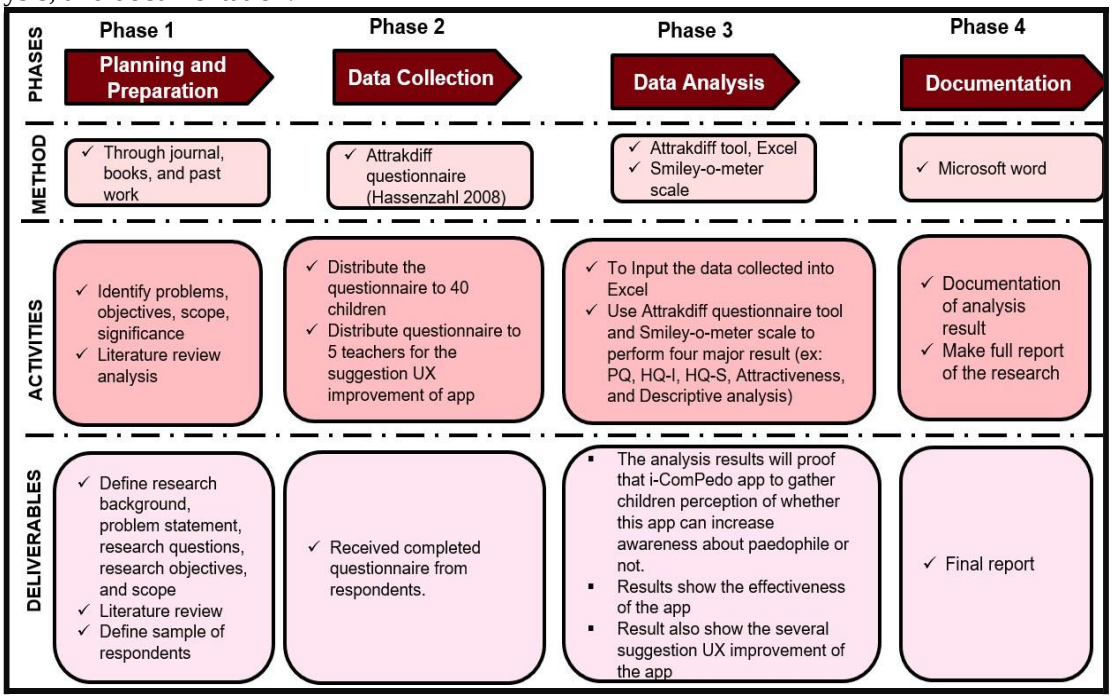


Figure 3.1 Research Framework adapted from Subbarao, A., & Mahrin, M. N. (2020) with Research Framework of Evaluation Model

In addition, the Attrakdiff questionnaire consists of questions that were not easier for children to understand. So that the researcher has translated the English version of Attrakdiff to become a Malay version and revised all of the 28 questions to only ten questions without changing the meaning. That was because the questions would make children more engaged and understandable. The findings would calculate into three groups on the Attrakdiff online platform: Portfolio Presentation, The Average Value, and Description Word-pairs. Researchers would establish whether data was feasible and consistent as a source of information based on these findings (User Experience rating). Besides, the research would use descriptive analysis to present and interpret the numerical data. Descriptive analysis was a procedure used to summarize, organize, graph, and describe the data (Schrepp, 2017). The processed data would have mean value and standard deviation calculations.

4. RESULT AND DISCUSSION

Survey data was collected using an online questionnaire based on the Atttakdiff questionnaire in the Malay language. The participants were from primary school children from 9 to 12 years old, Sekolah Kebangsaan Kuala Besut, Terengganu, who do not have any experience using the i-ComPedo application. The researcher created the online questionnaire by using the Attrakdiff questionnaire. The researcher had face-to-face distributed the revised questionnaire to the participants for gathering more information about the level of user experience of the participants, as shown in Figure 4.1. In total, 40 participants have answered the questionnaire within the data collection period, which was one day. The demographic profile was another robust set of information retrieved from the Attrakdiff questionnaires. The questionnaire gathered the gender and range of ages as shown in Table 4.1.

Table 4.1 Analysis of Demographic Profile

		N= 40	
Demographic Information	**Category**	**Frequency**	**Percent (%)**
Gender	Female	26	65
	Male	14	35
Age of range	9 years old	10	25
	10 years old	10	25
	11 years old	10	25
	12 years old	10	25

4.1 Results of Research Objective 1 (RO1)

The results gathered from the analysis were able to identify the evaluation of user experience (UX) criteria or elements of the i-ComPedo application. Even though all four main groups (PQ, HQ-I, HQ-S, and ATT) in the Attrakdiff scale individually received a positive evaluation, the Attractiveness (ATT) and Hedonic quality identification (HQ-I) received the highest score. Grouping scales follow Pragmatic quality (PQ) and Hedonic quality stimulation (HQ-S), the second-highest. The results indicated that users familiar with the technology understood it well, felt in control, and were motivated, creating awareness about pedophiles while using the i-ComPedo app. These results proved that four main groups (PQ, HQ-I, HQ-S, and ATT) were the criteria or elements of user experience (UX) in the Attrakdiff platform when evaluating the i-ComPedo application shown in Table 4.2.

In addition, the result gathered from the analysis, as shown in Table 4.3 of the smiley-o-meter, revealed that most participants gave positive feedback, which was scored between 4.50 to 5.00 (90%),

from 36 children attracted to and enjoyed the i-ComPedo app, especially "The Stories" part. But, only four females (10%) of the comments expressed negative experiences. Some children stated that they did not like the app and found it boring. Others felt that the drawing comic was not pretty, and some of the features that not state or give the instruction properly. Thus, some suggested that the i- ComPedo app needs enhancements on some points, as some of them suggest that it would be great if more games in the "Quiz" session were added. But, all of them understood that this app's main point was to create an awareness of pedophiles in children. Therefore, all participants were likely to engage and enjoy the i-ComPedo application.

Table 4.2 The results of Attrakdiff scale from 9 to 12 years old

Age, Attrakdiff scale	9 years old				10 years old				11 years old				12 years old			
Result	PQ	HQ-I	HQ-S	ATT	PQ	HQ-I	HQ-S	ATT	PQ	HQ-I	HQ-S	ATT	PQ	HQ-I	HQ-S	ATT
Mean	1.41	1.50	1.74	2.51	1.26	1.33	1.69	2.20	1.56	1.56	1.89	2.53	1.87	1.60	1.81	2.51
Standard Deviation	1.42	0.96	1.15	0.52	0.85	0.81	1.16	0.38	1.06	1.00	1.21	0.28	1.20	1.04	1.17	0.26

Table 4.3 The average number score for smiley-o-meter positive and negative feedbacks gathered after exploring the i-ComPedo app

i-ComPedo app modules	The participants that involved the evaluation of the app							
	9 years old (N = 10)		10 years old (N = 10)		11 years old (N = 10)		12 years old (N = 10)	
	'+'	'-'	'+'	'-'	'+'	'-'	'+'	'-'
The stories (1 and 2)	4.50	0.00	4.70	0.00	4.40	0.05	5.00	0.00
Pedo info	4.45	0.05	4.60	0.05	4.25	0.05	5.00	0.00
Quiz	4.50	0.00	4.60	0.00	4.40	0.00	5.00	0.00

4.2 Result of Research Objectives 2 (RO2)

The findings above revealed that most of the participants were engaged and enjoyed the i-ComPedo app. Most of them found that this app was a new technology that consisted of a combination of multimedia principles and animated comics, the focus to create awareness for children about pedophile issues. They also felt that this app was suitable for children's learning at school. Therefore, the participants found that this i-ComPedo app has a limitation: they cannot access it online.

Furthermore, as mentioned in Chapter One, the i-ComPedo application was the standalone courseware using .exe format and CD-ROM. Therefore, this app was also not distributed to the markets. Thus, it may lead to difficulties for other users to access this app which needs permission from the developer. So, most of the participants suggest the i-ComPedo application to be an online learning platform using internet access. Besides, several participants told the i-ComPedo app needs to create the 'print out' features, which is the resource from that app can be a guideline for teachers and children learning in school.

The participants also suggest that this app be more beneficial if it can be widespread become the application software available to install and run-on mobile devices. This app would make users, especially children, easy to access wherever they go, even at school or home. However, this shows that further improvement and the user interface (UI) needs to be made and considered. Overall, all the participants gave positive feedback. The research objective RO2 was also accepted, mainly to suggest UX improvement of the i-ComPedo application.

5. SUGGESTIONS

The researcher can suggest several improvements to provide a better user experience (UX) for the i-ComPedo application. Firstly, the suggestion for future studies would be to apply the Attrakdiff questionnaire as part of a usability test of the i-ComPedo application. The usability test would be part of a qualitative study. Researchers will ask the users to perform a test task on the i-ComPedo application and record their responses immediately. The researcher will give the Attrakdiff questionnaire after users have finished their usability test to understand the i-ComPedo application quickly. The researcher will conduct face-to-face interviews with users, asking them one by one of the 28 questions from the Attrakdiff questionnaire. Thus, the researcher would not need to revise the Attrakdiff questionnaire to become ten questions. This technique will save time during the data analysis phase, which is the researcher can direct get the findings to result immediately without keying in one by one manually.

After completing the Attrakdiff questionnaire, users can engage in a focus group discussion to further discuss and give opinions on areas to improve. Using qualitative study (usability test and focus group interview), researchers can get better feedback from users on the evaluation UX for an i-ComPedo application and ways to improve it. Other than that, the researcher recommended that this research increase the number of primary school children respondent for future research. In addition, the quantitative study should be better expanded and larger the sample size that involves primary school users, especially children. Finally, it can gather more accurate statistics of descriptive analysis data due to evaluating user experience (UX) for the i-ComPedo application.

6. CONCLUSION

The researcher evaluated the two (2) objectives identified for the study in this chapter. First, there was the evaluation of user experience (UX) and suggestion of UX improvements to the i-ComPedo application. The study has a defined scope research objective summary, and hence the researcher also discovered some limitations in this chapter. The suggestions for improvement for future works were discussed and proposed. To that end, the researcher was able to identify the evaluation of user experience (UX) elements that are suitable for children by using the Attrakdiff questionnaire framework and with the UX improvements to meet the requirements based on RO1 and RO2.

7. CO-AUTHOR CONTRIBUTION

Author1 carried out the field work, prepared the literature review, research methodology, findings and overlook the writeup of the whole article. Author2 gave the knowledge idea, and suggestion from the beginning of the research and interpretation of the results.

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Descriptive Analysis of MyKITS Usage Among Academicians in Kolej Poly-Tech MARA Ipoh for Marks Management

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ABSTRACT

The marks management of student assessments has increasingly leveraged digital tools and systems, transforming traditional educational practices. One of the MARA Strategic Plan 2021-2025 is Thrust 4: Strengthen the Communication and Governance also can be achieved by the Strategic 15 – on utilizing the technology in all service ecosystem, including education. To achieve this aspiration, one innovative system has been created in KPTM Ipoh, MyKITS. This study compares the usage of MyKITS among academicians in Kolej Poly-Tech MARA Ipoh. 56 respondents from the KPTM Ipoh academicians are the sampling of this study on the MyKITS usage for academic semester April 2024. This study is purely quantitative, and descriptive analysis and ANOVA is performed to achieve the research objectives. The findings reveal that the KSA variables have high variability considering the low sampling. The result also shows that there are no statistical differences between groups on the KSA variables. This study contributes to the initial valuable insights into the adoption and impact of digital tools for marks management in higher education, offering implications for KPTM Ipoh and other institutions seeking to enhance their assessment practices through technology integration.

KEYWORDS: Marks management, KPTM Ipoh, technology adoption

1 INTRODUCTION

The use of technology in higher education sector is one of the vital matters in providing the best education quality to the students. In Sustainable Development Goal (SDG) by United Nation (UN) (UN, 2015), SDG 4 is “Quality Education” which is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The quality education here should promote the best and high-quality education to

all which also integrate the education and technology to promote inclusive learning. This will provide the best education for all students.

The integration of education and technology also mentioned by the National IR4.0 Policy, where the "*technology supports the lifestyle while preserving humanistic and societal value, as well as cultural heritage and focusing on the well-being of Rakya*t" (EPU, 2021). In National IR4.0 Policy, education is among the 10 key sectors in attention that supporting the socio-economic needs. In this case, the technology is not only embedded in the education sector but also empower the sector itself to serve society. Arifin Abdu (2023) has reported that in MADANI Framework: Higher Education has outlines four (4) major domains; talent preparation, research and innovation, knowledge transfer, and internationalization of education sector. In all domains, the higher education provider is responsible to ensure that the graduates and the institutions can achieve those and equip the human talent with dynamics and progressive values.

The high-quality education includes the quality of the education management in higher education institutions (HEI)which often driven by technology emergence (Chugh, et al., 2023). The quality of education services has become a systemic point of value, which is always evaluated and refined to provide the high-quality education to the students as the main stakeholders. This consequently become the point of integrity and contribute to positive image of the HEIs by stakeholders (Ali, et al., 2020).

One of the key pipelines the quality education in HEI is students marks management system. Marks management system has gone through a lot of changes over time based on the phases of technology available. Marks management not only ensure the transparency of the assessment marks of the student, but also serve as evidence of documentation for the grading and reporting to the higher management.

Kolej Poly-Tech MARA, the subsidiary of Institusi Pengajian MARA (IPMA) is aware of the importances of marks management system hence Sistem Pengurusan Maklumat Pelajar (SPMP) is used for this purpose. Kolej Poly-Tech MARA have six branches in Malaysia offering diverse programs for SPM leavers to further their studies. One of the MARA Strategic Plan 2021-2025 is Thrust 4: Strengthen the Communication and Governance also can be achieved by the Strategic 15 – on utilizing the technology in all service ecosystem, including education. To achieve this aspiration, one innovative system has been created in KPTM Ipoh

This paper intends to examine the marks management system at Kolej Poly-Tech MARA Ipoh (KPTM Ipoh). Specifically, this study tries to examine the level of knowledge, skills and attitude in adopting My KITS.

2 PROBLEM STATEMENT

Current practice of students marks management system in KPTM Ipoh is the use of Sistem Pengurusan Maklumat Pelajar (SPMP) and Marks Distribution Report 3.0 (MDR 3.0) which a Microsoft Excel documents. At the end of the semester, the academicians have to key-in the marks in both; SPMP and MDR and ensure that the marks are telly. After the key-in process, academicians need to click Grade Process for both SPMP and MDR. The SPMP documents give details of the assessment marks of the students while MDR give details on the marks distribution, grade distribution, achievement of program learning outcome (PLO) and course learning outcome (CLO) based on direct assessment and based on entrance and exit survey. In the case of students in different cohort, or repeaters, the MDR should be prepared separately. This is because the MDR3.0 documents is prepared by the faculty according to the cohort and distributed to the KPTM branches. Both documents need to be checked with second validation and endorsed by Head of Department at respective branch.

This practice although is necessary to ensure the integrity of students' marks management system, but it is a tedious process and a hassle to the academician. These tasks are exposed to human error, typo error, major time consumption and micromanagement issue especially when the staff have several class sections with hundreds of students (Rahim et. al., 2024).

Research Question

1) What are the current levels of knowledge, skills, attitudes, and usage patterns of MyKITS among academicians in KPTM Ipoh,
2) How do these factors vary across different demographic and departmental categories?

Research Objective

1) To examine the level of knowledge, skills, attitudes and usage patterns of MyKITS among academicians in KPTM Ipoh
2) To assess the knowledge, skills, attitudes and usage of MyKITS with different groups (gender, department, education background, and years of teaching).

2 LITERATURE REVIEW

2.1 Students Marks Assessment Management

The 21st century is defined as the era of Information and Communication Technology (ICT). This is because Malaysians, who are navigating life in a globalised era driven by advancements in Science and Technology, are increasingly witnessing the widespread integration of ICT within the education sector in Malaysia. In response to this, the Malaysian government has taken proactive steps in the education sector by leveraging ICT to enhance learning, as outlined in the *Pelan Pembangunan Pendidikan Malaysia (2013-2025).* In this context technological advancements have played a role in the development of Student Assessment Management, leading to a shift from traditional grading methods to modern online systems. This transition has fundamentally altered the way educators document, track, and evaluate student performance information. Previously, assessment management was dependent on time-consuming manual procedures with potential errors, but modern digital tools have improved efficiency and precision. These electronic systems allow for fast data input, automatic calculations, and instant reporting of student grades, enhancing the accuracy of the stored information.

Additionally, integrating technology enables greater accessibility and transparency, offering instant access to assessment data for students, parents, and administrators. Analytics in such systems improve decision-making based on data, helping educators identify patterns and address learning shortcomings more effectively. Thus, the management of student evaluations has not just improved in its efficiency, but it has also aligned more closely with present educational goals, placing emphasis on precision and continuous improvement in student achievements. There are several key aspects that must be carefully considered when evaluating the use of a Mark Management system, including traditional mark entry methods, online mark entry processes, and the overall usage of mark entry systems. Each of these aspects plays a crucial role in ensuring that student assessment management is conducted efficiently, accurately, and in alignment with current educational requirement.

2.2 Traditional mark entry

In the study by Noryana, et al., (2019), it is stated that the use of ICT resources in teaching chemistry presents challenges for today's teachers, and that the development of ICT not only revolutionises life but also brings rapid transformation to the education system in Malaysia. This transformation is particularly evident when comparing traditional methods of entering grades, which require the manual input of student assessment data, usually recorded on paper or in simple spreadsheet programs. This approach has been a well-established tradition in schools and colleges, involving various important stages in the handling of student achievement information. At first, educators enter student scores by hand into grade books or spreadsheets, requiring careful focus on accuracy. Afterwards, grades and averages are computed, typically manually or with simple spreadsheet functions, necessitating a substantial commitment of time and labour. Compiling these grades into a report is the last step, which is usually done by either writing by hand or printing from spreadsheets. Despite being commonly used, this traditional method requires a lot of manual work and is susceptible to mistakes made by people, which can affect how accurate and effective assessment management is.

2.3 Online Mark Entry

Online mark entry systems have transformed the conventional method of keeping track of and controlling student assessment data by converting the complete procedure into digital format. These systems

allow for a smoother, more effective, and less error-prone approach to managing grades. Educators have the ability to enter grades directly into digital systems that are commonly connected to LMS or gradebook software for smooth data handling. Automated computations in these systems minimise the risk of human mistakes by automatically calculating averages, final grades, and other important metrics. Moreover, these systems allow for immediate reporting, granting students, parents, and administrators instant access to grades via secure online portals.

Online mark entry offers important benefits, it enables teachers to spend more time on teaching instead of administrative duties due to improved efficiency and reduces errors in data input thanks to automated processes. Moreover, providing grades and feedback in real-time enhances transparency and engagement among all parties involved. Nevertheless, depending on technology poses specific challenges like potential system downtime or data loss, requiring appropriate management and backup procedures. Educators also need proper training to effectively utilise these systems, which may require extra resources. Lastly, it is crucial to prioritise the protection and confidentiality of student data by implementing strict measures to adhere to applicable regulations and safeguard sensitive information.

2.4 Mark Entry System Usage

Mark entry systems are created to simplify the tasks of recording, managing, and analysing student grades, serving an important function in modern Student Assessment Management. These systems come with interfaces designed for easy use, which frequently have features like drag-and-drop options, templates, and dashboards, to make them convenient and effective for educators. Typically, they are incorporated with current Learning Management Systems (LMS), making it easier to transfer assessment data smoothly and reducing the need for manual data input. Sophisticated mark entry systems also include strong analytics and reporting tools, allowing teachers to track student performance trends, pinpoint areas in need of improvement, and create personalised reports. Moreover, these systems comply with educational standards and regulations, guaranteeing the maintenance of data privacy and security.

The influence of grading systems on education is significant. They improve data management through effective organisation and management of extensive student information, leading to increased accuracy and accessibility of academic records. Teachers gain advantages from being able to offer students thorough and prompt feedback that can be easily accessed and responded to. Additionally, the systems' analytical capabilities aid in making data-informed decisions, enabling educators to adjust teaching strategies and interventions based on insights. This thorough method enhances learning results and also brings educational practices in line with contemporary standards of efficiency and effectiveness.

2.5 DBMS Issues in Student Assessment Management System

Modern education increasingly relies on technological tools to streamline assessment management. Moshinski, et. al., (2021) highlighted the rise of digital technologies is prompting a reevaluation of how information is restricted, allowing authority to implement stricter measures for managing and controlling information. Technologies allow educational institutes to offer educators a flexible and mobile approach to organising and planning educational processes (Moshinski, et. al., 2021), including management tools such as spreadsheets, web browsers, and specialised software to enhance the efficiency and accuracy of managing student assessments while maintaining data security. Understanding these tools is essential for MyKITS to meet the demands of managing student assessments data.

Etemad and Küpçü (2018) emphasised that Database Management Systems (DBMS) are essential for the effective deployment of information systems in order to guarantee the efficient operations of various organisations and businesses. Hence in modern educational settings, Database Management Systems (DbMS) are also essential providing robust solutions for managing student assessment data. Ishaq, et. al., (2023) highlighted the importance of reviving the curricula, tools, and methodologies to cater for recent advancements in the field of database systems. These systems facilitate the organisation, access, and analysis of large datasets, enabling educators to streamline evaluation processes, retrieve data instantly, and make informed decisions

based on accurate records (Picciano, 2012). However, the effective use of DBMS is often hindered by several challenges, which can be addressed by adopting digital tools like MyKITS.

In the matter of student assessment management, which is a part of big data, one of DbMS major problems faced by educators is the responsibility of physically inputting data, where they have to manually transfer data before inputting it into the DbMS. This laborious and time-consuming process takes away valuable time that could be dedicated to instructional planning and management which occurred during the study and analysis of DbMS Microsoft Access by Mironova and Kadyrov (2017). One of their users' marks are low security features and low operation speed (Mironova and Kadyrov, 2017). In certain circumstances, educators may experience frustration and reduced motivation due to the repetitive nature of this task. Furthermore, the manual process of entering data is time-consuming and labour-intensive, reducing educators' productivity and efficiency. Hammerschmidt, et. al., (2004) defined a lengthy process as when it requires a lot of effort and involves inputting the same information multiple times. The problem could be solved with a system that handles hundreds of students, leading to considerable time savings (Hammerschmidt, et. al., 2004). This efficiency could motivate educators to adopt new technologies, as they may perceive them as decreasing their workload rather than increasing it.

A system can significantly decrease the time spent and error rates by utilising automated data processing, eliminating the need for error-prone human involvement (Hammerschmidt, et. al., 2004). But without a proper system, the possibility of mistakes made by humans during manual data input may result in inaccuracies in the DbMS, putting data integrity at risk and diminishing educators' confidence in the system. Typing errors were always present when engaging in tasks that took up a lot of time (Hammerschmidt, et. al., 2024). Errors made when copying, transferring, or inputting data can lead to records that are inaccurate or partial. Another important issue is the security of data when utilising third-party software for input into a database management system (DbMS). Maintaining the integrity of systems is crucial as organisations rely heavily on information for their effectiveness (Kankanhalli, et. al., 2003). External software usage may bring about security threats such as malware, data breaches, or cyber-attacks, putting student data confidentiality and integrity at risk. As MyKITS developed without saving any data, educators may be indulged to incorporate MyKITS without security worries about possible data breaches and information misuse from third parties softwares or tools in managing student assessment data.

In conclusion, a study on DbMS issues is required to determine whether MyKITS addresses the key challenges associated with them, including removing the burden of manual data entry, time-consuming processes, risk of errors, and security concerns. Based on the framework, educators' readiness levels need to be evaluated on digital assessment tools like MyKITS, which claim to improve the efficiency and accuracy of student assessment management.

2.6 KSA Framework

The Knowledge, Skills, and Attitude (KSA) framework serves as a fundamental structure for understanding academicians' engagement with educational technology platforms such as MyKITS at KPTM Ipoh. This framework is grounded in competency theory, which posits that effective performance requires an integration of cognitive understanding, practical abilities, and dispositional factors. As illustrated in Figure 1, these three components interact dynamically to influence technology adoption and usage behavior among faculty members.

Knowledge represents the cognitive understanding academicians possess regarding the MyKITS platform. According to Venkatesh and Bala (2008), technological knowledge encompasses declarative knowledge (knowing what), procedural knowledge (knowing how), and conditional knowledge (knowing when and why). In the context of MyKITS, knowledge includes awareness of system features, understanding of pedagogical applications, and comprehension of institutional policies governing its use.

Skills reflect the practical abilities and competencies academicians have developed for effectively utilizing the MyKITS platform. Tondeur et al. (2021) categorize technology skills into technical skills (operating the system), pedagogical skills (integrating technology into teaching), and management skills

(organizing resources and workflows). As emphasized by Abdul Halim et al., (2023) in their analysis of Malaysian higher education institutions, skills development requires ongoing practice, feedback, and refinement through authentic application in teaching contexts.

Attitude encompasses the affective dispositions, beliefs, and value judgments academicians hold toward the MyKITS platform. The Technology Acceptance Model proposed by Davis identifies perceived usefulness and perceived ease of use as critical determinants of attitude formation. Positive attitudes toward educational technology correlate strongly with increased adoption rates and more innovative implementation strategies (Lai & Bower, 2019). Conversely, negative attitudes often manifest as resistance behaviors that can undermine institutional technology initiatives.

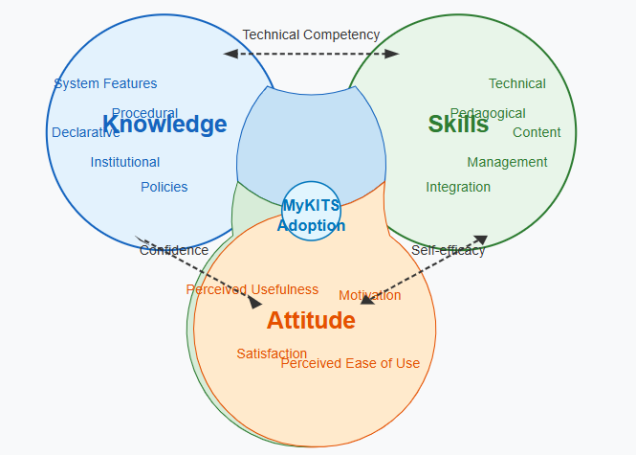


Figure 1: KSA Framework

3. METHODOLGY

3.1 Research Design

This research adopts a quantitative research design over qualitative due to the positivism paradigm and the objective nature of the research. The quantitative research design does not consider the opinion of the researcher, although there is some influence of the researcher in the research question and objective (Hair et al., 2018). The advantage of using quantitative research design over qualitative is that it is more useful in theory testing and has more structured data collection techniques and objective ratings. Furthermore, the concern on the issues of representativeness, reliability, and validity is highly regarded in this research design as it implies objectivity.

3.2 Sampling Design

The sampling elements are selected randomly for probability sampling, and the sampling probability is determined upfront. Probability sampling can ensure representativeness and generalisability (Sekaran & Bougie, 2010). For this study, probability sampling is selected to ensure representativeness and meet parametric analysis requirements (Krejcie & Morgan, 1970). This is because the academicians in KPTM Ipoh are the whole population of this study. In this case, simple random sampling is chosen for sampling design.

Simple random sampling has its own benefits and disadvantages. The advantages of simple random sampling is to ensure its unbiased and equal probability of the population (Noor et al., 2022). Simple random sampling is appropriate for this study because the generalized result can be applied to entire population (Rahman et al., 2022). This method also saves time, cost effective and easily implemented as population is already defined.

3.3 Measurement of the Construct

This study uses a metric measurement scale since the latent constructs in the conceptual model are non-measurable. Thus, the measurement scale will use metric type. In this study, the metric type is interval since the measurement of the constructs cannot register 0 as the degree of agreement. The normal practice for research uses a 5-point scale or a 7-point scale for construct measurement. A 5-point scale was used to increase the response rate and response quality along with reducing respondents' frustration level. The 5-point scale in construct measurement has been used over time in developed and less developing countries (Aslan et al., 2022).

3.4 Research Instruments and Instruments Administration

This study applies the technology KSA framework by Mota & Cilento (2020) and Gilbert et al., (2024) on the Knowledge, Skills and Attitude (KSA). The research instruments as in the following table.

Table 1: Research Instruments

No.	Items	Constructs	Source
1.	I have knowledge of using Microsoft Excel for student assessment mark management.	Knowledge	Adapted from Mota & Cilento (2020) and Gilbert et al., (2024)
2.	I have knowledge of using the Mark Distribution Report (MDR) function for student assessment mark management		
3.	I have knowledge of using web browsers (Google Chrome, Mozilla Firefox, Safari, etc.) for student assessment mark management.		
4.	I have knowledge of using the Student Information Management System (SPMP) for student assessment.		
5.	I have knowledge of using the Kernel Integration Tools for Spreadsheet (MYKITS) for student assessment.		
6.	I have skills in using Microsoft Excel for student assessment mark management.	Skills	Adapted from Mota & Cilento (2020) and Gilbert et al., (2024)
7.	I have skills in using the Mark Distribution Report (MDR) function for student assessment mark management.		
8.	I have skills in using web browsers (Google Chrome, Mozilla Firefox, Safari, etc.) for student assessment mark management.		
9.	I have skills in using the Student Information Management System (SPMP) for student assessment mark management.		
10.	I have skills in using the Kernel Integration Tools for Spreadsheet (MYKITS) for student assessment mark management.		
11.	The use of MyKITS facilitates the entry of marks for student assessment mark management.	Attitude	Adapted from Mota & Cilento (2020) and Gilbert et al., (2024)
12.	The use of MyKITS saves time in entering marks for student assessment mark management		
13.	The use of MyKITS reduces errors in mark entry for lecturers for student assessment mark management		
14.	The use of MyKITS is intimidating in mark entry for student assessment mark management		

15.	The use of MyKITS complicates mark entry for student assessment mark management.		
16	My usage of MyKITS continues to increase for student assessment mark management.	User Adoption	Adapted from: Venkatesh et al., (2003), Gupta & Arora (2020).
17	I use MyKITS more than my other apps for student assessment mark management.		
18	I use the latest version of MyKITS for student assessment mark management.		

The researcher has ensured that the questionnaire design is able to reach potential respondents and achieve a good response rate. First, the items per construct are suggested to have three (3) items and above. This ensures minimum coverage of the construct's theoretical domain (Hair et al., 2010). There are two items that have negative connotation. According to Suarez – Alvarez et al., (2018) the combination of positive items and reverse-coded items might affect the validity and reliability of the instruments. Reverse item such as in item 14 and 15, the researcher will key-in with reverse-coded item.

3.5 Data Analysis Procedure

Descriptive statistical analyses were performed using SPSS version 26.0 to calculate frequencies, percentages, means, and standard deviations for each variable. For categorical variables such as gender, department, educational background, and attendance at MyKITS courses, frequency distributions and percentages were generated to profile the respondent characteristics. For continuous variables like years of teaching experience, measures of central tendency and dispersion were calculated. The frequency of MyKITS usage was measured using a 5-point Likert scale ranging from "Never" to "Very Frequently" and analyzed through frequency counts, percentages, and mean scores.

ANOVA (Analysis of Variance) is a statistical method used to compare means across three or more groups to determine if there are statistically significant differences between them. Its primary purpose is testing **f**or differences**.** ANOVA helps determine whether differences observed between group means are statistically significant or likely due to random chance.

4. RESULTS AND FINDINGS

The descriptive analysis of gender distribution among respondents reveals that out of the total 56 participants in the study, 17 (30.4%) were male while 39 (69.6%) were female. This indicates a notable gender imbalance in the sample, with female academicians constituting more than two-thirds of the participants.

Table 2: Gender distribution

		Frequency	Percent
Valid	Male	17	30.4
	Female	39	69.6
	Total	56	100.0

The descriptive analysis of departmental distribution among respondents shows that out of the total 56 participants in the study, the Department of Multimedia (JMM) had the highest representation with 26 academicians (46.4%), constituting nearly half of all respondents. The Department of Education (JPEN) and Department of Social Science (JSS) showed equal representation with 13 participants each (23.2% per department). The Department of Mathematics and Computer Science (JMSK) had the lowest representation with only 4 participants (7.1%).

Table 3: Academic Department

		Frequency	Percent
Valid	JMM	26	46.4
	JMSK	4	7.1
	JSS	13	23.2
	JPEN	13	23.2
	Total	56	100.0

The descriptive analysis of educational qualifications among the respondents reveals that among the 56 academicians participating in the study, the majority held postgraduate degrees. Specifically, 30 respondents (53.6%) possessed Master's degrees, representing just over half of the sample. Bachelor's degree holders constituted the second largest group with 25 participants (44.6%), while only 1 respondent (1.8%) had attained a PhD qualification. The cumulative percentage shows that 98.2% of respondents held either Bachelor's or Master's degrees.

Table 4: Education background

Education level	Frequency	Percent
Bachelor	25	42.9
Master	30	53.6
PhD	1	1.8
Total	56	100.0

The descriptive analysis of teaching experience among respondents shows that the majority of academicians at KPTM Ipoh are relatively early to mid-career educators. Out of the 56 participants, 34 respondents (60.7%) reported having between 1-10 years of teaching experience, representing nearly two-thirds of the sample. The second largest group consisted of 16 academicians (28.6%) with 11-20 years of experience. Only a small proportion of respondents had extensive teaching careers, with 5 participants (8.9%) having 21-30 years of experience, and just 1 respondent (1.8%) with more than 31 years in the profession.

Table 5: Yeas of teaching experience

Years of teaching		Frequency	Percent
Valid	1-10	34	60.7
	11-20	16	28.6
	21-30	5	8.9
	31 and above	1	1.8
	Total	56	100.0

The descriptive analysis of MyKITS course attendance reveals that nearly two-thirds of the academic staff have participated in formal training. Of the 56 respondents, 36 academicians (64.3%) reported having attended MyKITS courses, while 20 participants (35.7%) indicated they had not received any formal training on the platform. This distribution suggests a substantial level of institutional commitment to professional

development regarding the MyKITS system, with the majority of faculty having received some form of structured instruction. However, the presence of more than a third of respondents who have not attended any MyKITS courses indicates potential gaps in training coverage across the institution. This finding is particularly relevant when considering knowledge, skills, and attitudes toward the platform, as formal training typically serves as a foundational element for developing competency and positive disposition toward educational technology. The relatively high proportion of untrained staff may impact overall system adoption and effective utilization, potentially creating disparities in digital teaching capabilities among KPTM Ipoh academicians.

Table 6: Attend the MyKITS course

		Frequency	Percent
Valid	Yes	36	64.3
	No	20	35.7
	Total	56	100.0

The descriptive analysis of MyKITS usage frequency reveals that the majority of academicians at KPTM Ipoh engage with the platform infrequently. Among the 56 respondents, 40 academicians (71.4%) reported using MyKITS less than 5 times a year, indicating minimal integration of the system into their regular teaching practices. A smaller proportion of 9 respondents (16.1%) demonstrated moderate usage, accessing the platform 6-10 times annually. Notably, 7 participants (12.5%) reported never using the MyKITS system at all, despite its institutional availability. The cumulative data suggests that a significant 83.9% of respondents (combining those who never use the system and those who use it less than 5 times annually) have very limited engagement with MyKITS. This predominance of low usage patterns raises important questions about potential barriers to adoption, including possible issues with user experience, perceived usefulness, technical challenges, inadequate training, or misalignment with marks management needs. This finding is particularly significant for institutional planning, as it indicates that despite the majority of staff having attended MyKITS course, regular implementation remains limited.

Table 7: Frequency of Usage

		Frequency	Percent
Valid	Never	7	12.5
	Less than 5 Times a Year	40	71.4
	6-10 times a year	9	16.1
	Total	56	100.0

The descriptive statistics table 8 provides an analysis of five knowledge-related variables (K01-K05) regarding MyKITS among 56 academicians at KPTM Ipoh. All variables were measured on a 5-point scale, with 1 representing the minimum and 5 representing the maximum value. The results indicate generally high knowledge levels across most measures, with means ranging from 3.91 to 4.73. Specifically, K02 shows the highest mean score (4.73) with the lowest standard deviation (0.522), suggesting strong and consistent knowledge in this particular area. K03 and K04 also demonstrate high mean scores of 4.41 and 4.71 respectively, with relatively low standard deviations (0.804 and 0.530), indicating good knowledge with moderate variability. K01 shows a mean of 4.46 with a standard deviation of 0.830, reflecting good knowledge but with slightly more variation among respondents. K05 received the lowest mean score (3.91) and exhibits the highest standard deviation (1.014), suggesting this knowledge area is less developed and has the greatest variability among participants. This variation is further supported by K05 having the widest range (minimum of 1, maximum of 5), while K02, K03, and K04 had minimums of 3, indicating no respondents rated themselves

very low on these items. The standard errors are relatively small across all measures, ranging from 0.070 to 0.136, which suggests good precision in estimating the population means from this sample.

Table 8: Descriptive Statistics of Knowledge

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
K01	56	1	5	4.46	.111	.830
K02	56	3	5	4.73	.070	.522
K03	56	2	5	4.41	.107	.804
K04	56	3	5	4.71	.071	.530
K05	56	1	5	3.91	.136	1.014
Valid N (listwise)	56					

Table 9 presents the descriptive statistics for five variables, labelled S06 through S10, based on a sample size of 56. For each variable, the table provides the minimum and maximum values, the mean and its standard error, and the standard deviation. All five variables have a sample size of 56, indicating no missing data points. The mean scores range from 3.73 for S10 to 4.52 for S07, suggesting that S07 had the highest average score among the five variables, while S10 had the lowest. The standard deviations, which measure the spread of scores around the mean, range from .603 for S07 to 1.070 for S10. This indicates that the scores for S07 were the most clustered around the mean, while the scores for S10 were the most spread out. The standard errors of the mean, which reflect the precision of the mean estimate, are relatively small across all variables, suggesting that the sample means are likely to be close to the true population means. Overall, the descriptive statistics provide a comprehensive overview of the central tendency and variability of the five variables in the sample.

Table 9: Descriptive Statistics on Skills

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
S06	56	3	5	4.30	.092	.685
S07	56	3	5	4.52	.081	.603
S08	56	2	5	4.29	.107	.803
S09	56	3	5	4.50	.085	.632
S10	56	1	5	3.73	.143	1.070
Valid N (listwise)	56					

Table 10 presents the descriptive statistics for five variables, labelled A11 through A15, based on a sample size of 56. For each variable, the table provides the minimum and maximum values, the mean and its standard error, and the standard deviation. All five variables have a sample size of 56, indicating no missing data points. The mean scores reveal a range of responses across the variables. A11, A12, and A13 show relatively high mean scores, ranging from 4.50 to 4.63, suggesting a tendency towards higher values on whatever scale these variables represent. In contrast, A14 and A15 exhibit significantly lower mean scores, 2.75 and 2.48 respectively, indicating a shift towards lower values. The standard deviations, which measure the spread of scores around the mean, vary considerably. A11, A12, and A13 have relatively low standard

deviations, ranging from .590 to .688, indicating that the scores are clustered closely around their respective means. However, A14 and A15 show much higher standard deviations, 1.505 and 1.549, suggesting a much wider spread of scores and greater variability. The standard errors of the mean are correspondingly higher for A14 and A15, reflecting the greater uncertainty in estimating the population mean for these variables due to the increased variability in the sample. Overall, the descriptive statistics highlight a clear distinction between the first three variables, which show high means and low variability, and the last two variables, which show low means and high variability.

Table 10: Descriptive Statistics on Attitude

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
A11	56	2	5	4.59	.087	.654
A12	56	3	5	4.63	.079	.590
A13	56	3	5	4.50	.092	.688
A14	56	1	5	2.75	.201	1.505
A15	56	1	5	2.48	.207	1.549
Valid N (listwise)	56					

Table 11 presents the results of three separate one-way ANOVAs, examining the differences in Knowledge, Skills, and Attitude across 12 groups (indicated by the 11 degrees of freedom between groups). For Knowledge, the F-statistic is 1.091 with a significance level of .390. This indicates that there is no statistically significant difference in Knowledge scores between groups. Similarly, for Skills, the F-statistic is 1.690 with a significance level of .108, suggesting that there is also no statistically significant difference in Skills scores between the groups, although the p-value is closer to the traditional .05 threshold. Finally, for Attitude, the F-statistic is 1.105 with a significance level of .380, indicating no statistically significant difference in Attitude scores between groups. In all three cases, the p-values are greater than .05, leading to the conclusion that there are no significant differences in Knowledge, Skills, or Attitude across the groups examined. The within-groups mean squares represent the variance within each group, and the between-groups mean squares represent the variance between the groups. The total degrees of freedom are 55, which is consistent with 56 total participants.

Table 11: ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Knowledge	Between Groups	81.458	11	7.405	1.091	.390
	Within Groups	298.524	44	6.785		
	Total	379.982	55			
Skills	Between Groups	126.089	11	11.463	1.690	.108
	Within Groups	298.464	44	6.783		
	Total	424.554	55			
Attitude	Between Groups	130.521	11	11.866	1.105	.380
	Within Groups	472.318	44	10.735		
	Total	602.839	55			

4 CONCLUSION

The significantly higher proportion of female respondents might reflect the actual gender composition of academicians at KPTM Ipoh, or it could suggest differential response rates between genders. This gender distribution should be considered when interpreting other findings related to MyKITS knowledge, skills, attitudes, and usage patterns, as it may influence the generalizability of results to the broader academic population at the institution. For department distribution, it indicates a disproportionate representation across academic units, with a strong predominance of multimedia faculty. The significant variation in departmental participation should be taken into consideration when interpreting findings related to MyKITS knowledge, skills, attitudes, and usage patterns, as different departments may have varying technological requirements, teaching approaches, and engagement levels with digital platforms. The limited representation from the Department of Mathematics and Computer Science (JMSK) is particularly noteworthy given their potential technological expertise. For education background, the result indicates that KPTM Ipoh's academic staff predominantly consists of educators with Master's-level qualifications, with a substantial proportion having Bachelor's degrees, and doctoral-level representation being minimal. This educational profile may influence the knowledge, skills, and attitudes toward MyKITS, as educational background often correlates with technological literacy, pedagogical approaches, and adoption of educational technologies. For distribution in years of teaching experience, the result indicates that KPTM Ipoh's academic workforce is predominantly composed of faculty in the earlier stages of their teaching careers, with 89.3% having 20 years or less of teaching experience. This experience profile may influence MyKITS adoption patterns, as research suggests that teaching experience can affect technology acceptance and integration into educational practices, with early to mid-career educators often showing different attitudes toward educational technology than their more seasoned colleagues. Overall, this ANOVA analysis indicates that there are no statistically significant differences between the groups for any of the three variables tested (Knowledge, Skills, and Attitude).

4.1 Limitation

Among the limitation in this study is low sample size, because there are only 56 respondents, and the short period of time usage of MyKITS, i.e. April session 2024 which only occurred for 7 weeks only. This means the result cannot be generalized for the MyKITS adoption and there is a need for further studies in the usage of MyKITS with larger sample and long semesters. Furthermore, MyKITS is quite a new application that need time for the academicians to be competent with its usage. Given the constraints of the study, such as sample size or time, these findings provide an initial perspective.

4.2. Future Works

Future research on the MyKITS application for marks management in KPTM Ipoh could focus on several key areas to enhance its effectiveness and user satisfaction. Firstly, exploring the integration of advanced features such as predictive analytics could help identify students at risk of academic difficulty, allowing for early intervention strategies. Secondly, investigating the impact of MyKITS on different academician demographics i.e. other KPTM branches, could reveal areas for improvement and customization. Thirdly, assessing the system's security and data privacy measures is crucial to ensure compliance with relevant regulations and maintain user trust. By addressing these areas, future research can contribute to optimizing the MyKITS application and maximizing its benefits for the KPTM Ipoh and other MARA institutions.

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Exploring the Impact of Technology-Enhanced Assessment on Student Engagement

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ABSTRACT

Student engagement is crucial for educational success, yet traditional assessment methods often struggle to effectively capture learners' interest and motivation. Engaging students remains a significant challenge in education due to the limitations of conventional assessment practices. Thus, this study was conducted to examine the impact of technology-enhanced assessment (TEA) on student engagement, addressing the shortcomings of traditional approaches. The research employed a quantitative cross-sectional design, collecting data from 340 students across various departments at Politeknik Sultan Abdul Halim Mu'adzam Shah, Jitra, Kedah, Malaysia. A structured questionnaire using a five-point Likert scale was distributed via Google Forms to gather insights on students' perceptions of assessment tools and awareness in relation to their engagement levels. The results of multiple regression analysis showed that assessment tools (AT) and student awareness (SA) contributed significantly to student engagement (SE), with an R^2 value of 68.7%. Assessment tools had a strong positive influence, while student awareness showed a negative influence on student engagement. The findings highlight the ability of TEA tools, such as gamified quizzes, real-time feedback, and adaptive testing, to foster active participation and improve learning outcomes. Based on these results, the study recommends integrating TEA into regular curriculum practices to enhance engagement and academic performance. Educators should prioritize adopting platforms that offer diverse, interactive, and personalized assessment methods tailored to students' needs. Additionally, institutions should provide training for educators to effectively implement TEA in their teaching strategies. Future research should investigate the long-term effects of TEA on student learning, as well as potential challenges related to its adoption in various educational contexts. This study underscores the transformative potential of technology in redefining assessment practices and meeting the needs of modern learners in an increasingly digital educational landscape.

KEYWORDS: technology enhanced assessment; digital learning; online assessment; student awareness; education technology

1 INTRODUCTION

The integration of technology into education has significantly reshaped conventional assessment methods. Technology-enhanced assessments (TEAs) including gamified quizzes, adaptive platforms, and interactive simulations offer dynamic, responsive learning experiences designed to increase student engagement (Cevikbas & Kaiser, 2022; Yu et al., 2022). These digital tools have attracted attention for their ability to enhance both the efficiency and effectiveness of evaluating student performance. TEAs, such as online quizzes, adaptive learning environments, and gamified assessments, are often praised for delivering instant feedback and fostering active student involvement (Lu & Cutumisu, 2022). However, despite their potential benefits, the empirical support for the effectiveness of TEAs in enhancing student engagement is still developing (Joseph et al., 2024; Nguyen et al., 2024). While traditional assessments have long formed the core of educational evaluation, the emergence of digital tools introduces both new opportunities and challenges. Although previous studies have explored the application of technology in teaching (Bedi, 2023; Fazil et al., 2024), fewer have specifically examined how these tools impact engagement during assessments (Ali & Narayan, 2021; Kuzminykh et al., 2021). Some research indicates that TEAs can increase engagement through interactive features Lu and Cutumisu (2022), but findings remain inconsistent, especially across different educational settings contexts (Aldhafeeri & Alotaibi, 2022; Rivera & Garden, 2021). Additionally, concerns persist regarding the reliability and fairness of online assessments, particularly due to factors such as student distractions and reduced participation (Fazil et al., 2024). There also remains a lack of strong evidence showing that TEAs consistently lead to better learning outcomes compared to traditional methods (Holm, 2024; Mirdad et al., 2024). This ongoing gap in understanding limits the capacity of educators and policymakers to make informed decisions about incorporating technology in assessment. Bridging this gap is essential to ensure TEAs not only promote student engagement but also contribute to fair and effective learning outcomes for diverse learners (Kresin et al., 2025; Su et al., 2024).Thus, this study aims to investigate the impact of TEAs on student engagement and learning, while identifying best practices for their implementation. In the context of a fast-evolving digital landscape, technology plays a vital role in enhancing both teaching and assessment. This study seeks to offer practical insights for educators in designing more effective, technology-integrated assessment strategies that enrich the overall student learning experience.

2 LITERATURE REVIEW

This study based on several relevant major theories. First, the Technology Acceptance Model (TAM) is used to support the assessment tools variable. TAM states that an individual's level of acceptance of technology is influenced by two main factors, namely perceived usefulness and perceived ease of use. Therefore, if students consider technology-enhanced assessment tools to be easy to use and beneficial for their learning, they are more likely to be actively involved in the assessment and learning process. Second, Self-Determination Theory (SDT) is used to support the student awareness variable. SDT emphasizes that a student's intrinsic motivation is influenced by three basic psychological needs, namely autonomy, competence and relatedness. When students have a high awareness of the assessment technology being conducted, they will better understand the role and goals of the assessment, thus fulfilling their psychological needs and increasing their engagement in learning. In addition, this model is also reinforced by Engagement Theory which emphasizes that meaningful learning occurs when students are actively involved through interaction, collaboration and the use of appropriate technology. Interactive and user-friendly assessment technology can create a fun learning environment and encourage student engagement from cognitive, emotional and behavioral aspects.

2.1 Student Engagements

Student engagement has become a key focus in current educational research due to its strong links with academic achievement, motivation, and the overall learning experience. It is generally defined as the level of attention, curiosity, interest, and enthusiasm that students demonstrate during the learning process. Recent studies highlight that engagement should not be limited to observable actions like participation and attendance, but should also include deeper psychological factors, such as internal motivation and emotional connection to the learning material and environment. For example, Bergdahl et al. (2024) pointed out that most empirical studies tend to emphasize behavioral indicators, often neglecting important cognitive and emotional aspects that are vital for meaningful learning. Typically, student engagement is viewed through three main dimensions: behavioral, emotional, and cognitive (Reeve, 2012). However, some scholars suggest adding agentic engagement, which reflects students' active role in influencing their own learning (Reeve & Tseng, 2011). A study by Getenet et al. (2024) that involved 110 undergraduate pre-service teachers found that positive attitudes towards digital tools, higher digital literacy, and greater self-efficacy correlated with increased online learning engagement. The findings indicated that positive student attitudes and digital literacy significantly contributed to self-efficacy, which, in turn, positively affected the engagement dimensions. This suggests that when designing and facilitating online, blended, or technology-enhanced courses in higher education, educators should pay attention to various elements of engagement.

In additional, a systematic review by Jaafaru Aliyu et al. (2022) explored the role of technology and cooperative learning in student engagement. It concluded that tools such as flipped classrooms and massive open online courses (MOOCs) enhance engagement by encouraging student-centered and active learning approaches. Nonetheless, the impact of such technologies greatly depends on how well they are integrated into teaching strategies and how effectively they address student needs. Similarly, Heilporn et al. (2021) investigated teacher practices that boost engagement in blended learning settings. They found that regular feedback, effective use of digital tools, and encouraging group learning can foster engagement, though their success hinges on the context and how well these strategies are executed. Critically, there is a lack of consensus on how best to measure engagement, especially when integrating technology. Many instruments rely heavily on self-reports, which may not accurately reflect students' actual engagement behaviours or attitudes (Kresin et al., 2025). This underscores the need for more mixed-method approaches that combine quantitative metrics with qualitative insights, such as student reflections or observational data, to provide a richer understanding of engagement in various contexts. In sum, while student engagement is widely acknowledged as vital to academic success, its complexity and context-specific nature demand more nuanced investigation. In particular, further research is needed to explore how emerging digital tools and assessment strategies impact the multidimensional facets of engagement across diverse educational settings.

2.2 Assessment Tools

Assessment tools are essential in the teaching and learning process, serving as instruments to evaluate student performance, learning progress, and overall educational outcomes. These tools provide educators with critical insights into student understanding, skill acquisition, and areas for improvement. Commonly used assessment tools include quizzes, cohort-based analysis, and educational games. Quizzes are widely recognized for their ability to measure knowledge retention and provide immediate feedback (Munuyandi et al., 2021). They are particularly effective in promoting active recall and reinforcing learning. Cohort analysis, on the other hand, allows educators to track the progress of specific groups of learners over time, enabling a deeper understanding of trends and patterns in learning (Zhang, 2024). Games, as an emerging tool, integrate engagement and interactivity into the assessment process. Research highlights those gamified assessments enhance motivation and foster critical thinking skills in learners (Johnson & Adams, 2021). The integration of these tools into educational practices aligns with the shift toward formative assessment strategies, which emphasize ongoing feedback and improvement rather than summative judgment alone(Aquino & Chavez, 2022). As the field of education continues to evolve, the development and application of innovative assessment tools remain a central focus of educational research and practice. Also, Ogunleye et al. (2024) revealed that

GenAI tools exhibit subject knowledge, problem-solving, analytical, critical thinking, and presentation skills and thus can limit learning when used unethically. Based on that studied showed that system possesses fine-grained interactive features, subject knowledge, problem-solving, analytical, critical thinking, and presentation skills.

Several studies have highlighted the effectiveness of quizzes as an assessment tool. According to recent findings, Quizizz facilitates the **assessment process** by providing automated grading and instant feedback, which significantly reduces the workload for educators (Niek & Abdul Aziz, 2022). In addition to improving efficiency, lecturers appreciate the platform's ability to provide detailed analytical reports on student performance, allowing them to identify learning gaps and refine their teaching approaches (Zainuddin et al., 2020). Also, Handoko et al., (2021) implemented Quizizz during midterm assessments with 29 Information Systems students at STMIK Royal, and the results confirmed its effectiveness as a gamified assessment platform. It not only simplifies evaluation for educators but also enhances student motivation through its engaging and interactive features. Similarly, Pham (2023) explored the use of Quizizz in improving grammar skills among ESL learners. Although both control and experimental groups showed progress, the group using Quizizz achieved significantly higher scores, underscoring the platform's positive impact on language learning. Overall, the literature supports the use of Quizizz as a supplementary instructional tool, with the caveat that its success depends on appropriate alignment with instructional content and pedagogical goals. Therefore, the hypothesis as follows:

H_1**:** *There is a significant relationship between assessment tools and student engagement.*

2.3 Student Awareness

The COVID-19 pandemic significantly accelerated the adoption of digital online education worldwide. This rapid shift necessitated an examination of students' awareness, attitudes, and adaptability to online learning environments. The awareness of students of AI tools in research has been an issue of great concern among scholars since a variety of tools are available in research. This is because students perceive and utilise the research tools that AI provides is crucial in developing good and quality work that meets global standards. Student awareness involves a cognitive and behavioral readiness to interact with digital platforms, including knowing how and when to use technology for learning. According to Shuhidan et al. (2022)**,** students who are more **aware of the educational potential** of digital tools are more likely to participate actively and take responsibility for their learning. This awareness goes beyond basic technical skills and includes understanding **digital etiquette, online collaboration, and information management.** Similarly, the awareness of AI tools among students is crucial to measuring how well they are prepared to utilise emerging technologies that are impactful in society (Joseph et al., 2024). Hence, study by Kresin et al. (2025) towards students' awareness about social media communication mechanisms showed own experiences and describe additional media communication mechanisms, such as bots, microtargeting, and, particularly, algorithms, which appear specifically relevant in dealing with scientific disinformation on social media. Despite increased access, many students still **lack awareness** of how to use technology meaningfully in education. For example, **a Malaysian study Mawardi et al. (2024)** found that many undergraduates use technology primarily for passive consumption (watching videos or accessing notes), and are unaware of more interactive tools (forums, e-portfolios, collaborative apps) that could enhance engagement. Therefore, the hypothesis as follows:

H_2**:** *There is a significant relationship between student awareness and student engagement.*

2.4 Research Model

This study was developed to examine the influence of technology-enhanced assessment on student engagement. As shown in Figure 1, the model outlines a basic structure where **assessment tools** and **student awareness** serve as independent variables, while **student engagement** functions as the dependent variable.

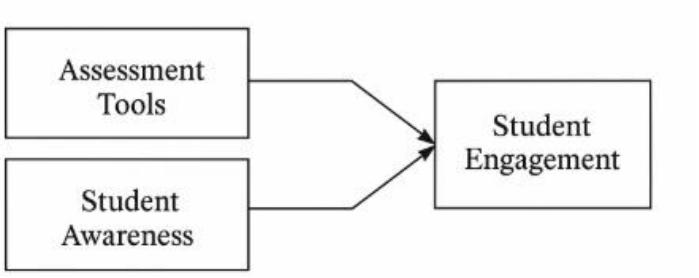


Figure 1: Systematic Diagram of Research Model

This model provides a brief but concise overview of the aspects of technology in assessment and student awareness of its use that can impact the level of student engagement in the learning process. In this model, both independent variables (Assessment Tools and Student Awareness) are connected by arrows towards Student Engagement, reflecting the expectation that both have a direct and significant influence on the level of student engagement.

3. METHODOLOGIES

This study applied a quantitative method with a cross-sectional design to systematically collect data through questionnaires. Data were gathered at a single point in time, requiring respondents to complete a questionnaire distributed by the researchers. This method is suitable for obtaining factual information related to personal and social beliefs, attitudes, and perceptions, allowing the researchers to capture the real situation as it exists (Kerlinger, 1973).

3.1 Sampling and Data Collection

The population for this study was derived from the *Sistem Pengurusan Maklumat Politeknik (SPMP)*, consisting of 3,266 students enrolled at Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS). Based on Krejcie and Morgan (1970) sampling table, a sample of 346 students was selected to represent various academic programmes at POLIMAS. However, only 340 completed responses were obtained and included in the final analysis. The study utilised a simple random sampling method, where questionnaires were distributed exclusively to the selected participants. Participation was voluntary, and informed consent was obtained prior to survey completion. Data were collected through a structured online questionnaire, based on respondents' access and convenience. The data were analysed using IBM SPSS Statistics version 26 to test the hypotheses and validate the study's conceptual model.

3.2 Instrument

In this study, data was collected using questionnaires distributed to the respondents involved. All the questions used have been tested and used in previous studies (Saiful Afzan Baru et al., 2014). It consisted of a structured questionnaire using a 5-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. All the data obtained after the collection process, the validity test using Cronbach's alpha method is done first. This aims to ensure that each item to be tested reflects the characteristics to be measured. Additionally, Hair et al. (2010); and (Sekaran (2003) suggested a Cronbach's Alpha value above 0.6 is considered acceptable and indicates good reliability. Therefore, this section describes the measurement process of variables and constructs involved in the research. The independent variable in this research are assessment tools and student awareness and the dependent variables is student engagement. Table 1 presents a summary of the variable used in this study.

Table 1: Reliability Analysis of Variables

Variables	Item	Cronbach Alpha
Student Engagement	8	0.852
Assessmet Tools	9	0.861
Student Awareness	7	0.840

4 RESULTS

4.1 Descriptive analysis of demographic information

The descriptive statistics of the sample are listed in Table 1. The sum of the respondent of this research is 340 of the respondents involved in the study. It shows the percentage for each respondent's details according to the category placed in the questionnaire. All the data that has been collected is analysed and the results are summarized in a table. The demographic profiles are detailed in Table 1.

Table 1: *Descriptive Statistics of Respondent Characteristics*

Demographic Profile	Frequency	Percentage
Gender		
Male	82	24.1
Female	258	75.9
Race		
Malay	238	70
Chinese	63	18.5
Indian	23	6.8
Others	16	4.8
Department		
Commerce Department	105	30.9
Mechanical Department	64	18.8
Civil engineering Department	49	14.4
Information & Technology Department	80	23.5
Electrical engineering Department	42	12.4
Year of Study		
Sem 1	9	2.6
Sem 2	25	7.4
Sem 3	72	21.2
Sem 4	107	31.5
Sem 5	97	28.5
Sem 6	30	8.8

4.2 Finding

To determine the contribution of assessment tools and student awareness to student engagement, a multiple linear regression analysis was conducted. The Coefficient Table shows that both independent variables make a significant contribution to the dependent variable. The results of the analysis showed that the variable assessment tool (AT) had an unstandardized coefficient of B = 1.228, t value = 15.537 and $p < 0.001$, while the standardized beta was $\beta = 1.046$, indicating a very strong and positive influence on student engagement (SE). This means that every one unit increase in the use of assessment tools will increase student engagement by 1.228 units. On the other hand, the variable student awareness (SA) recorded an unstandardized coefficient of B = -0.570, t value = -8.035, and $p < 0.001$, with a standardized beta $\beta = -0.541$, indicating a significant negative relationship with student engagement. This indicates that the increase in student awareness, in this context, may be related to stress or anxiety about assessment, which can affect their level of engagement. Both variables recorded a VIF value of 2.890 and a tolerance of 0.346, indicating that there was no serious multicollinearity problem in this model.

Table 2: *Results of Hypothesis Test*

Hypothesis	Variables	Coefficient	T-Value	P-Values	Result
H_1	AT > SE	1.046	15.537	0.001**	Accepted
H_2	SA> SE	0.570	-8.035	0.001**	Accepted
Notes: * p<0.05; ** p<0.01					

5 DISCUSSION

The findings of this study reveal that both assessment tools (AT) and student awareness (SA) significantly influence student engagement (SE). The result for assessment tools ($\beta = 1.046$, $p = 0.001$) indicates a strong positive impact, highlighting that well-designed, technology-enhanced assessments can foster greater engagement among students. Similarly, student awareness ($\beta = 0.570$, $p = 0.001$) also shows a significant contribution, suggesting that students who are more conscious of their learning processes are more likely to engage actively. These findings are consistent with prior research. For instance, Balslev et al. (2015) emphasized that assessments integrated with digital tools not only improve academic performance but also boost student motivation and involvement. Likewise, Nicol and Macfarlane-Dick (2006) highlighted that constructive feedback embedded within assessment tools helps students better understand learning expectations, thereby enhancing engagement. In relation to student awareness, Zimmerman (2002) argued that self-regulated learning — which includes goal setting, self-monitoring, and strategic action — is a key driver of engagement. Students with higher awareness of their academic responsibilities tend to exhibit greater persistence and involvement in learning activities. Supporting this, Pintrich (2004) stressed that metacognitive awareness significantly affects how students engage with learning materials, as it allows them to plan, monitor, and evaluate their own understanding. Overall, these results validate the conceptual model, confirming that assessment tools and student awareness are important predictors of student engagement. Institutions such as POLIMAS can benefit from these insights by enhancing digital assessment strategies and cultivating greater awareness among students regarding their roles in the learning process.

6 CONCLUSIONS

The integration of digital literacy into higher education curricula has emerged as a crucial strategy for enhancing student engagement in a rapidly evolving digital world. The findings from the literature review demonstrate that digital literacy positively influences various dimensions of student engagement, including cognitive, emotional, and behavioral engagement. Studies show that digital tools not only improve critical

thinking and problem-solving skills but also enhance collaboration and participation, especially in blended and online learning environments. This reinforces the importance of equipping students with digital literacy skills to ensure they are active, motivated participants in their education. Despite the clear benefits, the review also reveals several gaps in existing research, particularly in the exploration of digital literacy's broader impact on emotional and behavioral engagement. While many studies focus on the cognitive outcomes of digital literacy, such as academic performance, fewer have examined how these skills influence students' overall engagement and motivation. Moreover, much of the research has been limited to specific contexts, such as online learning or technical fields, indicating a need for more comprehensive studies across different disciplines and learning environments

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Exploring Undergraduate Students' Experience Towards Online Assessment

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ABSTRACT

The shift to online classes caused by the COVID-19 pandemic has paved the way for the increased use of online assessments in higher education. This research aims to understand how undergraduate students feel about online assessment, the difficulties they face when undertaking online tests, and the improvements they would like to see in the future. Using semi-structured interviews with six final-year students from a private higher education institution within the age range of 22–25 years, the study explores the students' experience regarding online assessment. Findings showed that students admitted to finding positive aspects of teaching and online assessment such as flexibility, ease, and convenience, but at the same time suffer from problems like instability of internet connection, cases of cheating, and adoption of dishonest practices, including AI aid. It is recommended that future researchers find out the extent to which such forms of assessment enhance student learning outcomes and readiness for the job market after a long-term establishment.

KEYWORDS: *undergraduate students, online assessment, benefits, challenges, improvement*

1 INTRODUCTION

1.1 Background of The Study

At a higher education level, online learning is something that is not unfamiliar to undergraduate students, as it is used for distance learning. Because of the COVID-19 outbreak, higher education providers had to quickly switch to online teaching and learning to maintain the students' involvement and progress. This resulted in several issues, such as worries about academic integrity and expectations of professional accrediting bodies regarding invigilated assessment (Holden et al., 2021). It also had a significant impact on staff workloads and the student experience (Lloyd et al., 2021). Today, online assessments are widely used, especially in higher education. Online assessment is just like any other assessment, where the main objective is to measure a student's understanding and mastery of a particular subject. Most methods of assessment have typically involved in-person interaction, such as final exams at the end of the term or in-class presentations. However, online assessments offer more flexibility as there is no need for face-to-face interaction between the student and the educator. Online assessments are a crucial component of this revolutionary process, illustrating how technology and education are interacting more and more. This research paper will explore the undergraduate students' experiences with online assessment, the difficulties that they faced, and what they hope will improve in the future.

1.2 Problem Statement

The purpose of this research is to learn how undergraduate students view online assessments. It would emphasise their experiences, difficulties, and recommendations for development. This research is being conducted because, ever since the pandemic, there has been an increased use of online assessments. Because online learning is widely used, the use of online assessment is also inevitable. Concerns included the possibility of technical issues during the online exam, the possibility that a project or assignment wouldn't be as useful as an exam in gaining access to students' learning, and the challenge of maintaining academic integrity and preventing plagiarism or cheating during online tests. (Deranek & Parnther, 2015). The undergraduate students' responses to the online assessment are varied. Some of the students agree that online assessment is a good assessment method, while others seem to be thorny as they believe that it still could be improved.

Thus, this study aims to examine students' experiences with online assessment, identify the challenges they encounter, and explore strategies for enhancing its quality.

2 LITERATURE REVIEW

2.1 Online Assessments

Online assessments, which measure students' knowledge, skills, and comprehension of a particular subject, are administered to students via the use of an internet-connected device. The results are recorded and analysed, offering teachers and students insightful feedback. All forms of assessments, whether online or delivered in person at a designated site, have three main purposes in higher education: they improve learning, attain accountability, and offer certification, advancement, and transfer (Archer, 2017). According to Allan (2020), online assessment can be defined as assessments (including non-graded hurdle activities) that are offered online and mediated/facilitated by digital technologies. Thus, online assessments need to be just as rigorous academically as in-person exams, according to Heil & Ifenthaler (2023). They also need to match programme learning objectives, give students worthwhile learning experiences, and set a high bar for students to aim for. More significantly, it needs to be in line with the frameworks for accountability, quality control, and standards established by professional accrediting bodies.

2.2 The Benefits Of Online Assessment

Many benefits come from using online assessment, be it for students or educators, and among them is the flexibility that it offers. These results align with earlier research that demonstrated the ease of use of online tests for instructors and learners, frequently citing their flexibility in terms of time and location (Fitriyah & Jannah, 2021). It permits the direct preservation of data that is accessible from anywhere at any time. This enables instructors to examine student work for any issues that may arise later on or to track changes in students' performance over time (Fitriyah & Jannah, 2021). Moreover, it was discovered that students had more time for revision because they were able to take examinations online instead of having to commute to test centres. Waheeda et al. (2023) also state that online assessment enhances the efficiency of giving out feedback. The majority of lecturers mentioned how simple it was to give immediate feedback while administering exams online.

Simultaneously, a growing body of research has discussed the benefits and possibilities offered by the online evaluation approach. According to research, well-thought-out online tests provide several advantages over more conventional evaluation techniques (Mate & Weidenhofer, 2021). The use of technology in higher education to improve assessments' authenticity, accessibility, security, efficiency, and effectiveness is justified for pedagogical as well as practical grounds.

2.3 Student Perceptions Of Online Assessments

According to Khan and Khan (2019), 41 university science students in the United Arab Emirates' attitudes towards online assessment were found to be shaped by several factors, including personal preferences, technological proficiency, layout, cheating and subject discipline, and, lastly, grading and feedback. Students also expressed resistance to online high-stakes assessments. The study found that although students perceived certain benefits to online exams, such as coloured diagrams, the ability to modify responses, and spell check, they did not seem to appreciate "the usefulness of the transition to online assessments" (Page 673 of Khan & Khan, 2019).

However, undergraduate students believe and are aware that cheating practices are happening during online assessments. In 2019, Baijnath and Singh carried out a study in which they looked at several papers from over 14 different nations about research on academic dishonesty, attitudes towards the issue, and possible remedies. They concluded that academic institutions must play a critical role in tackling the societal issue of cheating and that cheating is a global problem with technology acting as a key facilitator. Academic dishonesty occurs in conventional classrooms as well, but cheating becomes more of a concern when assessments are given online.

3 METHODOLOGY

3.1 Research Design

This chapter focuses on the method by which this research is conducted. In order to explore undergraduate students' experiences towards online assessment, qualitative research design is the chosen research method. It can be applied for collecting detailed information on a specific issue or for developing hypotheses for further investigation. Besides that, all data collection for this research was done through semi-structured interviews. This interview was conducted between the researcher and several respondents who were final-year students at the chosen institution. This research finding was made through thematic analysis.

3.2 Sample Of The Study

In order to have a reliable and accurate finding for this research, several interview sessions were conducted between the researcher and a total of 6 respondents. All respondents that were selected to be interviewed met all the requirements set by the researcher.

The respondent characteristics are as follows:

- Final-year undergraduate students
- Has experience with using online assessment tools
- Undergraduate students of a private higher education institution
- Aged between 22 and 25 years old

Table 1: Biographies of the Respondents

Respondent	Age	Nationality	Gender
A	24	Malaysia	Female
B	24	Ghana	Female
C	23	Thai	Female
D	23	Malaysia	Female

E	23	Malaysia	Male
F	25	Malaysia	Female

3.3 Instruments

Instruments used in this research are semi-structured interviews. It was done according to the respondent's convenience, which led to the interview being conducted in the form of both physical and online interviews. The language used in the interview is also according to the respondent's preference, be it Malay, English, or a combination of both. The questions given to the respondents are all the same set of questions, which cover all research objectives. All respondents are willing to participate in the interview session. They were also selected after a thorough background check. During the interview, they were free to answer based on their own opinion. The interview sessions were recorded and transcribed.

3.4 Themes of Findings

The interview that was conducted has resulted in a few themes, including the prior theme set for the study.

The themes are as follows:

- Theme 1: Students' positive experiences towards online assessment
- Theme 2: Flexibility is the main benefit gained by the students during an online assessment
- Theme 3: The most common challenge faced by students during online assessment is the network connection
- Theme 4: Students' ethical issues are the main concern when using online assessment

4 FINDINGS AND DISCUSSIONS

4.1 Students' Positive Experiences Towards Online Assessment

As a result of the interview, all respondents agreed that the use of online assessment as an assessment method is good and effective. However, two of the respondents assert that it also depends on the students themselves.

Respondent A:

"I think that is the most effective way to give students an assessment."

Respondent B:

"*I think online assessment is good." "I think online is the best way everyone can be in their comfort zone."*

Respondent C:

"*Yes... but sometimes, the lecturers say that it's not an open book, but somehow, when it comes to online assessment, students will just like open book search in Google. So sometimes, you know, it depends on the students mostly."*

Respondent D:

"For me, online assessment is something good"

Respondent E:

"For me, I think online assessments are good for evaluating students' performance in today's world."

Respondent F:

"Online assessment is good."

Students stated that taking frequent online tests encouraged them to study. They were grateful that the mock exam was held because it was a great way to prepare for the online exams. Students made fewer mistakes when filling out bubbles on their answer papers thanks to online assessment (Elzainy et al., 2020). Based on the result of the interview, we could conclude that all of the undergraduate students perceive online assessment as a good and effective assessment method to use. However, it also depends on the students themselves. If the student cheats during the assessment, the assessment objective will not be achieved.

4.2 Flexibility Is the Main Benefit Gained By The Students During An Online Assessment

Four out of six respondents gain the same benefit from using an online assessment, which is the flexibility that it offers. It is flexible as it allows students to assess it and work on it no matter where, when, or however they want to.

Respondent B:
"*..when you are in like maybe a pandemic, for example, COVID, or maybe some of the students is sick, or even the lecturer is busy and needs to conduct assessment." "I think online is the best way everyone can be at their comfort zone."*

Respondent D:

"You can do it everywhere."

Respondent E:

"...make it easier for students who have low thinking skills to answer it." "good for evaluating students' performance in today's world."

Respondent F:

"We do not need to write a lot when we do online assessment. When we make a mistake we can edit it. Since we are not using paper, there is no need to waste paper."

These responses showed that the student understands the benefits or advantages of using online assessment, especially its flexibility. According to Fahid (2021), online assessment could reduce the requirement for paper, making it more environmentally friendly and cost-efficient. Due to the time and resource savings and the automatic data collection and analysis, doing an online evaluation is quite inexpensive. Reducing paper use indirectly lowers energy use. It is applicable. Depending on the instructors, an online test can be done from anywhere at any time. Additionally, it permits a more adaptable learning speed. In addition, the computer can draw randomly from item pools and handle a lot of larger objects than can be written on paper. Online courses and tests may have an impact on students' motivation and attitudes, which might lead to unusual circumstances. Online evaluation is more creative, entertaining and fully satisfies 21st-century standards.

4.3 The Most Common Challenge Faced By Students During Online Assessment Is The Network Connection Problem

As a result of the interview, five out of six respondents shared the same challenges during their online assessment experience. They all have problems with the internet connection.

Respondent A:

"..because of technical issues. When you have the connection error, you cannot access the assessment that is given from your lecturers."

Respondent B:

"*Yes, for example, network problems. Sometimes the network is always like the issue and trying to enter the site and all that."*

Respondent C:

"*Sometimes the internet connection is really slow. those kinds of technical issues."*

Respondent D:

"Yes, I face challenges. One of my challenges is the internet. Because at my place, the internet is very slow. Even my data is slow. When the internet is slow, you cannot do anything. You need to wait until it's working"

Respondent F:

"Yes, because somehow we need to have Wi-Fi; we need to have data to do the online assessment. So mainly, I think that is the problem I'm usually facing."

According to Beleulmi (2022), numerous difficulties were encountered when using online assessments, including poor technical infrastructure development, students' disengagement, cheating and plagiarism on the rise, internet access issues, and a lack of expertise in using online tools. Through the interviews, it can be concluded that the most common challenge that was faced by the undergraduate students was the network connection problem.

4.4 Students' Ethical Issues Is The Main Concern In Using Online Assessment

Five out of six respondents shared their concern regarding the student's ethical issues during the online assessment. This is because cheating and dishonest practices are commonly practiced by undergraduate students during online assessment sessions.

Respondent A:

"...when we call it as online assessment, we can assess Google. And, for example, that when the lecturer give the students online assessment, so of course they can cheat, of course they can use AI and so on. So, I think that is to have a quality online assessment is the lecturer itself should to, what we call it, maybe ask the students to not use AI or not cheat so they can enhance their knowledge. They can gain their knowledge more using their higher order thinking skills."

Respondent B:

"But with the online assessment, students can cheat. Because if they have like two devices and then they use one to search on other apps and AI to do the work and then paraphrase." "So I think maybe lecturers can make

sure that they have like AI detectors to actually check," " try and make the site reliable. Like, once you open the site, you can't leave. You just have to be on it to finish your work. And also if students try to use AI, the teachers should be able to detect."

Respondent C:

"*Sometimes the lecturers say that it's not open book, but somehow when it comes to online assessment, students will just like open book search in Google. "I think online assessment will be good if they can sit together; it's not just like giving them a limited time for them to do something."*

Respondent D:

"The main point is cheating because when you go online, you answer questions, you answer your quiz online, nobody will see it. So, it can make you ask Google for answers or ask your friend or ChatGPT or something." "For example, the lecturer or maybe a teacher needs to come up with a Google Form that cannot be exited.Or you can warn your students not to copy and paste answers from other online sources. If they do that, their marks will be deducted."

Respondent F:

"Sometimes online assessment tools are very difficult to use, like some tools we need to edit, copy-paste, or something like that. So I think we need to change these tools so that we can directly answer without using many tools or editing many tools."

Based on the interview responses, it can be concluded that most students are concerned about the practice of cheating or dishonest behaviour that is happening. However, they also share some interesting ideas, such as coming up with an innovation where the students are not allowed to leave the assessment site until they finish, or their answer will be directly sent the moment they leave the site. Innovations in ICT have made it possible to implement online assessment systems with increased security to thwart fraud and cheating. These online assessment systems employ several strategies, including data analysis techniques, monitoring techniques, authentication techniques, and limitation approaches, to stop and/or identify cheating. Certain online assessment systems, for example, employ recognition techniques such as multimodal biometric systems, which employ facial recognition and keystroke dynamics for continuous authentication; restriction techniques, which disable various features on a user's device to disallow cheating (e.g., copy/paste, block exit from full screen, turn off print-screen function, deactivate right click, prevent additional software from running, disable printing, disable browser control keys, and function keys); and monitoring and surveillance techniques, which allow for both human and machine proctoring (Topuz, Saka, Fatsa, & Kursun, 2022). Students frequently suggested converting the exam from a closed book to an open book format, requiring the use of a locked browser and camera for exam invigilation, and modifying the nature of the exam by adding more difficult and useful questions. It would be wise to give changing assessment techniques careful thought, particularly for professional programmes (Sagoo et al., 2020).

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In conclusion, this research focuses on exploring undergraduate students' experiences towards online assessment. Based on the findings, it could be seen that most of the respondents have a good impression towards online assessment based on their experiences. They seem to think that online assessment is a good and effective assessment tool to be used following the 21st-century standard. This research also focuses on exploring the challenges that undergraduate students face while using online assessments throughout their studies. And it can be seen that most of the students have trouble with the network connection, so it is hard for them to find a place

with a good and strong internet connection. Additionally, there are a lot of dishonest practices being practiced by students, especially since the rise of AI tools. The last focus of this research is to identify how to improve the quality of online assessment. Among the suggestions received, it seems like the respondents are concerned regarding the ethical issues of using online assessment, as there are a lot of unethical practices that were done by undergraduate students, such as cheating and dishonest behaviour.

5.2 Recommendation

Based on the research findings, a recommendation and suggestion for stakeholders is to try to improve the quality of online assessment. Enhance the security to avoid any cheating or dishonest practices being widely practiced among the undergraduate students during their online assessment. By enhancing security, the assessment will be conducted fairly. The educator also needs to be more creative in creating the assessment content. It is recommended that they create a set of questions that combine several types of formats and make a test that requires the students to use their higher-order thinking skills without relying on AI tools.

As for future researchers, it is suggested that they need to extend the study of students' experiences with online assessments to other universities, regions, and disciplines, as well as students with different learning abilities. They should explore the extent to which such forms of assessments enhance student learning outcomes and readiness for the job market after a long-term establishment. Also, the assessment of AI tools as detectors, biometric identification, and proctoring is significant to improving assessment security and minimising cheating in online learning. Such studies will be useful to understand the patterns and set benchmarks that would be useful for successfully adopting online assessments in the context of learning environments.

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Project Assessment Pitching Through Posters: A Visual Storytelling Method.

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ABSTRACT

In the evolving landscape of education and technology era, conventional methods no longer suffice to meet the diverse and dynamic needs of learners as students. This research introduces a groundbreaking innovation in assessment techniques designed for enhanced engagement, real-time feedback and personalized learning. By leveraging cutting-edge technologies such as artificial intelligence, adaptive algorithms and data-driven insights we propose a new assessment model that is both bring flexible and scalable. The pitch poster model integrates smart, interactive platforms capable of continuously evolving based on learner performance, ensuring that assessment is not only accurate but also truly reflective of individual progress. This innovation has the potential to revolutionize how assessments are conceived moving beyond mere evaluation to a tool that drives ongoing learning and development. This research focus on demonstrates **(1)** how this method can enhance assessment effectiveness inclusivity and efficiency. **(2)** The transforming the educational experience for both lecturer and students in class during the semester assessment and **(3)** students' ability to communicate their main message clearly while drawing the viewer's attention and encouraging them to engage with the content in pitch poster. This abstract is designed to highlight the innovation aspect while focusing on the practical application of new methods and design technologies in assessment. Methodology employs qualitative approach (open-ended approach).
Its aims to capture attentions in a pitch poster format, emphasizing both by using concise and impactful style for pitch poster format and based on project-based and experimental learning in real-world problem solving. The findings indicate that using posters in pitching not only simplifies and organizes information but also enhances emotional engagement, creativity and retention. It is a powerful tool for communicating ideas clearly and persuasively in a range of professional and creative contexts.

KEYWORDS: education innovation, pitch poster, education, transformation and innovation, academic posters, research communication, science communication, design thinking, narrative structure, visual literacy, knowledge translation.

1 INTRODUCTION

In perspective of higher education (HE) institution in Malaysia either Public Universities or Private Universities deliver education through various means including traditional face-to-face instruction, online or remote teaching and blended learning approaches. Effective learning in higher education is largely dependent on the choice of appropriate delivery mode. The Face-to-Face (F2F) mode has been traditionally considered as the most reliable one where the content is provided by the instructor in person in regular classes or labs with in person feedback (Gros, Garcia, & Escofet, 2012). This mode is mostly related to the instructor's delivery method and the classroom activities (Boon, 2010).

The increasing emphasis on online learning outcomes in higher education, blended learning has the potential to create the best setting for improving engagement among students, resulting in better performance (Alducin-Ochoa & Vázquez-Martínez, 2016). Daily social engagement with students and peers is crucial in learning and teaching environments in management education (Truss & Anderson, 2023). In both online or blended learning, undergraduate business students face a considerable barrier to work on group projects (Fang, Pechenkina, & Rayner, 2023; Conrad et al., 2022).

For many students, the transition to higher education (HE) is a difficult hurdle (Gale and Parker Citation2014; Harvey, Drew, and Smith Citation 2006). They must learn how to deal with the new learning environment, build new relationships with peers and faculty and grow into their new role as (HE) students (Wilson et al. Citation 2014). Higher education, also known as tertiary or post-secondary education, refers to formal educational institutions and programs that follow secondary school. This includes universities, colleges and polytechnics offering degrees and certifications beyond high school. Higher education is crucial for developing advanced knowledge, critical thinking, and specialized skills, preparing individuals for careers and contributing to societal advancement.

1.1 Tools use in class to deliver the knowledge to students.

In classrooms, various tools are used to deliver knowledge effectively, including technology and traditional methods. Technology tools include interactive whiteboards, online platforms like Zoom and Edmodo, video platforms like YouTube and Edpuzzle and gamification tools like Kahoot!. Meanwhile, traditional methods include physical textbooks, lectures and group discussions. Nowadays, technology play the important roles in delivery lectures in class. Here the more details breakdown of traditional and interactive technology methods such as interactive whiteboards:

This method can be used for presentations, collaborative activities and engaging students with digital content. Others tools involves with technology such as tools like Pear Deck, Nearpod, and Animoto can be used for interactive presentations, real-time feedback, learning management system (LMS) and multimedia learning experiences.

Traditional methods that common always use in lecture or in classroom such as textbook, works book, module, lecture presentation, group presentation, activities in class, hand-on class practical tasks and visual aids. Both methods are relatively common use in higher education and any lecture in classroom. The question lecturer should ask to measure the effectiveness of tools in delivery knowledge are:

1. What tools should teachers have to keep discipline in the classroom?
2. What are some effective ways of teaching in the classroom?
3. What are some innovative teaching tools to help teachers in a classroom?

Besides as higher students, the use of student peer evaluation was effective in enhancing student learning. It enabled reflexive learning (Kolb, 1984; Knowles, 1990, Schön, 1987) to be part of the educational experience. Debriefing of pitches occurred in the following week and provided further learning for the students.

1.2 Pitch Poster Presentation (POP)

A Pitch Poster Presentation (POP) is a way that is done to share or inform are data and information in oral communication. In education, poster presentation is always used for the research seminar and the

conference. For example, the English-speaking students, they use a poster presentation as a project to learn English and how they can use English as the academic speaker. The poster itself could become the cross-disciplinary anchor for multiliteracies pedagogy. This method can help make multi-literacy works visible, increasing students' awareness of their everyday engagement in multimodal communication in class or presentation on pitch poster. In Malaysia government school especially target to use smart-board from psychical black board to digital platform. This shown academic presentation in delivery information or knowledge to student begin the evolution.

2 LITERATURE REVIEW.

Part pitching, visual storytelling and dialogue the scientific research poster session is like no other academic performance. A popular genre in science, technology, engineering, and mathematics (STEM) fields, in international conference. Picth Poster Presentation (POP) also dramatically improve oral communication skills (Boggu, 2015; Swara & Sriwinarti, 2024; Tarigan & Listyani, 2021), which are an essential component of English competence. Students develop their articulation, pronunciation, and public speaking skills by preparing and giving presentations. Regular experience presenting ideas to peers and teachers builds confidence and lessens the fear associated with speaking in English. Furthermore, this approach encourages cooperation and teamwork (Barrett et al., 2022; Tarigan & Listyani, 2021).

Additionally, a larger audience can view digital posters because they are simple to share online. Digital presentations have the benefit of accessing a variety of audiences, which increases the effect of student work, according to Tarigan and Listyani (2021). Students' linguistic proficiency is also greatly improved by digital poster presentations. The emergence of multiliteracy centers and scholarly interest in oral, visual, and multi-modal literacies in higher education (Sheppard, 2009; Sheridan & Inman, 2010; Balester, Grimm, Grutsch McKinney, Lee, Sheridan, & Silver, 2012; Lee & Carpenter, 2014), writing and multiliteracy centers have a rare opportunity to not only introduce writing center pedagogy but also reframe multimodal discussions with faculty and students through the genre of the research poster.

2.1 Visual and Oral (Story Telling) Literacies in Pitch Poster Presentation (POP)

In communication studies and memory research, it is well established that developing and presenting information in the form of a story, rather than in an expository form, enhances memory recall and comprehension (Cahill & McGaugh, 1995; Glonek & King, 2014). Storytelling of the presentation is rhetorically important because stories improve comprehension and recollection by leveraging people's semantic memory process. Hence, students find that developing a data story that is relating the meaning of various results or discoveries. While data stories are important, we also teach students techniques in modulating stories and word choice for different audience types, categorized primarily (for the sake of simplicity) by level of expertise. For newly formed, the researcher recommends the following ways in which the scientific research poster may be presented through workshops or consultations with faculty and students:

• Facilitate a discussion of research poster sessions (poster and pitch) in light of the New London Groups (Í996/20Í4) theory of multimodal design: This may involve, for instance, asking students to conduct mock research pitches with each other and asking them to discuss how their partners apply linguistic, visual, gestural, spatial, and/or auditory design in their research poster session. Students might also watch video recordings of dynamic research presentations and discuss how strategies they've seen may be effectively applied. From the research outcome below the details:

• Recommend that students take time to study and be creative with a range of layout styles of actual posters in their field: for instance, students might be provided with samples of a variety of
layout styles (both conventional layouts and nonconventional visualizations). Students should be encouraged to explore different layout styles, no matter how unlikely they are to

apply them, to their own data set or data on full report.

• Ask students to craft framing or filtering questions to better identify audiences and then modulate the research pitch appropriately: Students could practice asking audience questions to determine their level of knowledge or interest on the subject, then develop a concise "pitch" for three likely types - general, field, and expert audiences.

2.2 Core Principles of Visual Storytelling in Pitch Posters.

Visual storytelling in posters is a powerful tool to communicate a message quickly and effectively through design. The core principles of visual storytelling in posters revolve around using visual elements to convey a narrative or emotion without the need for words or lengthy explanations. (R. Owen & J. Roberts, 2024) suggest a design study of developing a visualization poster. Using a case-study approach they proposes three important aspects: the poster should have a clear focus (especially a hero visualization), envisioning its use helps to drive the important aspects and third the essence (its fundamental concept and guiding idea) must be clear. In the research they use case studies that have focused on the use of the Five Design-Sheet method (FdS) as a way to sketch and plan a visualization, before successfully implementing and creating the visual poster. The case studies serve as a practical illustration of the workflow, offering a means to explain the three key processes involved: (1) comprehending the data, (2) employing a design study with the FdS (Five Design-Sheet), (3) crafting, evaluating and refining the visualization.

By following some researcher suggest few principles of pitch poster visual story telling. Below the list of principle can be use:

1. **Simplicity**- less is more. A poster should be visually striking, but not overloaded with information. The simplicity of design allows the viewer to focus on the essential message. The use of minimal text, clean visuals, and strategic negative space can make the poster more impactful.

2. **Composition**- balance and harmony. Good composition organizes elements in a way that leads the viewer's eye through the poster. Proper balance (whether symmetrical or asymmetrical) creates visual interest while maintaining a sense of order.

3. **Color**- emotional impact. Color has a powerful effect on emotions and mood. The color palette should align with the theme or message being conveyed. For example, warm colors can evoke energy or urgency, while cool colors can suggest calmness or professionalism.

4. **Imagery**- symbolism and metaphor. Using imagery that symbolizes or metaphorically represents the theme or concept of the poster adds depth to the story.

5. **Hierarchy**- Visual weight. Arrange elements in a way that leads the viewer through the poster, from the most important to the least important. This hierarchy is achieved through size, placement, and emphasis on key elements like the headline, visuals, or call to action.

A students can create a poster that does more than just advertise but it tells a compelling story that resonates with viewers or audients and makes an emotional connection. Whether for event, cause, or product, academic project via visual storytelling through posters can be incredibly effective at conveying a message quickly and powerfully.

3 RESEARCH QUESTIONS.

1. How can this method enhance the effectiveness, inclusivity, and efficiency of assessment?
2. How can project-based assessment transform the educational experience for students in the classroom?

3. How can students communicate their main message clearly while drawing the viewer's attention and encouraging engagement through storytelling in a pitch poster?

4 RESEARCH METHODOLOGY

This research was conducted in three stages: (1) an exploration involving the qualitative data collection from participants (2) determining relevant literature through the application of inclusion and exclusion criteria at the levels of title or abstract and full text, and (3) preparing a thematic analysis of qualitative findings. The study commenced with preliminary investigations aimed at discerning the influence of student's behavior towards the academic presentation and assessment. It adopted an exploratory qualitative approach, complemented by limited quantitative data gathered through in-depth interviews with 10 students from various academic disciplines at Universiti Sultan Azlan Shah (USAS) who actively engaged with academic presentation, report assessment in their daily routines and other activities as a higher education students.

Researchers conducted a thematic analysis of qualitative data within the studies according to (Braun,V.,& Clarke, V., 2006) Thematic analysis primarily depends on utilizing text to combine the most significant patterns from various studies in a manner that remains rooted in the data. Researcher undertook thematic analysis within the following steps or phases according to (Jones, 2022):

1. Recognizing and listing the data
2. Search for patterns or themes in the codes
3. Defining and naming themes
4. Review themes
5. Reporting

The secondary data and information were gathered from various scholars, researchers, existing research reports, e-books, and publicly available articles on digital marketing. The study's limitation is its focus on Universiti Sultan Azlan Shah (USAS) students. However, these target population was considered ideal for the research due to their status as a young generation immersed in higher education and new technology. As students pursuing higher education, they demonstrate a higher level of understanding and engagement with academic presentation compared to other populations. Nonetheless, students have limited expert on fields.

5 FINDINGS

5.1 Summary of the respondent's gender and age.

Students	Gender	Age
A	F	21
B	M	22
C	M	21
D	F	21
E	F	22
F	M	21
G	F	21
H	F	22
I	M	22
J	M	26

M: Male F: Female

5.2 About Pitch Poster Presentation.

The use of pitch poster the idea is a great way to have an attractive and professional presentation. However, there are some key details you should include in order to make the most impact for your audience.

1. **Visual Summary**: A poster that effectively conveys the main points of a research project, project idea, or a business plan in a visually engaging and easily digestible format.

2. **Concise Oral Pitch**: A short, impactful presentation that summarizes the poster's main content and draws the audience in to discuss the project further.

3. **Interaction**: The presenter uses the pitch as a springboard to engage in conversation with the audience, answer questions, and provide additional details as needed.

4. **Attracting attention**: Pitch posters are designed to grab the attention of passersby and encourage them to engage with the presenter and the research.

5. **Communicating information**: They provide a visual summary of the research or idea, making it easier for the audience to grasp the key findings or concepts.

6. **Facilitating discussion**: The oral pitch and interactive element encourage discussion and feedback, fostering a more in-depth understanding of the project.

5.3 Experienced Presenting Pitch Poster Ideas Visually.

According to the interview, respondents were asked to specify whether they had previously created a Pitch Poster or experienced it. Based on the results, 85% of respondents no experiences or create Pitch Poster for presentation, while 15% had experience or create Pitch Poster for presentation. Therefore, this shown the young generation respondents, who are students, start to use new method in delivery academic presentation.

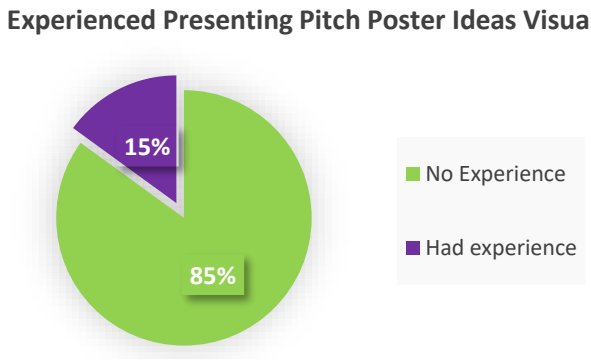


Figure 5.3: Experience Presenting Pitch Poster Ideas Visually.

5.4 Degree of Confident Presenting Pitch Poster Method.

According to the interview, respondents were asked:
QUESTIONS: How confident are you in presenting final report ideas visually use Pitch Poster Presentation?

Based on the results, 60% of respondents Confident, 30% of respondents Neutral and 10% of respondents Very Confident. Meanwhile another degree of confident 0%. Therefore, the young students in first degree not feel fear to use new method of Pitch Poster in delivery their academic presentation.

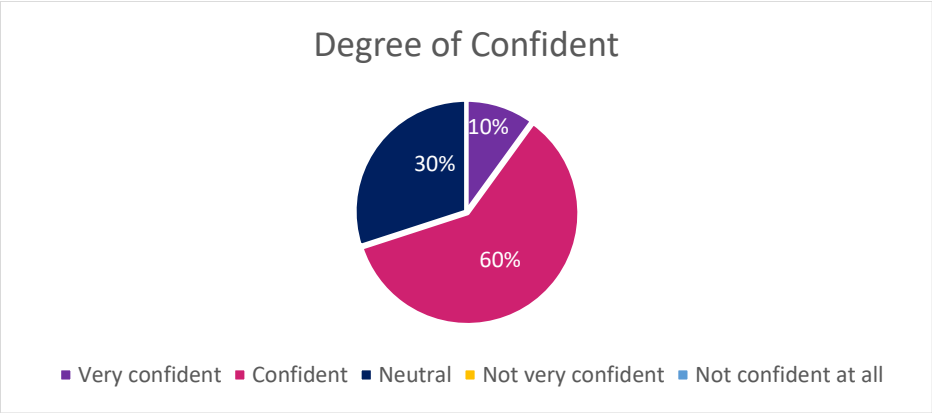


Figure 5.4: Degree of Confident Presenting Pitch Poster Method.

5.5 The Useful of Session on Visual Storytelling and Pitch Posters.

According to the interview, respondents were asked:
QUESTIONS: How useful you find the session on visual storytelling and pitch posters?

Based on the results, 21% of respondents extremely feel useful on visual storytelling and pitch posters. Meanwhile 43% of respondents feel very useful and 36% feel moderately useful. Therefore, the method of pitch poster presentation can be implementation to students in assessment academic project or academic presentation.

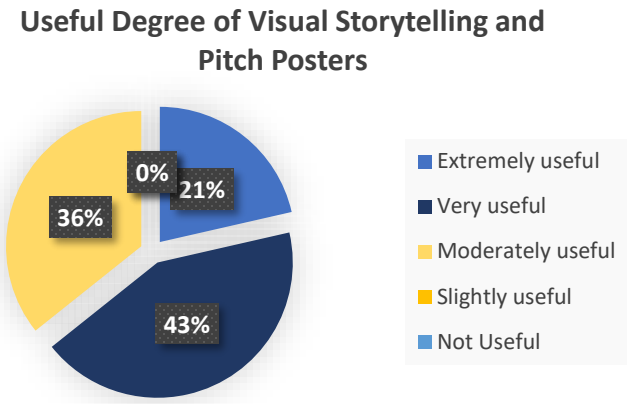


Figure 5.5 Useful degree of visual storytelling and Pitch Posters.

5.6 Pitch Poster Effective in Presentation.

According to the interview, respondents were asked:
QUESTIONS: What do you think makes an assessment pitch poster effective in presentation?

Based on the results shown almost of respondents shared the positive answer such as per below:
C: This method presentation more cheerful and fun in delivery information.

E: More concise and easier to understand because only the important points are given.
J: Very good because delivering information in visual form is better and helps with focus.
A: I think this would be a good idea and new experience for me to makes an assessment pitch poster using my creativity level.

6 FINDINGS

Across the past experiences, the students developed their confidence in their oral communication abilities and skills. The students were supportive and critically constructive as self and peer evaluators. Many took the opportunity to receive individual feedback from the lecturer regarding lecturer feedback. Importantly, they understood the need for passion in their pitches and how best to effect this. Based on the interview results, the significant of method Pitch Posters can be used in academic presentation especially toward students in IPTA/IPTS (Higher education). Furthermore, it can be evaluated in final report of project assessment. Students responded their confidents and feel this method majority mentioned very useful. This method also enhance the degree of students confident to delivery their presentation.

Through a new approach 'Pitch Poster' assessment, students studying student groups present their pitch through a combination of video (visual), oral and poster presentations and supplementary information of final project. Results shown it can attract students to use this method in future. Over three-quarters of employers suggested that improving graduate employability skills should be a key priority for universities (CitationCBI/UUK, 2009), while CitationLowden et al. (2011) found that some employers are frustrated that courses do not meet their needs. CitationKemp et al. (2008) identify a mismatch between student perceptions of acquired skills and employer expectations regarding skills such as time management, working under pressure, problem solving and the delivery of professional presentations. Its helps students to enhance their skill presentation and design interactive poster to attract audience more focus during the presentation. Perspective for lecturer this method can useful for students project assessments or presentation of academic purpose. The innovation of pitch poster helpful towards learning process to students directly.

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Dual Language Program (DLP) dalam Dasar Pendidikan Malaysia: Implikasi dan Cabaran

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ABSTRAK

Dual Language Program (DLP) merupakan salah satu inisiatif dalam Dasar Pendidikan Malaysia yang bertujuan meningkatkan penguasaan bahasa Inggeris dalam kalangan pelajar dengan pengajaran mata pelajaran Sains dan Matematik dalam Bahasa Inggeris. Walau bagaimanapun, pelaksanaan program ini menghadapi pelbagai cabaran termasuk kesediaan guru, penerimaan pelajar dan ibu bapa, serta ketersediaan sokongan sumber pembelajaran yang mencukupi. Pendekatan kajian ini menggunakan kaedah kajian kes dengan pengumpulan data melalui temu bual mendalam, analisis dokumen, dan pemerhatian. Dapatan kajian ini dijangka dapat memberikan gagasan yang lebih mendalam mengenai keberkesanan DLP serta membantu pembuat dasar dalam menggubal polisi yang lebih holistik dan berkesan. Kajian ini diharapkan dapat menjadi rujukan utama dalam menambah baik dasar pendidikan bahasa dan program dwi-bahasa dalam konteks globalisasi dan transformasi pendidikan.

KEYWORDS: *Dual Language Program (DLP)*, Dasar Pendidikan, Cabaran Pelaksanaan, Penilaian Pembelajaran, Kajian Kes

1 PENDAHULUAN

Dual Language Program (DLP) merupakan satu inisiatif di bawah Dasar Memartabatkan Bahasa Malaysia dan Memperkukuh Bahasa Inggeris (MBMMBI) yang memberi pilihan kepada sekolah kerajaan dan sekolah bantuan kerajaan untuk melaksanakan pengajaran dan pembelajaran (PdP) mata pelajaran Sains dan Matematik dalam bahasa Inggeris (Kementerian Pendidikan Malaysia, 2018). Program ini bertujuan untuk meningkatkan penguasaan bahasa Inggeris dalam kalangan pelajar, memberi akses kepada ilmu dalam bidang sains dan teknologi secara lebih meluas, serta meningkatkan kebolehpasaran murid dalam alam pekerjaan.

Walau bagaimanapun, pelaksanaan DLP menghadapi pelbagai cabaran, termasuk kesediaan guru dalam mengajar subjek teknikal dalam bahasa Inggeris, penerimaan pelajar dan ibu bapa, serta keberkesanan pedagogi yang digunakan (Rodriguez, 2024). Kajian menunjukkan bahawa keberkesanan program dwi-bahasa seperti DLP sangat bergantung kepada kualiti latihan guru, perancangan jangka panjang di peringkat sekolah, dan kesediaan sumber pembelajaran (Sharma & Sharma, 2023). Tambahan pula, penyertaan sekolah dalam DLP tertakluk kepada kriteria yang ketat, seperti ketersediaan guru yang berkelayakan, pencapaian akademik dalam

Bahasa Melayu yang memenuhi syarat, dan permohonan bertulis daripada sekurang-kurangnya 15 ibu bapa atau penjaga sebelum kelas boleh dibuka (Kementerian Pendidikan Malaysia, 2018).

Di peringkat antarabangsa, kajian mendapati bahawa pelajar yang mengikuti sistem pembelajaran dua bahasa memperoleh kelebihan dalam aspek kognitif dan akademik, terutama dalam subjek matematik dan sains (Park et al., 2023). Oleh itu, kajian ini menggunakan pendekatan kajian kes untuk menilai keberkesanan pelaksanaan DLP, mengkaji cabaran yang dihadapi oleh guru serta pelajar, dan mencadangkan langkah-langkah penambahbaikan bagi memastikan keberhasilan program ini dalam konteks pendidikan global (Moran et al., 2024).

2 SOROTAN LITERATUR

2.1 Dasar Pendidikan dan Latar Belakang DLP

Dual Language Program (DLP) di Malaysia berkait rapat dengan dasar pendidikan terdahulu, khususnya Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris (PPSMI). Mesyuarat Jemaah Menteri pada 8 Julai 2009 telah memansuhkan pelaksanaan Dasar Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris (PPSMI) di sekolah-sekolah, iaitu Tahun 1 hingga Tingkatan 5, dan digantikan dengan Dasar Memartabatkan Bahasa Melayu dan Memperkukuh Bahasa Inggeris MBMMBI. Jemaah Menteri juga memutuskan bahawa Dasar MBMMBI dilaksanakan secara berperingkat-peringkat mulai tahun 2010. Matlamat melahirkan masyarakat yang berupaya menguasai bahasa Malaysia (BM) dan bahasa Inggeris (BI) dengan baik adalah antara fokus dalam sistem pendidikan negara. (Kementerian Pendidikan Malaysia, 2014).

2.2 Cabaran Pelaksanaan di Peringkat Sekolah

Pelaksanaan dasar pendidikan di Malaysia menghadapi cabaran utama dalam memastikan keberkesanan reformasi yang dirancang. Pelan Pembangunan Pendidikan Malaysia (2013-2025) bertujuan untuk meningkatkan kedudukan sistem pendidikan negara di peringkat antarabangsa, namun jurang pelaksanaan di peringkat sekolah sering menjadi halangan utama (Bush et al., 2019). Pendekatan berpusat yang terlalu menekankan hierarki menyebabkan maklumat dasar sering disalahtafasir apabila disampaikan dari peringkat kementerian ke sekolah, mengakibatkan tafsiran yang berbeza dan kelemahan dalam pemahaman serta pelaksanaan dasar.

2.3 Kesediaan Guru dan Sokongan Institusi

Kurangnya penglibatan guru dan pemimpin sekolah dalam proses pembuatan keputusan turut menjejaskan keberkesanan reformasi. Kajian mengenai pelaksanaan *Dual Language Program (DLP)* di Malaysia sebelum ini telah menyoroti pelbagai aspek, termasuk persepsi guru, cabaran institusi, serta akses pelajar terhadap program ini. Bullah dan Yunus (2018) mendapati bahawa kejayaan DLP bergantung kepada kemahiran bahasa guru serta sokongan pentadbiran. Suliman et al. (2019) pula menekankan pentingnya kesinambungan program melalui kajian terhadap faktor institusi yang mempengaruhi pelaksanaannya. Sementara itu, Gomez dan Cisneros (2020) membincangkan cabaran ketidaksamaan akses ke program dwibahasa dalam kalangan pelajar, yang sering dipengaruhi oleh faktor sosioekonomi. Selain itu, Hatheway et al. (2015) pula menyatukan konsep pendidikan dwibahasa dengan model kolaborasi integrasi, mencadangkan pendekatan yang lebih inklusif dalam pedagogi. Manakala, Sierra-Padilla (2020) mengkaji dasar pendidikan di peringkat daerah dalam konteks pembelajaran dwibahasa dan menegaskan peranan penting dasar dalam membentuk keberkesanan pelaksanaan program.

Kesimpulannya, DLP ini terus menjadi kajian yang relevan dan semasa dalam bidang pendidikan. Adakah seseorang murid tersebut memerlukan DLP dalam kehidupan mereka atau tidak terus menjadi persoalan dan kajian para sarjana.Malah, pada masa akan datang, kemahiran berbahasa lebih daripada satu ini terus menjadi kelebihan dan peluang kepada mereka yang memiliki kemahiran ini.

3 METODOLOGI KAJIAN

Kajian ini menggunakan pendekatan kualitatif dengan reka bentuk kajian kes, seperti yang dicadangkan oleh (K.Yin, 2018), Sebuah kajian kes membolehkan penyelidik menyelidiki fenomena secara mendalam dalam persekitaran sebenar. Yin 2018, menekankan bahawa kajian kes sesuai digunakan apabila penyelidik ingin memahami suatu fenomena dalam konteks dunia sebenar, terutamanya apabila sempadan antara fenomena dan konteksnya tidak jelas. Kajian ini bersifat eksploratori untuk memahami isu yang dikaji dengan lebih terperinci. Sampel kajian dipilih secara bertujuan bagi memastikan subjek yang terlibat mempunyai pengalaman dan pengetahuan yang relevan dengan kajian. Peserta terdiri daripada guru, pensyarah akademik, dan pegawai pendidikan daerah.

Kajian ini menggunakan pelbagai kaedah pengumpulan data bagi mendapatkan maklumat yang komprehensif. Kaedah utama yang digunakan ialah temu bual separa berstruktur, yang dilakukan dengan peserta utama untuk memahami pengalaman dan pandangan mereka berkaitan dengan fenomena yang dikaji. Temu bual merupakan sumber data penting dalam kajian kes kerana membolehkan penyelidik mendapatkan maklumat terperinci daripada perspektif peserta. Selain itu, pemerhatian secara langsung juga dijalankan melalui borang pemerhatian bagi mengumpulkan data secara kontekstual, selari dengan pandangan Stake (1995) yang menyatakan bahawa pemerhatian dalam kajian kes membolehkan penyelidik memahami situasi secara lebih holistik. Di samping itu, analisis dokumen turut digunakan dengan meneliti dokumen berkaitan seperti surat pekeliling ikhtisas dan dokumen rasmi kerajaan bagi menyokong dapatan kajian. Menurut Merriam (2009), dokumen rasmi boleh berfungsi sebagai sumber sekunder yang menyokong dan mengesahkan dapatan daripada temu bual dan pemerhatian. Oleh itu, objektif kajian ini adalah untuk meneliti pelaksanaan Dual Language Program (DLP), mengenal pasti cabaran yang dihadapi oleh guru serta pelajar, dan mencadangkan langkah-langkah penambahbaikan bagi memastikan kejayaan pelaksanaan program ini.

4 DAPATAN

4.1 Temu Bual

Hasil dapatan menunjukkan bahawa pendekatan pengajaran yang digunakan melibatkan penggunaan bahasa Inggeris pada permulaan sesi pengajaran, diikuti dengan peralihan kepada bahasa Melayu, dan kadangkala mencampurkan kedua-dua bahasa. Hasil daripada dapatan temu bual tersebut, terdapat tiga tema yang berjaya diteroka iaitu, Strategi Pengajaran oleh Guru; Kompetensi dan Cabaran Guru; dan Sokongan dan Latihan.

4.2 Strategi Pengajaran oleh Guru

Strategi ini digunakan bagi memastikan pemahaman yang lebih mendalam dalam kalangan pelajar, terutamanya apabila konsep yang diterangkan dalam bahasa Inggeris memerlukan penjelasan tambahan dalam bahasa Melayu. Hal ini dinyatakan seperti penyataan berikut:

> *RA0113002: Saya mengajar mula-mula dalam Bahasa Inggeris, selepas itu, Bahasa Melayu dan kadang-kadang campur*
>
> *RA0113004: "Saya dapati pelajar lebih berminat apabila saya mengajar dalam kedua-dua bahasa kerana mereka boleh bertanya dalam bahasa Melayu jika mereka tidak faham, tetapi saya tetap galakkan mereka menjawab dalam bahasa Inggeris."*
>
> *RA0113005: "Apabila saya gunakan kedua-dua bahasa dalam kelas, pelajar kelihatan lebih yakin untuk bertanya soalan kerana mereka tidak takut salah guna bahasa Inggeris."*

Selain itu, penggunaan kedua-dua bahasa dalam sesi pengajaran juga dilihat sebagai satu bentuk pedagogi dwibahasa yang membantu pelajar menyesuaikan diri dengan istilah akademik dalam bahasa Inggeris sambil mengekalkan kefahaman yang kukuh dalam bahasa ibunda mereka. Dapatan ini turut menunjukkan bahawa pendekatan campuran ini memberi fleksibiliti kepada tenaga pengajar untuk menyesuaikan kaedah penyampaian mengikut tahap pemahaman dan keperluan pelajar.

Walaupun begitu, penulisan buku rekod pengajaran, ditulis dalam Bahasa Inggeris. Hal ini dinyatakan seperti berikut:

RA0113002:Saya tulis RPH semua dalam Bahasa Inggeris mengikut DSKP yang ditetapkan

RA0113003: "Saya mengambil masa yang lebih lama untuk menulis RPH dalam bahasa Inggeris kerana saya perlu memastikan penggunaan tatabahasa dan istilah yang betul mengikut kehendak kurikulum."

RA0113004: "Walaupun saya menulis RPH dalam bahasa Inggeris, saya masih menerangkan kandungan kepada pelajar dalam kedua-dua bahasa supaya mereka lebih faham."

RA0113005: "Kadang-kadang saya perlu merujuk kepada contoh RPH dari rakan sekerja kerana menulis dalam bahasa Inggeris bukan sesuatu yang mudah bagi saya."

4.3 Kompetensi dan Cabaran Guru

Daripada konteks pensyarah akademik, DLP ini sangat penting untuk melahirkan palajar yang mahir dalam kedua-dua bahasa. Ini dinyatakan seperti kenyataan berikut:

EA0113002: Betul, terdapat kelebihan orang yang belajar dalam satu bahasa berbanding dua bahasa. Ini akan memberikan manfaat yang lebih kepada mereka yang mempunyai kemahiran dua bahasa.

EA0113003: "Pelajar yang mengikuti DLP cenderung lebih yakin menggunakan bahasa Inggeris dalam perbincangan akademik, yang memberi kelebihan kepada mereka dalam pembelajaran di peringkat lebih tinggi."

EA0113004: "Penguasaan dwibahasa dalam DLP bukan sahaja membantu pelajar memahami konsep dalam Sains dan Matematik tetapi juga meningkatkan kebolehan mereka dalam menyusun pemikiran secara analitik dan kritikal."

EA0113005: "Dalam dunia pekerjaan, majikan lebih cenderung mengambil graduan yang mampu berkomunikasi dalam lebih daripada satu bahasa, dan DLP memberi kelebihan kepada pelajar dalam aspek ini."

4.4 Sokongan dan Latihan

Selain itu, kemahiran ini perlu dimulakan oleh guru tersebut. Dalam erti kata yang sama, guru perlu lebih mahir penggunaan kedua-dua bahasa ini sebelum mengajar kepada murid. Disamping itu, latihan dan kemahiran perlu ditingkatkan dari semasa ke semasa. Hal ini dinyatakan seperti penyataan-penyataan berikut:

IA0113004: "Latihan bukan sahaja perlu memberi tumpuan kepada kemahiran bahasa Inggeris, tetapi juga strategi pedagogi yang sesuai untuk membantu pelajar memahami konsep dalam kedua-dua bahasa."

EA0113002: Guru perlu mempunyai kompetensi yang tinggi dalam penggunaan Bahasa Inggeris

IA0113002: Latihan demi latihan perlu dipertingkatkan dari semasa ke semasa untuk meningkatkan kemahiran dan kompetensi guru

IA0113003: "Saya rasa latihan khusus dalam pengajaran dwibahasa perlu diberikan lebih kerap kerana bukan semua guru selesa mengajar dalam bahasa Inggeris, terutama bagi subjek teknikal seperti Sains dan Matematik."

4.5 Analisis Dokumen

Kajian ini menganalisis dua dokumen utama yang menjadi asas kepada pelaksanaan Dual Language Program (DLP) di Malaysia, iaitu Garis Panduan Pelaksanaan DLP dan Dasar Memartabatkan Bahasa Melayu dan Memperkukuh Bahasa Inggeris (MBMMBI). Kedua-dua dokumen ini memberikan landasan dasar serta garis panduan yang jelas mengenai bagaimana program DLP dilaksanakan dalam sistem pendidikan negara. Walaupun MBMMBI dan DLP berkongsi matlamat untuk meningkatkan penguasaan bahasa Inggeris, pendekatan mereka berbeza. MBMMBI menekankan pembangunan penguasaan dwibahasa secara menyeluruh dalam pendidikan, sementara DLP lebih bersifat pilihan khusus untuk sekolah-sekolah tertentu yang memenuhi syarat kelayakan dan memberi tumpuan kepada subjek Sains dan Matematik. Secara keseluruhannya, perbandingan antara kedua-dua dasar ini menunjukkan bahawa MBMMBI bertindak sebagai dasar induk yang memastikan pengukuhan Bahasa Melayu dan Bahasa Inggeris dalam sistem pendidikan, manakala DLP adalah salah satu inisiatif di bawah MBMMBI yang memberi fleksibiliti kepada sekolah untuk meningkatkan penggunaan bahasa Inggeris dalam subjek teknikal. Pelaksanaan kedua-dua dasar ini perlu dilakukan dengan seimbang agar Bahasa Melayu terus dimartabatkan, sambil memastikan pelajar Malaysia mempunyai kemahiran bahasa Inggeris yang baik untuk menghadapi cabaran global.

4.5 Pemerhatian

Pemerhatian telah dilaksanakan melalui borang senarai semak. Hasil pemerhatian terhadap pelaksanaan *Dual Language Programme (DLP)* dalam sesi pengajaran dan pembelajaran (PdP) mendapati bahawa penggunaan bahasa dalam pengajaran adalah bersifat fleksibel. Kebanyakan guru memulakan sesi PdP dalam bahasa Inggeris, sejajar dengan objektif DLP, tetapi terdapat juga guru yang beralih kepada bahasa Melayu apabila pelajar menghadapi kesukaran memahami konsep yang diajar. Selain itu, bahan pengajaran seperti buku teks dan slaid pembelajaran kebanyakannya dalam bahasa Inggeris, tetapi beberapa guru menyediakan nota tambahan dalam bahasa Melayu untuk membantu pemahaman pelajar.

Dari segi kaedah dan strategi pengajaran, guru menggunakan pendekatan pembelajaran aktif seperti perbincangan berkumpulan, kajian kes, dan eksperimen bagi menggalakkan pelajar berinteraksi dalam bahasa Inggeris. Namun, didapati bahawa hanya sebilangan pelajar yang benar-benar berani menggunakan bahasa Inggeris dalam perbincangan, sementara yang lain lebih selesa bertanya dalam bahasa Melayu. Guru memainkan peranan penting dalam menggalakkan penggunaan istilah teknikal dalam bahasa Inggeris, namun sebilangan pelajar masih bergantung kepada terjemahan dalam bahasa Melayu untuk memahami konsep yang lebih kompleks.

Dari segi kecekapan guru dalam mengendalikan DLP, majoriti guru menunjukkan keyakinan dalam penggunaan bahasa Inggeris, tetapi ada segelintir yang masih kurang lancar dalam penyampaian secara penuh

dalam bahasa Inggeris. Guru yang berpengalaman lebih mudah mengadaptasi kaedah dwibahasa dan mampu menerangkan konsep dengan lebih jelas, manakala guru yang kurang fasih dalam bahasa Inggeris cenderung untuk kembali kepada bahasa Melayu apabila menghadapi kesukaran menjelaskan sesuatu konsep. Pemerhatian juga mendapati bahawa guru yang menggunakan bahan digital seperti video atau simulasi dalam bahasa Inggeris dapat meningkatkan pemahaman pelajar dengan lebih berkesan.

Dari segi penglibatan dan respons pelajar, didapati bahawa pelajar yang mempunyai penguasaan asas yang baik dalam bahasa Inggeris lebih berani untuk bertanya dan menjawab soalan, manakala pelajar yang kurang mahir kelihatan kurang yakin dan lebih pasif dalam kelas. Walaupun pelajar memahami kandungan yang diajar, masih terdapat kesukaran dalam membentuk ayat dan menyampaikan jawapan dalam bahasa Inggeris. Bagaimanapun, kehadiran latihan berbentuk kuiz dan aktiviti berstruktur dalam bahasa Inggeris membantu meningkatkan kemahiran komunikasi mereka sedikit demi sedikit.

Beberapa cabaran utama turut dikenal pasti dalam pemerhatian ini. Antara cabaran utama ialah kesukaran guru untuk mengekalkan penggunaan bahasa Inggeris sepenuhnya sepanjang sesi PdP, disebabkan oleh perbezaan tahap kefasihan pelajar. Selain itu, pelajar yang lemah dalam bahasa Inggeris kurang berkeyakinan untuk bertutur dan menjawab soalan dalam bahasa tersebut, menyebabkan guru perlu memberi lebih banyak penjelasan dalam bahasa Melayu. Selain itu, kekurangan bahan sokongan tambahan dalam bahasa Inggeris turut menjadi cabaran, terutama bagi sekolah luar bandar yang mungkin mempunyai akses terhad kepada bahan pengajaran digital.

Secara keseluruhannya, pelaksanaan DLP di sekolah yang diperhatikan menunjukkan kesan positif dalam meningkatkan penguasaan bahasa Inggeris dalam kalangan pelajar, tetapi masih memerlukan sokongan tambahan dalam bentuk latihan guru, penyediaan bahan pengajaran yang lebih interaktif, dan pendekatan pengajaran yang lebih adaptif. Guru perlu diberikan latihan berkala dalam pedagogi dwibahasa, manakala pelajar memerlukan lebih banyak latihan bertutur dan menulis dalam bahasa Inggeris untuk meningkatkan keyakinan mereka. Bagi memastikan keberkesanan DLP, pemantauan secara berkala perlu dilakukan bagi mengenal pasti cabaran yang dihadapi serta menyesuaikan strategi pengajaran bagi meningkatkan kefahaman pelajar.

5 PERBINCANGAN DAN KESIMPULAN

Terdapat implikasi praktikal yang boleh dimanfaatkan oleh pihak sekolah, pembuat dasar, dan institusi latihan guru dalam meningkatkan keberkesanan pelaksanaan Dual Language Programme (DLP). Pertama, dari segi latihan guru, dapatan menunjukkan bahawa guru memerlukan sokongan berterusan dalam aspek penguasaan bahasa Inggeris dan pedagogi dwibahasa. Oleh itu, program pembangunan profesional berasaskan amalan sebenar perlu dirangka, termasuk latihan berbentuk simulasi pengajaran, kolaborasi antara guru berpengalaman, dan akses kepada bahan bantu mengajar dwibahasa.

Kedua, penyediaan sumber pembelajaran perlu lebih inklusif dan mesra pelajar. Buku teks, nota ringkas, dan bahan digital yang tersedia dalam kedua-dua bahasa dapat membantu pelajar memahami konsep teknikal dengan lebih baik tanpa mengabaikan penggunaan bahasa Inggeris sebagai medium utama. Ketiga, pihak sekolah perlu memainkan peranan lebih aktif dalam memantau pelaksanaan DLP dengan menyediakan bimbingan berterusan kepada guru serta memastikan penglibatan ibu bapa dalam menyokong penggunaan dwibahasa di rumah.

Akhir sekali, pada penilaian tahap dasar, Kementerian Pendidikan perlu mempertimbangkan pembangunan satu instrumen penilaian diagnostik bagi mengenal pasti tahap penguasaan bahasa pelajar sebelum mereka menyertai DLP. Ini membolehkan intervensi awal dirancang dengan lebih berkesan dan memastikan pelajar tidak tercicir dalam aspek pemahaman akademik. Secara keseluruhannya, pelaksanaan DLP yang lebih bersasar dan disokong oleh pelbagai pihak mampu meningkatkan keupayaan pelajar Malaysia untuk bersaing di peringkat global.

Kesimpulannya, pelaksanaan *Dual Language Programme (DLP)* di Malaysia menunjukkan potensi besar dalam meningkatkan penguasaan bahasa Inggeris dalam kalangan pelajar, terutamanya dalam bidang Sains dan Matematik. Program ini bukan sahaja memberikan akses kepada sumber pembelajaran global, tetapi juga meningkatkan kemahiran komunikasi dalam bahasa Inggeris serta daya saing pelajar dalam dunia pekerjaan. Walau bagaimanapun, keberkesanan program ini masih bergantung kepada beberapa faktor utama, antaranya kompetensi guru, penerimaan pelajar dan ibu bapa, serta ketersediaan sumber pembelajaran yang mencukupi.

Dari aspek pengajaran, dapatan kajian menunjukkan bahawa guru menggunakan pendekatan dwibahasa di mana sesi pengajaran dimulakan dalam bahasa Inggeris, diikuti dengan penjelasan dalam bahasa Melayu bagi memastikan pemahaman yang lebih mendalam. Walaupun strategi ini membantu pelajar memahami konsep dengan lebih baik, cabaran utama yang dikenal pasti adalah kesukaran guru dalam menyediakan Rancangan Pengajaran Harian (RPH) dalam bahasa Inggeris sepenuhnya, yang memerlukan mereka memiliki penguasaan bahasa Inggeris yang tinggi. Oleh itu, latihan berkala dan sokongan profesional perlu diberikan kepada guru bagi meningkatkan keyakinan mereka dalam melaksanakan DLP dengan lebih berkesan.

Selain itu, pemerhatian terhadap pelajar menunjukkan bahawa respon terhadap DLP bergantung kepada tahap penguasaan bahasa Inggeris mereka. Pelajar yang memiliki asas yang kukuh dalam bahasa Inggeris lebih berani bertutur dan bertanya soalan dalam bahasa tersebut, manakala pelajar yang lemah cenderung menggunakan bahasa Melayu atau mengelakkan komunikasi dalam bahasa Inggeris. Keadaan ini menunjukkan bahawa strategi pengajaran yang lebih fleksibel diperlukan untuk memastikan semua pelajar mendapat manfaat daripada program ini.

Dari sudut dasar pendidikan, analisis terhadap Dasar MBMMBI dan Garis Panduan Pelaksanaan DLP menunjukkan bahawa walaupun DLP merupakan sebahagian daripada usaha untuk memperkukuh penguasaan bahasa Inggeris, ia perlu dilaksanakan secara seimbang agar tidak menjejaskan peranan Bahasa Melayu sebagai bahasa kebangsaan. Oleh itu, pemantauan yang lebih ketat serta penyesuaian dasar yang lebih fleksibel perlu dilakukan bagi memastikan matlamat DLP dan MBMMBI dapat dicapai secara serentak tanpa menimbulkan konflik dalam sistem pendidikan.

Selain itu, kajian ini menyatakan beberapa langkah penting bagi meningkatkan keberkesanan DLP. Antaranya, latihan berterusan kepada guru perlu diberikan bagi meningkatkan kemahiran pedagogi dan kefasihan mereka dalam bahasa Inggeris. Selain itu, penyediaan bahan pengajaran yang lebih mesra pelajar, termasuk nota dwibahasa, dapat membantu pelajar memahami konsep dalam kedua-dua bahasa dengan lebih baik. Pemantauan berkala terhadap pelaksanaan DLP juga diperlukan untuk mengenal pasti cabaran dan menyesuaikan strategi pengajaran mengikut keperluan pelajar. Tambahan pula, peningkatan kesedaran dalam kalangan ibu bapa dan komuniti mengenai kepentingan dwibahasa dalam pendidikan amat penting untuk memastikan sokongan berterusan terhadap program ini.Sebagai langkah sokongan, satu alat ukur untuk kemasukan pelajar sebelum memulakan sesi pembelajaran secara DLP ini perlu dibangunkan.Dengan pelaksanaan yang lebih strategik dan sokongan menyeluruh daripada pelbagai pihak, DLP berpotensi menjadi program yang berkesan dalam membentuk pelajar yang lebih kompetitif dan bersedia menghadapi cabaran global.

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TVET Lecturer Competency Assessment Utilizing Fuzzy Logic Mamdani Approach

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ABSTRACT

This paper investigates the impact of years of teaching and industrial experience on the competency assessment of Technical and Vocational Education and Training (TVET) lecturers by utilizing the artificial intelligence of Fuzzy Logic Mamdani (FLM) approach in conjunction with the Ability Map competency assessment framework. Although competency assessments are widely applied, there is a noticeable gap in methodologies that usually without other parameters like the years of working experience parameter, which become an important element for conducting effective training needs analysis (TNA). Given the critical role experienced TVET lecturers play in instructional delivery and program development, assessing their competencies and abilities with years of working experience is vital. To bridge this gap, this study integrates the Ability Map competency assessment with the FLM model to assess the competencies of TVET lecturers. The findings show that Ability Map-FLM effectively identified the influence of year of working experiences on competency levels and facilitated rule-based classification using linguistic variables. This enabled the transformation of subjective, qualitative inputs into structured and quantifiable insights that improving TVET lecturer's competency assessment, utilizing the artificial intelligence of FLM approach.

KEYWORDS: TVET; Fuzzy Logic; CUDBAS; training need analysis; Ability Map

1 INTRODUCTION

In Malaysia, the goal of Technical and Vocational Education and Training (TVET) is to develop skilled workers in specific industries through TVET institutions from secondary school to higher education levels. TVET is an occupationally focused education and training process that emphasizes industrial practices. TVET institutions were guided by established employment criteria, emphasizing psychomotor skills, practical features, and exposure to industry training (Yasak & Alias, 2015). It is necessary to assess lecturers' job skills, competency and function (Wilk & Sackett, 1996).

Enhancing lecturers' abilities and expertise can improve the calibre of TVET institution graduates. (Syamil & Bassah, 2022). Lecturer competency was found to be significantly strengthened by continuous TNA (Kim et al., 2019). The TNA techniques for assessing Lecturers' ability competency include competency

mapping, focus groups, interviews, questionnaires, and vocational ability frameworks (Abba & Rashid, 2020; Kim et al., 2019; Wan Ngah et al., 2021; Zinn et al., 2019). The essential competencies was required by TVET teachers in Nigeria to ensure the successful implementation of inclusive education, emphasizing the need for specific skills in managing diverse learning environments and adapting instructional processes to meet the needs of all students (Abba & Rashid, 2020). The further training needs for TVET trainers in Rwanda by assessing their instructional competencies through a national survey revealing an areas where teaching skills are lacking and pilot training programs have shown positive impacts on improving trainer behaviours (Kim et al., 2019). The Curriculum Development Based on Ability Structure (CUDBAS) method was found as an effective tool for TVET instructor's training needs analysis by performing a systematically profile instructors and reduce competency gaps by aligning training with specific vocational abilities required for their work (Wan Ngah et al., 2021). A significant training needs of TVET teachers in South Africa, particularly highlighting how existing qualifications and the educational system's structure often fall short of preparing lecturers for modern pedagogical and technical demands, thereby necessitating further profession-oriented training (Zinn et al., 2019). One of the TNA techniques used to evaluate competency is competency mapping. Competency mapping refers to the process of determining the key skills and knowledge that trainees must gain as a result of undergoing the training program (Harraf et al., 2019). Three separate focus groups or individuals were interviewed using this method, and the data was gathered via video recording (Abba & Rashid, 2020). The 5-point Likert scale was utilized in the survey approach to assess "attitude" in a scientifically recognized and validated manner (Joshi et al., 2015). The focus group technique was based on specific input sets and areas of expertise (Zinn et al., 2019). Four competency profiles are used in the vocational ability structure technique: (i) assessing competency needs; (ii) determining competency requirements; (iii) bridging the competency gap; and (iv) selecting lecturers (Wan Ngah et al., 2021).

The curriculum development based on ability structure (CUDBAS) approach is another technique used to evaluate vocational competence. The CUDBAS method is a TNA approach developed by Prof. Dr. Kazuo Mori from Japan in 1990 (Affero Ismail, Zeti Kasman, Sri Sumarwati, Faizal Amin Nur Yunus, 2019; Mori, 2019). The innovation behind the CUDBAS method contributes to enhancing the TNA. This method was used to create the Ability Map, which is designed to facilitate self-assessment of lecturers' competencies based on their job profile and skill set. The Ability Map evaluates the lecturer competencies in terms of Attitude, Skill, and Knowledge also known as A, S, and K, respectively. The result of the Ability Map assessment provides a competency score for the lecturer based on their job profile and skill set. The scope of the Ability Map, developed using the CUDBAS method, can extend beyond curriculum development to encompass areas such as employment, entrance exams, training, and evaluation (Wan Ngah et al., 2021). The mean and standard deviation were used to evaluate the results of the CUBDAS Ability Map evaluation. A study shows that the lecturers competency assessment mean scores based on Ability Map falls between 2.73 and 4.14, while the standard deviation is between 0.607 and 1.145 (Kim et al., 2019), (Dadi, 2017).

Employee experience has a significant impact on TNA in a number of important areas. First, skill gaps differ greatly depending on experience levels. Entry-level workers usually need basic training, while seasoned workers gain from more complex or leadership-focused programs created to meet their unique requirements. (Kura & Supreet Kaur, 2021). Second, employee experience and the effectiveness of training programs are tightly related. While less experienced employees get the best results from basic skill-building initiatives, more experienced individuals benefit more from specialized, role-specific training. (Robert & Mori, 2024). Third, TNA plays a crucial role in coordinating training initiatives with organizational goals, guaranteeing that new hires are prepared for their roles and seasoned personnel are prepared for management and strategic challenges. (Dierdorff & Surface, 2008). Ultimately, customized training programs that align with the career goals of experienced employees boost engagement and promote retention, leading to long-term workforce motivation and organizational stability. On top of that, the working experience of lecturers significantly impacted by their skill and competency with study shows that the mean value for the competency ranges from 4.23 to 4.71, while the standard deviation falls between 0.41 and 0.64. (Abdullah et al., 2022).

The corporate management evaluated the new rating system and determined it to be more effective and dependable than the previous method, thanks to its foundation in fuzzy logic (Capaldo & Zollo, 2001). Fuzzy theory addresses vagueness and uncertainty, allowing the system handle imprecise and loosely defined concepts

while maintaining mathematical rigor and of top of that, fuzzy offers an effective way to represent ambiguity and has proven successful in a wide range of applications (Chiang & Wang, 2007). Fuzzy logic, developed by Lotfi Zadeh in the 1960s, extends classical Boolean logic by allowing variables to have degrees of truth ranging continuously between 0 for completely false and 1 for completely true, rather than being restricted to just true or false values (Kyriazos & Poga, 2024). An individual who possesses the appropriate blend of skills and innate abilities is likely to perform the job effectively (V. D. Samaila et al., 2018). Fuzzy logic techniques also capable of managing variables that are inherently ambiguous or difficult to quantify an effective framework for competency assessment. (Jevscek, 2016).

This study uses the novel CUDBAS Ability Map approach which later referred to an Ability Map and in conjunction with the Fuzzy Logic Mamdani (FLM) technique to investigate the effects of lecturers' years of work experience on their ability assessments. The CUDBAS method has proven effective in competency mapping, but there still a room to explore for input parameter for the assessment (Mori, 2019; Wan Ngah et al., 2021) This study applies a combination of the Ability Map and FLM techniques to assess the impact of years of work experience on lecturer competency evaluations. By comparing the Ability Map assessment scores with those from FLM, which includes year of working experience, the study seeks to offer insights into how years of experience influence competency assessment results and improve the accuracy of the TNA for lecturers.

2 METHODOLOGY

2.1 The Respondent

The lecturer scores on Ability Map assessment sheet was obtained from German-Malaysian Institute (GMI), Kajang, Selangor, Malaysia. GMI is a higher education institution under Council of Trust for the People or MARA. A competency results based on Ability Map competency assessment sheet from three groups of fields, Smart Manufacturing (SM), Network System (NS) and Autotronic Technology (AT) were chosen. The Ability Map competency assessment sheet contains the information for duty, ability, score and standard deviation together with lecturer details. There are 9 respondents from SM, 4 from NS and 5 from AT. The age of the lecturers in this study was between 36 and 52 years old, with working experience between 1 month and 18 years.

2.2 Ability Map

The TVET Trainer Profile Development Manual 2018, published by the Centre for Instructor and Advanced Skill Training (CIAST) in Shah Alam, Selangor, Malaysia, served as a reference guideline for preparing the Ability Map assessment (Ismail, 2018). Ability Map competency assessment sheet was used to assist the organization or institutional in the selection of training for their lecturers. The preparation of the Ability Map competency assessment sheet involves 14 key elements as seen in Fig. 1. Items 1 and 2 include the course name and the date the Ability Map was developed. A color-coding system is used at item 3 to represent ability scores, with cyan indicating a score of 1 and red indicating a score of 5. Detailed descriptions of each ability score are provided in item 4. The actual ability scores are entered in item 12. Column 5 displays the ability number, followed by columns 6, 7, and 8, which contain the importance level, duty, and corresponding ability checklist. The lecturers name, work experience was recorded in items 9, 10, and 11, respectively. Column 13 presents the lecturer ability results, while column 14 contains the standard deviation scores. The current Ability Map competency assessment sheet produces a competency score for each lecturer, calculated based on the mean and standard deviation of their ratings. Lecturers evaluate their competencies on a scale from 1 to 5, as detailed in Table 3, where a score of 1 indicates a dependent lecturer requiring guidance to complete tasks, and a score of 5 signifies an instructor capable of teaching others. The overall mean and standard deviation scores, presented in columns 13 and 14, are aggregated from all lecturers' ratings.

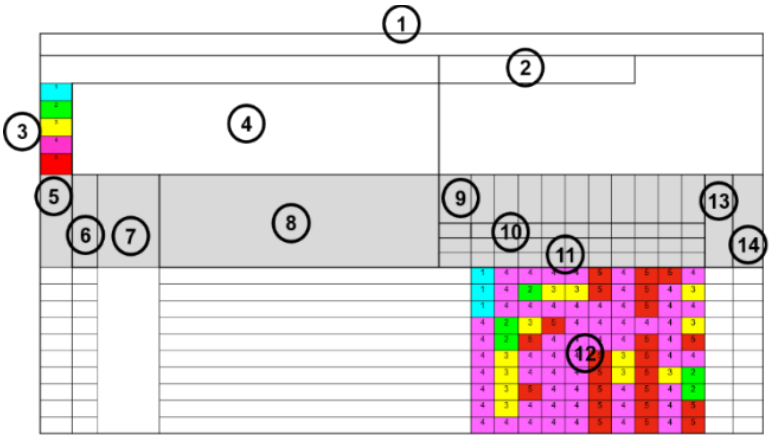


Figure 1: The Ability Map assessment sheet layout

Table 1. The Ability Map scoring system

Description	Score
Unable to do independent	1
Able to do but still need help	2
Able to do by their own	3
Fairly capable	4
Capable to do completely and can instruct other	5

This study utilizes the Ability Map competency assessment data from 18 lecturers across SM, NS, and AT, featuring 37, 58, and 96 ability competency statements respectively. Currently, the lecturer performed self-assessment in block A using an Ability Map, without includes the parameter of year of working experience as shown in block A in Fig. 2. For the proposed method of the Ability Map-FLM technique, the year of working experience and the Ability Map competency assessment scores for each competency become inputs to the FLM inference system as seen in block B. The results from the Ability Map competency assessment in block A were fed as input via the proposed path to block B and analysed by the FLM inference system.

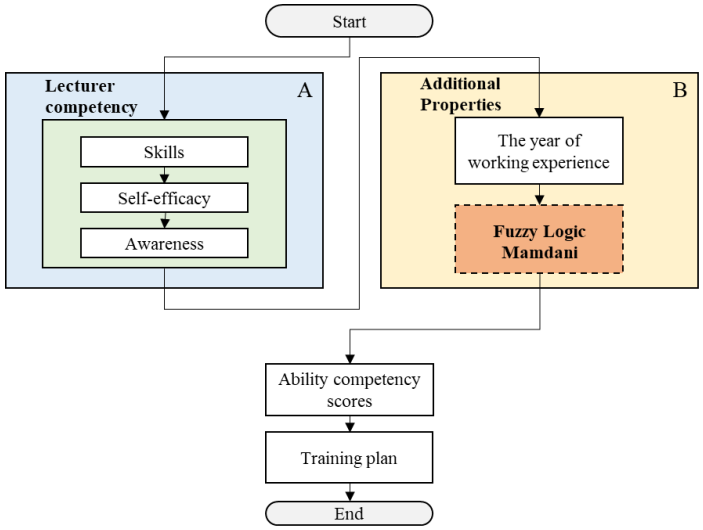


Figure 2: The Ability Map-FLM competency assessment method

2.3 Fuzzy Logic Mamdani

Mamdani fuzzy systems or FLM are the most common choice for coding expert knowledge or experience into a rule-based IF-THEN form (Lughofer, 2016). In general, the procedure FLM consists of three main stages known as fuzzification, inference, and defuzzification. During the fuzzification stage, the Ability Map competency assessment mean scores along with the years of working experience are fed into the Ability Map-FLM inference system as illustrated in Figure 3 (Mohd Hashim et al., 2022). The value of standard deviation was not included. These inputs are then processed through membership function (MF) rules in the inference stage. Ultimately, the defuzzification stage produces the updated competency assessment scores, which now incorporate the additional factor of years of working experience.

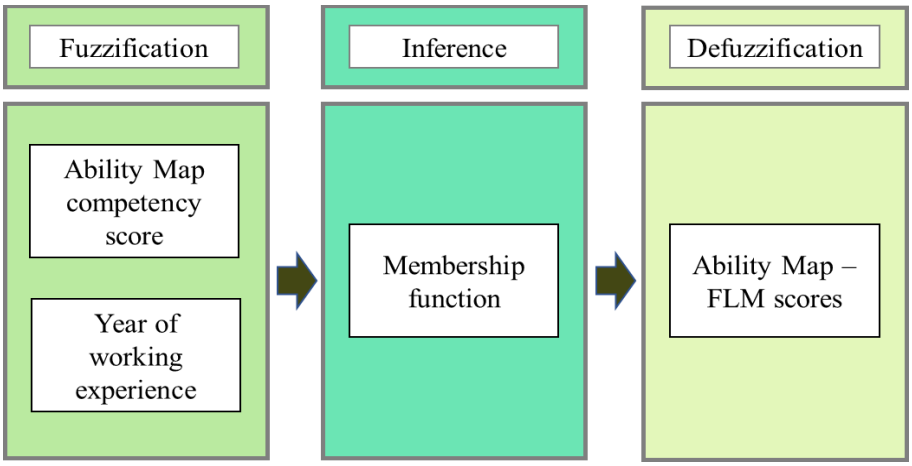


Figure 3: The process flow for Ability Map-FLM competency assessment

Fuzzy system consists of input and output variables that used to create the consequent. The input, output and consequent relation is known as fuzzy rule. The fuzzy rule general equation for this study can be seen in Eq. 1 (Lughofer, 2016):

$Rule_i$= IF (x_i IS $x\mu_i$) AND…AND (y_i IS $y\mu_i$) THEN I_i (z) IS Φ_i (1)

where;

x_i is the Ability Map competency score,
μ_{i1} is the level of Ability Map competency score,
y_i is the year of working experience,
$y\mu_i$ is the level of year of working experience,
z is the Ability Map-FLM and
Φ_i is the level of Ability Map-FLM score.

In this study, there are four MF for each x, y and z parameter as seen in Fig. 4. This approach enables the system to model the complexity of real-world skills more accurately. Gaussian type membership function was chosen in this study. For Ability Map and Ability Map-FLM MF rules, the range of score is between 1 and 5 while for year of working experience is between 1 and 35. Table 2 show the scoring system for FLM MF rules use in this study. There are four

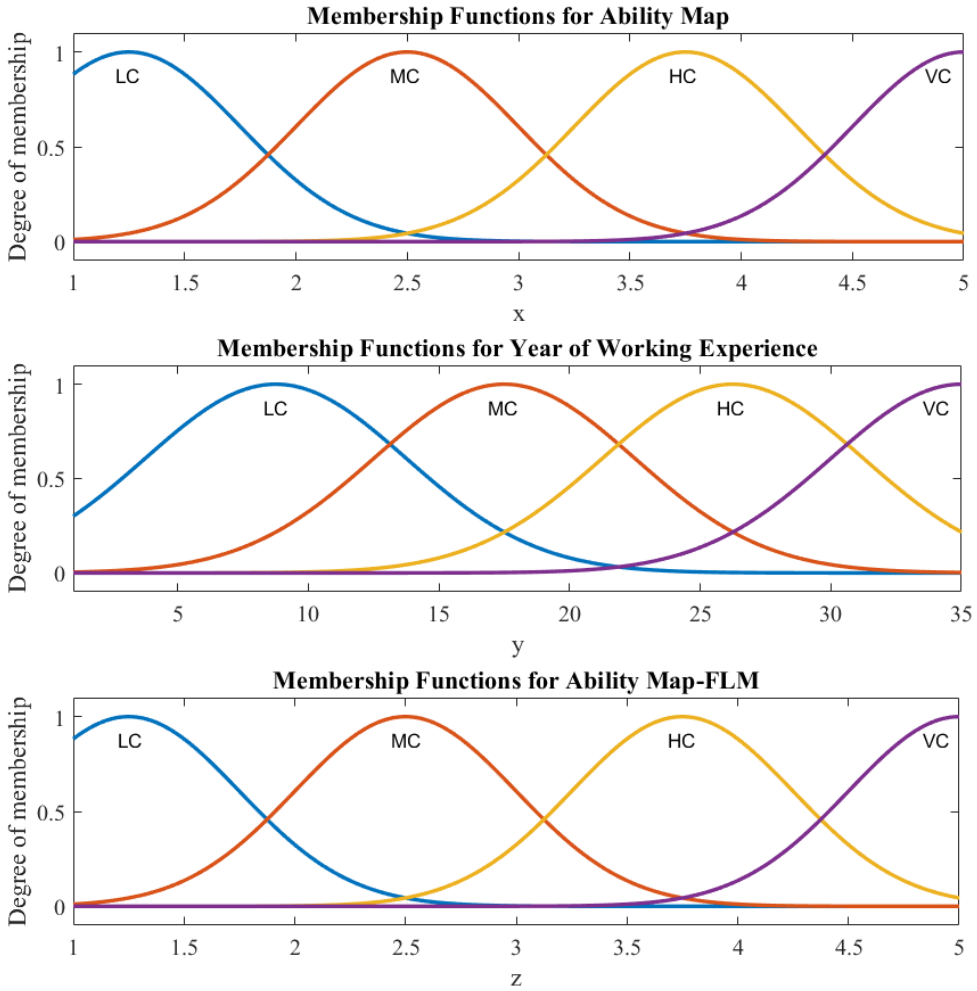


Figure 4. Membership function rules for Ability Map-FLM

Table 2. The FLM membership function variables

Description	Code
Less competent	LC
Moderate competent	MC
High Competent	HC
Very competent	VC

3 RESULT AND DISCUSSION

The dataset for this study contains the scores of competency assessment results from two systems; Ability Map and Ability Map-FLM, evaluated across three respondent groups; SM, NS, and AT. Ability Map provides scores based solely on self-assessment, excluding years of working experience, whereas Ability Map-FLM incorporates experience and other additional inputs using a Mamdani fuzzy logic system with four MF's. The Ability Map scores range from 1.1 to 3.8 with a mean of approximately 2.72, while Ability Map-FLM scores range from 1.67 to 3.23 with a mean of about 2.29 as seen in Fig. 5.

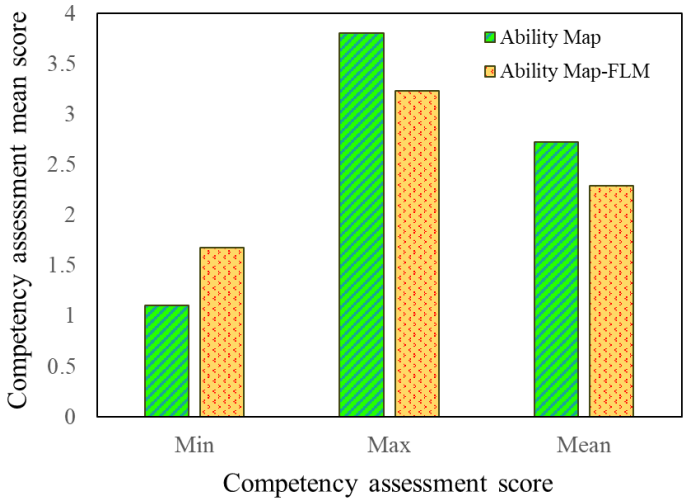


Figure 5: The comparison of mean value between Ability Map and Ability Map-FLM competency assessment

The average score difference is 19.05%, with a minimum of 0% and a maximum of 51.82%. This wide range demonstrates that Ability Map-FLM captures additional competency factors, especially work experience, leading to significant differences for some respondents. For instance, respondents with minimal experience, as low as 0.1 years, show the highest score differences, emphasizing how Ability Map-FLM inclusion of experience adjusts competency evaluation substantially compared to Ability Map as shown in Fig. 6.

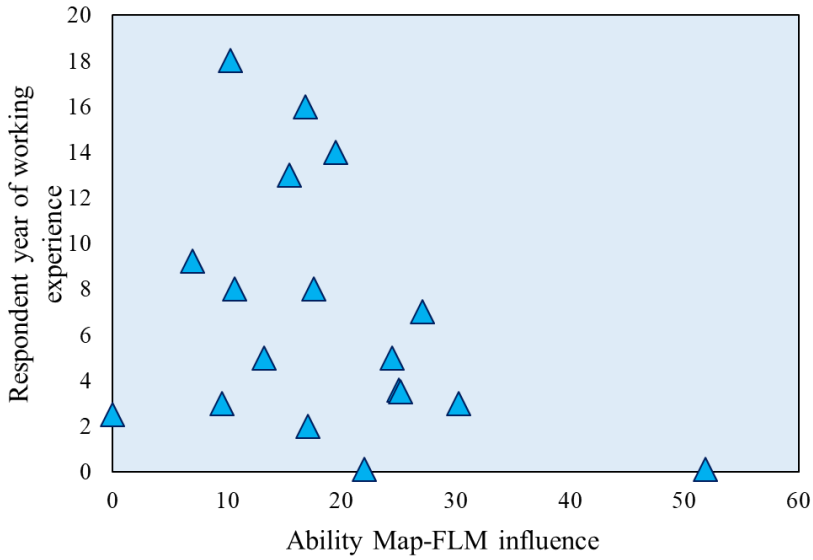


Figure 6: The influence of year of working experience on lecturer competency assessment based on Ability Map-FLM

The average age of respondents is 41.9 years, and experience averages 6.7 years, ranging from 0.1 to 18 years. The data suggests that Ability Map-FLM effectively integrates these demographic factors, providing a more holistic competency assessment. Unlike Ability Map's crisp scoring, Ability Map-FLM applies four

MF's to map input variables onto fuzzy sets, allowing partial membership and capturing the ambiguity inherent in human competencies.

The Ability Map-FLM uses expert-defined rules to combine these fuzzy inputs, mimicking human expert judgment and providing transparent, interpretable outputs. This flexibility allows Ability Map-FLM to differentiate competency levels more finely, especially across categories and groups. For example, respondents in higher competency categories or with more complex roles tend to show larger score differences, indicating that Ability Map-FLM's nuanced assessment better reflects their true competency profile.

4 CONCLUSION

In conclusion, the AI-based competency assessment based on Ability Map-FLM technique enhances competency assessment by incorporating experience and managing uncertainty through membership functions and fuzzy inference rules. This results in a more comprehensive, flexible, and realistic evaluation compared to Ability Map, which relies on rigid ability maps. By capturing the subtleties of human competencies, Ability Map-FLM enables organizations to better identify strengths and gaps, ultimately supporting more effective workforce development. This method was informed and briefed to the program leader and human resource member, which both party agreed on the approach. The current results obtained were found acceptable from their reviews.

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6 AUTHORS CONTRIBUTION

Conceptualization, methodology, validation, resources, writing—original draft preparation, writing—review and editing, Noraida Abdullah, Ahmad Hafiz Mohd Hashim and Nazarul Abidin Ismail. All authors have read and agreed to the published version of the manuscript.

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Basic Mathematics Skills among Community College Students

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ABSTRACT

Basic knowledge of mathematics is understatedly useful especially for technical and science programs at higher education institutions. Mathematics grades at secondary school obtained through standardized test invariably include more advanced topics. Given the findings that mathematics skills are predictive of course achievement, assessing students' basic mathematics skills is relevant for both teaching and research purposes. Basic Math Quiz (BMQ) is a tool for such assessment and had been adapted for use by Malaysian students. This study aims to further refine a Bahasa Melayu version of the BMQ. Additionally, the study seeks to examine the relationship among basic mathematics skills, mathematics self-concepts, and behavioural intention for help-seeking. The BMQ-Mv2 was administered to 210 students from five Community Colleges in the state of Perak, Malaysia. Data analysis (Simple Rasch Model) was performed using Winstep. The BMEQ-Mv2 demonstrated acceptable item reliability, providing strong confidence in the ranking of items based on their difficulty levels. Distractors' functioning vastly improved compared to a previous version of the BMQ-M. The overall psychometric properties are satisfactory with further improvement suggested for the aspects of item targeting, person reliability, and person separation. The BMQ-Mv2 was not significantly correlated to either Mathematics Self Concept or Behavioral Intention to Seek Help. Further refinement of the quiz could focus on unidimensionality and explain the lack of local dependence among similar questions.

KEYWORDS: basic mathematics skills, community college students, help-seeking, mathematics self-concepts, Rasch measurement

1 INTRODUCTION

Mathematics proficiency is a critical determinant of academic and career success. However, many Malaysian tertiary students struggle with basic math skills, impacting their performance in STEM and related fields despite a high job demand for qualified graduates of such programs (OECD, 2021). According to the Programme for International Student Assessment (PISA) 2022, Malaysian students scored an average of 409 in mathematics, significantly below the OECD average of 472, highlighting persistent gaps in quantitative competency (OECD, 2023). Similarly, the Trends in International Mathematics and Science Study (TIMSS) 2019 revealed that only 46% of Malaysian secondary students achieved the intermediate benchmark in math, compared to 64% internationally (Mullis et al., 2020). These trends extend to higher education, where diagnostic assessments in Malaysian universities frequently identify deficiencies in basic algebra, arithmetic, and problem-solving among incoming students (Ministry of Higher Education Malaysia, 2021). Such deficits not only hinder academic progress but also contribute to high attrition rates in quantitatively demanding programs.

The challenges faced by Malaysian students mirror global concerns about declining math competencies and their implications for workforce readiness. In many countries, weak basic math skills correlate with reduced persistence in STEM disciplines and lower employability in data-driven industries (Geary et al., 2019). For instance, a 2021 World Bank report noted that 60% of employers in Southeast Asia mentioned inadequate quantitative skills as a barrier to hiring graduates (World Bank, 2021). This trend underscores the urgency of addressing math proficiency at the tertiary level, where targeted interventions—such as bridging courses, adaptive learning technologies, and peer tutoring—can mitigate skill gaps. Given Malaysia's aspirations to become a high-tech economy under initiatives like Industry 4.0 and STEM Education Policy, improving math competency is not just an educational priority but also an economic imperative.

Literally going back to basics, this study examined the psychometric of a tool used to measure basic mathematics skills among Community College students in the state of Perak, Malaysia. By assessing the tool's psychometric properties, this paper aims to provide a recommendation of the tool's suitability for use by educators and possible insights on basic math skills for researchers.

2 LITERATURE REVIEW

This literature review examines the interplay between basic math skills, math self-concept, and behavioural intention to seek help. It explores how these factors are relevant to student success in quantitative disciplines and academic programs more generally. Understanding these relationships can help to justify the selection of behavioural intention to seek help and mathematics self-concept for evaluating the psychometric properties of a revised measure of basic math skills.

2.1 Basic Mathematics Skills

Basic mathematics skills can be elusive to define. Almost 50 years ago, Scheffer (1976) had presented challenges in conceptualising it from the aspect of delineating mathematics from other subjects and psychological vs philosophical point of view of the term 'skills'. Its meaning may be stipulated differently for students at different development stages. For example, Baroody (1983) examined the ability to write formal numbers among children as young as four years old. It may cover multitude of topics covered in primary and secondary education levels. To the extent that math curricula differ across nations, the topics constituting a set of basic math skills may also differ. Repeating the view stated in Abd Hamid et al (2025), basic math skills in this study refers to skills gained in primary and secondary schools and expected to be applied in tertiary education programs.

A lot of research efforts had been expanded to improve basic math skills among students. For example, Quinga et al (2021) used Moodle to deliver virtual instructions and students were tested using Early Mathematical Assessment Test. Similarly, Nusir et al. (2013) used multimedia-based instructions to teach basic math skills among young children. However, the instrument used to assess basic math skills was not described. A clear description and actual items for assessing basic math skills were found in two studies with students enrolled at university-level programs. These studies show that basic math skills are, as measured by a multiple-

choice quiz, related to achievement in introductory economics (Ballard & Johnson, 2004) and statistics course (Johnson & Kuennen, 2006).

2.2 Mathematics Self Concept

Mathematics self-concept refers to a person's belief about his or her academic ability pertaining to learning of mathematics. Math self-concept is significantly related to math achievement, as demonstrated in studies involving senior secondary students (Obilor, 2018) and college students (Adlawon et al., 2022), where a positive self-concept was linked to higher performance in mathematics. The belief in one's mathematical abilities, or self-efficacy, is closely tied to self-concept and has been shown to predict math achievement positively. Students with high self-efficacy are more likely to engage in effective learning behaviours and problem-solving strategies (Yousuf & Rajeswari, 2024).

The link between math self-concept and math achievement is not necessarily a direct causal path. For example, a positive self-concept can reduce math anxiety, which in turn enhances math performance (Ruijia et al., 2022). An antecedent variable may also play a role in the relationship between self-concept and achievement. The subjective value of mathematics, or how students perceive the usefulness and importance of math, is an example of such an antecedent variable. Students who value math highly tend to have a stronger self-concept and perform better (Reić-Ercegovac et al., 2019).

2.3 Behavioral Intention to Seek Help

In academic context, help seeking is divided into instrumental ("Can you help me show how I can solve this problem") and executive ("Can you show me the solution to this problem?") help seeking (Gonida et al., 2019). Instrumental help-seeking itself is a form of adaptive help-seeking that also includes intention to seek help, and help-seeking from peers and teachers while non-adaptive help seeking include help-seeking avoidance and cost of seeking help (Sergi Martín-Arbós et al, 2021). In a meta-analysis, Fong et al. (2023) found a positive correlation between instrumental help-seeking and academic achievement among post-secondary students. For example, instrumental help-seeking was found to have a direct positive effect on university students' grade point average (Algharaibeh, 2020). Thus, seeking help is highly relevant in explaining students' academic achievement.

Students in mathematics and statistics courses often encounter challenges that necessitate seeking academic help, yet many hesitate due to perceived stigma or self-efficacy concerns. Research indicates that help-seeking behaviours are influenced by factors such as achievement goal (mastery vs performance oriented) and teachers' perceived support (Karabenick & Dembo, 2011). In their review, Li et al. (2023) found a complex interrelationship among personal, environment, and contextual factors that shape help-seeking behaviour. While females are generally more willing to ask for help, other variables may affect the decision to ask for help. The perceived threats to self-esteem, perceived cost (time and resources), supportiveness of peers, and type of tasks may be important parts of the equation in taking the steps to get help. In quantitative disciplines, where concepts are learned cumulatively, delays in seeking assistance can exacerbate difficulties, leading to prolonged struggles or disengagement. On top of what is known about help-seeking in academic setting, additional findings shed more light on mathematics learning. In mathematics courses or task, help seeking was found to be related to math anxiety (Wang et al., 2025), and prior achievement (Levy Cohen, & Zusho, 2023).

Despite the benefits of help-seeking, underutilization of resources remains a challenge, particularly in online or large lecture settings where students may feel anonymous. Promoting metacognitive strategies—such as self-assessment and reflection inherent in self-regulated learning—can empower students to recognize when they need (Butler & Winne, 1995). Self-regulated learners can use strategies like adaptive help seeking which is "contingent on the student's sense of competence". (Newman, 2012, p 137). There is a possible link between math self-concept and behavioural intention to seek help. Additionally, research using Theory of Planned Behaviour had found behavioural intention is correlated with actual behaviour performance (Abdel Moneim et al., 2024; Webb & Sheeran, 2006). Thus, it makes sense to focus on behavioural intention to seek help in the context of learning mathematics due to its direct influence on actual help-seeking behaviour.

2.4 The present study

This study seeks to enhance the measurement of basic math skills among community college students by refining and evaluating the psychometric properties of the Basic Mathematics Quiz Malaysian Extended Version (Abd Hamid et al., 2025). While existing measures are used to measure basic numeracy, many lack robust psychometric validation or adaptability to diverse student populations, particularly in community college settings where gaps in basic math proficiency are prevalent. In particular, previous studies do not demonstrate convincing fit of test data to the Rasch model.

The measurement of MSC (Mathematics Self Concept) also deserves further fine tuning. As a short instrument (five items), unidimensionality could be jeopardized even with one or two items. Therefore, in this study, the negatively-worded item was revised into a positive direction.

Additionally, one aspect of learning mathematics had not gotten enough attention from researchers. Given the difficulty of learning mathematics, help-seeking behaviour could potentially help students to perform better. No explicit measure for measuring behavioural intention to seek help in learning math was found. Therefore, this study introduces a new instrument namely BISH-Math (Behavioral Intention to Seek Help – Mathematics) and its correlation with BMQ-Mv2 was tested.

By refining and validating the BMQ-Mv2, this study contributes to the growing need for psychometrically sound tools to diagnose and address math skill gaps in colleges. Findings will inform targeted interventions and placement policies, ultimately supporting student success in STEM and workforce pathways.

2.5 Objectives

The study aims to improve a basic mathematics skill measure (BMQ-M-Ext) and use it to describe basic math skills among Community College students. To achieve the aim, the following objectives were set.

a) Revise the Basic Math Quiz Malaysian Extended version.
b) Examine the psychometric properties of the revised BMQ-Mv2 using Simple Rasch Model.
c) Test the correlation between BMQ-Mv2, MSC and BISH-Math.

3 METHODS

3.1 Participants

The study population is students enrolling in certificate and diploma programs at Community Colleges in Perak. There are 13 Community Colleges in Perak with an estimated student population of 3,155 in 2023 and 2024 based on information in Community College Information System accessed by the second author. In this study, five Community Colleges were conveniently selected. At each college, a lecturer selected a class in which to distribute the questionnaire booklet. Thus, a voluntary response sampling method was used at each college. The intended sample size was 200 students from various certificate and diploma programs across selected institutions to ensure ±0.5 logit stability with 95% confidence, accounting for possible unusable data.

Normally, students enrolled into the certificate or diploma programs **by** using their Malaysian Certificate of Education (Sijil Pelajaran Malaysia – SPM). A pass in Mathematics at the SPM level is compulsory for some programs (e.g. Certificates in Information Technology, Certificate in Mechanical Engineering) but not for others (e.g. Certificates in Culinary, Certificate in Electrical Technology). Students with better SPM results would normally continue their study at universities, college universities, or polytechniques that demand higher qualifications for enrolment. Thus, the students' mathematics past achievement may range from very poor (Fail grade) to moderate. Never the less, Mathematics grades at the SPM level represent an achievement for a more comprehensive set of math knowledge and skills. The present study attempted to measure a more basic skills than those included in the SPM examination.

3.2 Instruments

A 10-item *Basic Mathematics Quiz* (BMQ) was originally reported by Ballard and Johnson (2004) and later expanded by Johnson and Kuennen (2006). It was then modified to be a 20-item bilingual (English and Bahasa Melayu) test (BMQ-M-Ext) by Abd Hamid et al. (2025). The items cover basic topics such as linear equation (2 questions), multiplication of fractions, simple algebra (3 questions), geometry (area of shapes, symmetry: 3 questions), number formats, linear Cartesian graph's slope (2 questions), exponents, and probability. The items are straight forwards except four which are scenario-based. As mentioned earlier, there are topics with multiple items. An example of similar items is as follow:

3. Diberi x=a/b. Jika a = 6 dan b = 2, cari nilai x. (*Given x=a/b. If a = 6 and b = 2, find x.*)
4. Diberi x=a/b. Jika x = 4 dan b=2, cari nilai a. (*Given x=a/b. If x = 4 and b = 2, find a.*)

In the present study, the BMQ-M-Ext was further revised based on Abd Hamid et al. (2025) data. The number of options was reduced from five to four. The removal of distractors was done for each item by identifying the distractor with the lowest percentage of endorsement. In case of ties (two or more distractors), the distractor with the larger or largest average logit distance from the correct answer was retained.
Only the Bahasa Melayu version of the questions was included in this study. Hereafter, the instrument is referred to as BMQ-Mv2.

Mathematics Self-Concept (MSC) as used in PISA (Programme for International Student Assessment) measures students' perception of their ability in mathematics subjects (OECD, 2012). There are five items with five agreement rating scale (1=strongly disagree, 5=strongly agree). The MSC have both positively and negatively worded items. In this study, item 1 was revised to be "Saya cukup pandai dalam mathematic" (*I am good enough in mathematics*). Thus, the higher the total score, the more positive the self-concept. The modification was motivated by the finding that "reverse directional items have different psychometric properties than the straightforward items" (Hooper et al., 2013, p1) in an analysis of Students' Confidence in Mathematics Scale. Similarly, for MSC, item fit issues were identified by Cai (2017).

The internal consistency of the MSC among Croatian students was reported to be at $\alpha = .77$ (Cvencek et al., 2021) and a = .88 (OECD, 2012). The MSC does not demonstrate measurement invariance across 40 countries and cycles of PISA administration (Ding et al., 2023). However, measurement invariance as identified by Ding et al is not a threat to this study because it involved only one country and one wave of data collection.
Behavioral Intention to Seek-Help (BISH-Math) was written for this study to measure students' perceived likelihood to acquiring assistance for solving problems related to learning and applying mathematics in an academic setting. Guided by a review of help-seeking resources identified by Li et al. (2023), the BISH-Math has 12 items representing two broad categories (persons and resources) that students can consult. Under persons, the sub-categories are formal (e.g. lecturer) and informal (e.g. friends). The same can be said about resources (formal – library; informal – online forum). The BISH-Math was designed as a reflective measure, and other reasonable persons or resources could be added.

Students were given the following instruction: "Nyatakan kebarangkalian anda mendapatkan bantuan daripada 12 sumber berikut untuk selesaikan masalah berkaitan matematik dan aplikasinya dalam pembelajaran semasa anda di Kolej" (*State the likelihood for you to get help from the following 12 resources to solve problems related to mathematics and its application in your learning while in College*). A 5-categories likelihood rating (1=very low, 5=very high) was used. The higher the scores, the stronger is the behavioural intention to seek help.

3.3 Data Collection

Students at 5 colleges were approached by the second author (MAH) through lecturers at the respective college. Permission from the colleges' Director was obtained prior to data collection. Administration of the research instruments were done during the students' normal class time. The booklet comprising the instruments mentioned above were distributed. Students were briefed about the study and their informed consent were

obtained by them signing a page on the cover of the booklet. Students were told that their participation in the study, or lack thereof, does not affect their courses' grades.
Students were given 30 minutes to answer the questions. The use of calculator or any electronic gadgets were not permitted. The lecturers were available all the time during the procedure to answer any questions that the students had. Students were allowed to return the booklet to their lecturers before the time was up. At the end of 30 minutes, the lecturers collected any remaining booklets.

3.4 Data analysis

Students' answers to the BMQ-Mv2 were keyed in into a spreadsheet and analysed in Winstep 5.7.1.0. Misfitting students (Outfit MNSQ > 2.00) would be screened out if their removal results in a significant change to the item measures (based on paired t-test and correlation$_{\text{before-after removal}}$). The psychometric properties were examined at the instrument (reliability, separation, unidimensionality, item targeting) and item (fit, polarity, location (logit measure), precision, distractor functioning) levels. The criteria for the analyses are the same as reported in Abd Hamid et al. (2025).

Responses to MSC and BISH-Math were also analysed in Winstep 5.7.1.0 but using the Rasch Rating Scale Model instead of the Simple Rasch Model. Similar analyses and criteria were applied except for distractor analysis which was replaced with rating category functioning analysis. Additionally, differential item functioning analysis was conducted to detect item bias by gender and level of study. Correlation among the three variables were done in Jamovi (The Jamovi Project, 2022). Detailed analyses for these two questionnaires were not included in this paper.

Logit scores from all three measures were used to examine correlations among them. Jamovi (The Jamovi Project, 2022) was used to run bivariate Pearson correlation analysis.

4 RESULTS

A total of 210 usable responses from five colleges were collected. The number of males is higher than females which is expected at these institutions. Only 2 (1%) of the students reported having learning disability. The distribution of students' previous achievement in mathematics subject is skewed. Less than 12% of students obtained 'credit' grade (C and above). Overall, the demographic characteristics of the sample are consistent with what are expected of students at community colleges in Perak.

Table 1. Demographic characteristics of the students

Variable	f	%	Variable	f	%
Sex			**Level of study**		
Male	137	65.9	Diploma	47	22.4
Female	71	34.1	Certificate	163	77.6
College			**Math grade**		
1	22	10.5	A+	2	1.1
2	53	25.2	A	3	1.6
3	98	46.7	A-	2	1.1
4	21	10.0	B+	3	2.2
5	16	7.6	B	4	1.6
Semester			C+	11	5.9
1	42	20.0	C	8	4.3
2	138	65.7	D	42	22.6
3	30	14.3	E	69	37.1
			G	42	22.6

Screening. Item 9's fit indices exceeded the acceptable range (OutfitMNSQ = 6.61, Z-standard = 8.18). Therefore, item 9 was removed. The subsequent analyses were done without item 9. Two students (1%) answered all the questions correctly and one student (0.5%) had zero mark indicating negligible ceiling and floor effects. Only two students (less than 1%) had Outfit MNSQ exceeding 2.0. Thus, their data was retained for the analysis.

Reliability and Separation. The BMQ-Mv2's person reliability and separation are .74 and 1.70 respectively. Meanwhile, the item reliability and separation are very good at .95 and 4.30 respectively. In relation to the purpose of the study, a high item reliability value is very desirable in that the item calibration (item's location based on their difficulty) can be trusted.

Unidimensionality. The percentage of variance explained by the primary dimension is 29.5%. The first contrast has an eigenvalue of 1.984 and explains 7.4% of the variance which is less than the 15% threshold. Additionally, by a factor of three, the variance explained by the first contrast is still less than 29.5%, indicating a weak possibility of it being a true secondary dimension. Moreover, local dependence is not evident. The highest standardized residual correlation is .21 (items 4 and 5). Therefore, the BMQ-Mv2 can be said to measure a single dimension (basic mathematics knowledge).

Item fit. The 19 items have acceptable fit to the Rasch model. As presented in Table 2, the fit statistics (Infit MNSQ, Outfit MNSQ, Point-measure Correlation) are within their acceptable range. There are items whose z-standard for either infit or outfit, or both, are outside of ±2.0; however, given the sample size, this violation is not considered deleterious to the measurement model.

Table 2. Item statistics.

Item	Measure	IN.MSQ	IN.ZSTD	OUT.MSQ	OUT.ZSTD	PTMA
1	-1.28	0.79	-1.83	0.56	-1.85	0.55
2	-0.05	0.99	-0.16	0.90	-0.70	0.51
3	-1.34	0.81	-1.58	0.53	-1.93	0.55
4	-0.79	1.11	1.14	1.41	1.81	0.35
5	-0.04	1.12	1.47	1.16	1.11	0.42
6	-0.28	1.15	1.74	1.08	0.56	0.40
7	-0.04	0.88	-1.59	0.96	-0.25	0.55
8	0.59	0.83	-2.49	0.77	-2.25	0.61
10	0.55	0.83	-2.44	0.78	-2.15	0.61
11	-1.18	0.86	-1.27	0.56	-1.93	0.54
12	0.64	1.04	0.63	1.09	0.86	0.48
13	0.53	0.94	-0.76	0.90	-0.87	0.54
14	1.26	1.12	1.66	1.18	1.56	0.42
15	-0.06	1.18	2.07	1.33	2.08	0.34
16	1.03	1.20	2.74	1.32	2.71	0.36
17	-0.11	0.90	-1.21	0.81	-1.34	0.55
18	-0.10	0.87	-1.65	0.72	-2.06	0.58
19	-0.81	1.13	1.31	1.07	0.39	0.38
20	1.47	1.14	1.90	1.30	2.19	0.39

Note: IN.MSQ = Infit Mean Square, IN.ZST = Infit z-standard, OUT.MSQ = Outfit Mean Square, OUT.ZSTD = Outfit z-standard, PTMA = Point measure correlation

Distractor Analysis. All of the items have functioning distractors. In other words, for all items, all answer options were chosen by the students. Moreover, the correct answers have higher average logit values compared to the distractors.

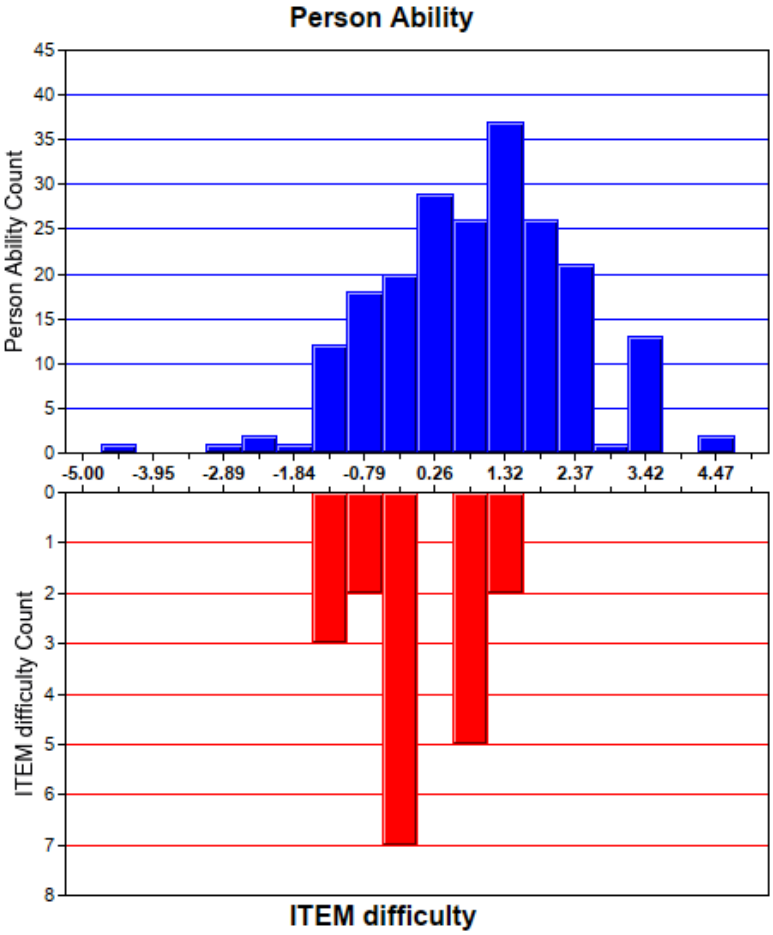


Figure 1: Person-item measure for the BMQ-Mv2.

Item location. As seen in Figure 1, the range of item difficulty does not completely cover the students' range of ability. Considering the 'basic' nature of the test, a comprehensive coverage may not be a necessary target. In other words, the test does not necessarily need very difficult questions that could be in a category of 'intermediate' or 'advanced' math skills. Having said that, the distribution of items by difficulty levels could be improved from the current version where there are possibly redundant items.

Item bias. DIF analysis by gender showed five items with big (>0.5) and significant DIF contrast (see Table 3). The same number of items were found for DIF comparison by level of study (Diploma vs Certificate). In the case of gender, four items favoured male students. Male students were better at solving algebraic fraction questions (Q4 and Q5), fraction calculation (Q6), and percentage in a word problem (Q13). However, female students performed better in geometry (Q14) question.

For item bias by level of study, the same set of questions were observed to have significant DIF contrast except for one: Q20 (square root estimation) instead of Q6. Diploma students performed better in three of those items. Given the small sample for each group, compared to the ideal size of 1,000 per each group for dichotomous items (Linacre, n.d.), the findings can only be considered as tentative.

The raw scores (not the Rasch scores) were then compared by sex, level of study. Welch's t-test values from Winstep are reported here. Male students have lower scores (M=11.6, SD=1.43) than female students (M=13.2, SD=1.21) and this difference is significant, $t(163) = -2.64$, p=.009. Diploma students scored significantly higher (M=13.9, SD=1.13) than Certificate students (M=11.6, SD=1.40), $t(90)$=3.59, p=.001. A significantly larger sample would be needed to establish whether the observed bias found in this study is a real bias or artificial as explained by Andrich and Hagquist (2012).

Table 3. Item bias by gender and level of study

Grouping	Item	DIF contrast	Rasch-Welch t	p
Male vs Female	4	-1.32	-3.41	.0008
	5	-1.39	-3.95	.0001
	6	-1.09	-3.01	.0031
	13	-.75	-2.21	.0289
	14	1.76	4.68	<.0001
	4	1.63	3.90	.0002
Diploma vs Certificate				
	5	.96	2.43	.0172
	13	.80	2.11	.0379
	14	-1.68	-3.88	.0002
	20	-.90	-2.26	.0265

Correlation. As shown in Table 4, the only significant correlation was observed for Behavioral Intention to Seek Help and Mathematics Self-Concept. A moderate positive correlation was found between the two variables: seeking help is stronger among those with more positive self-concept. However, against expectation, the BMQ-Mv2 was not correlated with the other two variables.

Table 4. Correlation among measured variables

		1	2	
1.	BMQ	—		
2.	MSC	0.008	—	
3.	BISH-Math	-0.079	0.346***	—

Note: *** p < .001.
BMQ = Basic Math Quiz,
MSC = Math Self-Concept,
BISH-Math = Behavioral Intention to Seek Help

5 DISCUSSIONS

The BMQ-Mv2 showed psychometric improvements compared to the previous versions used. Most notably, all distractors were functioning. There were also marginal improvements in terms of unidimensionality and item reliability. The BMQ-Mv2 looks better overall compared to the earlier version. The modifications made to the instrument was successful in meeting the research aim.

The lack of correlation between BMQ-Mv2 and mathematics self-concept is contrary to a previous study (Abd Hamid et al., 2025). Perhaps the improved quality of the test had contributed to the diminished relationship. The findings could also be seen in light of the nature of the higher education institutions involved in this study (government-owned community colleges). Math self-concept tends to have a closer association with achievement in independent schools than in public schools (Ding et al., 2024). Thus, this study extends the finding to college level institution.

Further studies are needed to explore the issues revealed by the data. Firstly, similar items ([1,2], [4,5,6], and [9,10]) were locally independent. Given the high degree of similarity among those items, the lack of local dependency is surprising. Students who were able to answer question 4 should also be able to answer questions 5 and 6. However, this was not the case. A possible and convenient explanation is that the students chose the answers randomly. This might be hard to accept given that the students' scores are larger than that expected from random answering. Thus, further studies need to be done to unravel this issue before dismissing it as merely a measurement artifact.

Related to the point above, having a test with non-redundant or non-locally dependent items are useful for research in this area. It was observed that some items have similar difficulty levels and therefore could be removed. In their place, perhaps other relevant topics could be included. Thirdly, the test could be administered to a group that include students known to have better past mathematics achievement.

In conclusion, the revised BMQ-Mv2 is a marginally improved tool to measure students' basic mathematics skills. By examining students' basic knowledge, it is hoped that future works can advance our understanding of students' mastery of the subject.

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Impak Kaedah *Authentic Assessment* Terhadap Kefahaman Dan Keyakinan Pelajar Dalam Tugasan Pembentangan KIAR

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ABSTRAK

Kajian tindakan ini dijalankan bagi meneliti impak kaedah *authentic assessment* terhadap kefahaman dan keyakinan pelajar dalam tugasan pembentangan Kursus Integriti dan Antirasuah (MPU2352). Seramai 109 orang pelajar Diploma Pengurusan Sumber Manusia (AB107) di Kolej Poly-Tech MARA, Kuantan telah terlibat dalam kajian ini. Isu utama yang dikenal pasti ialah pelajar kurang jelas dengan arahan tugasan dan berhadapan dengan masalah keyakinan diri semasa pembentangan. Kajian ini menggunakan kaedah pengumpulan data berbentuk kuantitatif dan kualitatif menerusi soal selidik dan analisis pemarkahan rubrik. Intervensi dilaksanakan dengan memperkenalkan arahan tugasan berasaskan *authentic assessment* yang lebih jelas, realistik dan memberi pilihan kepada pelajar. Dapatan kajian menunjukkan berlaku peningkatan kefahaman pelajar terhadap soalan pembentangan dan kesannya terhadap keyakinan diri ketika pembentangan. Kajian ini mencadangkan perluasan penggunaan *authentic assessment* bagi kursus Mata Pelajaran Umum (MPU) lain serta penambahbaikan rubrik penilaian yang lebih menekankan aspek kefahaman topik.

Kata kunci: Kajian Tindakan, Kefahaman Pelajar, Keyakinan Diri, Pembentangan Kes Rasuah, *Authentic Assessment*, Kursus Mata Pelajaran Umum (MPU).

1 Pengenalan

Kursus Integriti dan Antirasuah (MPU2352) bertujuan untuk memperkukuh pemahaman pelajar terhadap nilai-nilai asas integriti, isu rasuah, penyalahgunaan kuasa serta kaedah pencegahan yang relevan dalam konteks individu mahupun organisasi (Akademi Pencegahan Rasuah Malaysia, 2021). Pendekatan pembelajaran yang digunakan bersifat pengalaman langsung melalui pelbagai aktiviti seperti perbincangan kumpulan, pembentangan kajian kes, kuiz dan projek video. Salah satu elemen utama kursus ini ialah tugasan pembentangan kes rasuah, di mana pelajar dikehendaki meneliti dan menganalisis kes sebenar berpandukan rubrik penilaian yang telah ditetapkan.

Namun, hasil pemerhatian awal menunjukkan bahawa sebilangan pelajar kurang memahami tugasan yang diberikan dan kurang yakin ketika menyampaikan pembentangan mereka. Sehubungan itu, kajian tindakan ini dijalankan bagi meneliti kesan penggunaan kaedah *authentic assessment*, iaitu satu bentuk penilaian yang berasaskan konteks dunia sebenar, melibatkan pemikiran kritis serta penilaian kendiri (Mueller, 2018), terhadap tahap kefahaman pelajar terhadap tugasan dan keyakinan mereka semasa pembentangan.

Melalui kajian ini, diharapkan pendekatan *authentic assessment* dapat dikenal pasti keberkesanannya dalam membantu pelajar memahami tugasan dengan lebih jelas dan meningkatkan keyakinan diri ketika membuat pembentangan secara berkesan dan terarah (Gulikers, Bastiaens, & Kirschner, 2004).

1.1 Penyataan Masalah

Hasil penelitian awal terhadap pelajar, terdapat beberapa masalah yang dikenal pasti. Antaranya ialah:

i. Pelajar tidak jelas dengan arahan tugasan yang diberikan.
ii. Pelajar kurang berkeyakinan ketika melakukan pembentangan kajian kes berdasarkan tajuk yang telah dipilih.

Penyataan masalah ini disokong oleh Black dan William (2009) yang mana kekeliruan terhadap kehendak soalan serta ketidaksediaan untuk membentangkan dapatan kajian menjadi antara cabaran utama kepada pelajar. Hal ini kerana arahan tugasan yang tidak jelas menyebabkan pelajar tidak faham dengan kehendak soalan seterusnya menyebabkan pelajar kurang berkeyakinan ketika melakukan pembentangan.

1.2 Objektif Kajian

Terdapat dua objektif kajian. Antaranya ialah:

i. Mengenal pasti tahap kefahaman pelajar terhadap soalan pembentangan kes rasuah.
ii. Menilai hubung kait antara kefahaman pelajar terhadap soalan pembentangan dan keyakinan diri pelajar ketika pembentangan.

1.3 Persoalan Kajian

i. Bagaimanakah kefahaman pelajar mempengaruhi keupayaan mereka menjawab soalan pembentangan?
ii. Adakah terdapat hubungan yang signifikan antara kefahaman pelajar terhadap soalan pembentangan dan tahap keyakinan diri mereka?

1.4 Kepentingan Kajian

Kajian ini dijalankan adalah untuk membantu pensyarah membuat atau menyediakan arahan tugasan yang lebih teliti dan jelas berdasarkan *authentic assessment*. Melalui kaedah *authentic assessment* tersebut, arahan tugasan yang diberikan akan lebih realistik, arahan lebih jelas dan mudah difahami oleh pelajar. Hasil daripada arahan tugasan yang mengikut kepada kaedah *authentic assessment* tersebut pelajar akan dapat memahami arahan tugasan yang diberikan serta dapat membantu pelajar membuat pembentangan dengan lebih baik dan yakin berdasarkan tajuk kajian kes yang dipilih.

2 Sorotan Literatur

Hasil kajian literatur yang telah dibuat, terdapat beberapa kajian lepas yang telah dilakukan berkaitan pelaksanaan kaedah *authentic assessment.* Antaranya ialah oleh Villarroel et.al, (2020) yang mana beliau menggalakkan pendekatan *authentic assessment* untuk pembelajaran. Hasil daripada pendekatan *authentic assessment* yang digunakan dalam reka bentuk arahan tugasan, ia dapat meningkatkan usaha dan memberikan pengalaman pembelajaran yang sebenar kepada pelajar. Tambahan lagi, melalui pendekatan tersebut pelajar lebih bersedia untuk menghadapi kehendak tugasan.

Melalui kajian Villarroel et. At, (2020), terdapat tiga prinsip *authentic assessment* iaitu *realism*, *cognitive eggagement* dan *evaluative judgement*. Melalui prinsip tersebut, dapat dilihat sesetengah kemajuan boleh dilakukan dengan merekabentuk tugasan dengan menggalakkan pendekatan yang lebih mendalam, lebih bermakna dan menarik kepada pelajar. Selain itu, beliau juga mengatakan pendekatan tersebut dapat memberikan persediaan yang lebih baik bagi menghadapi dunia pekerjaan yang diceburi oleh pelajar pada masa akan datang.

Menurut Swan dan Hofer (2013), mereka menekankan bahawa tugasan yang mempunyai ciri realistik atau *realism* akan mendorong pelajar untuk lebih terlibat secara aktif dalam pembelajaran dan memupuk kemahiran menyelesaikan masalah serta membuat keputusan yang relevan. Melalui konteks realistik dalam *authentic assessment*, soalan-soalan yang dibuat adalah hasil daripada maklumat tentang menggambarkan situasi atau permasalahan yang berlaku dalam kehidupan yang perlu diselesaikan.

Kefahaman pelajar terhadap tugasan yang diberikan adalah sangat penting untuk membantu pelajar menjawab atau melakukan tugasan yang diberikan. Kefahaman yang jelas terhadap kehendak tugasan merupakan asas kepada pelajar dalam menghasilkan tugasan yang baik dan berkualiti. Pelajar yang kurang jelas tentang kriteria atau arahan tugasan cenderung membuat kesilapan atau kurang menunjukkan prestasi sebenar mereka (Black dan William, 2009). Dalam konteks kefahaman pelajar, *authentic assessment* memberikan struktur yang kukuh melalui rubrik, arahan yang jelas, dan tugasan yang menggambarkan situasi sebenar akan membantu pelajar memahami tugasan dengan lebih menyeluruh (Villarroel et al., 2020).

Pembentangan pelajar bukan sahaja menguji kefahaman pelajar terhadap tugasan yang diberikan, malah menjadi asas penting untuk membina keyakinan dan kemahiran komunikasi. Yahya dan Muhamad (2010) menyatakan bahawa pelajar yang terlibat secara aktif dalam pembentangan cenderung memiliki tahap keyakinan yang lebih tinggi, khususnya apabila mereka mendapat peluang untuk berbincang, bekerjasama, dan berlatih sebelum menyampaikan maklumat di hadapan khalayak.

Persediaan pelajar dalam menghadapi tugasan pembentangan merupakan aspek penting dalam menjamin keberkesanan penyampaian. Menurut Nabihan dan Mohd Effendi (2022), pendedahan awal melalui latihan atau raptai dapat membantu pelajar menyesuaikan diri dengan suasana pembentangan dan mengurangkan perasaan gementar. Dalam *authentic assessment*, peluang untuk berlatih dan membuat refleksi terhadap tugasan meningkatkan keyakinan dan kawalan diri semasa menyampaikan hasil dapatan kajian. Selain itu, pelajar yang menguasai kemahiran berfikir secara kritis dan kreatif lebih bersedia untuk menghadapi tugasan yang kompleks. Tugasan yang bersifat autentik menuntut pelajar untuk membuat penilaian, memberi hujah yang relevan, serta menyampaikan pandangan berdasarkan bukti yang kukuh (Gulikers et al., 2004). Oleh itu, hasil kajian tersebut menunjukkan bahawa *authentic assessment* berupaya merangsang perkembangan pemikiran aras tinggi dalam kalangan pelajar.

Pendekatan *authentic assessment* bukan sahaja menyumbang kepada pemahaman dan keyakinan pelajar, tetapi juga meningkatkan motivasi intrinsik mereka dalam pembelajaran. Menurut Deci dan Ryan (1985), mereka menjelaskan bahawa pelajar akan lebih terdorong apabila mereka berasa tugasan adalah relevan dengan dunia sebenar serta memberi mereka kawalan terhadap cara pelaksanaannya. *Authentic assessment* memberikan peluang kepada pelajar untuk mengaitkan tugasan dengan pengalaman sebenar, seterusnya memupuk penglibatan aktif dan minat yang mendalam terhadap kandungan pembelajaran (Gulikers, Bastiaens, dan Kirschner, 2008).

Rubrik penilaian yang terperinci dan telus merupakan elemen penting dalam *authentic assessment.* Rubrik berperanan sebagai panduan kepada pelajar untuk melihat aspek yang dinilai oleh pensyarah serta menjadi alat maklum balas formatif yang berguna. Andrade (2000) menyatakan bahawa rubrik yang dijelaskan

secara menyeluruh dapat meningkatkan kejelasan matlamat pembelajaran dan membantu pelajar menilai serta memperbaiki hasil kerja sendiri secara reflektif.

Pelaksanaan *authentic assessment* semakin relevan dalam sistem pendidikan tinggi di Malaysia, selaras dengan pendekatan pembelajaran berpusatkan pelajar yang digariskan dalam *Malaysian Qualifications Framework 2.0* (MQA, 2020). Kaedah ini menekankan penilaian bukan hanya pada aspek kognitif, tetapi turut melibatkan kemahiran insaniah seperti komunikasi, kerjasama, dan pemikiran kritikal. Oleh itu, *authentic assessment* dilihat sebagai satu pendekatan yang sesuai untuk menyokong matlamat pendidikan nasional dan melahirkan graduan holistik.

Teknologi memainkan peranan penting dalam memperkukuh pelaksanaan *authentic assessment*. Penggunaan alat digital seperti Google Slides, Canva, atau aplikasi suntingan video membantu pelajar menghasilkan produk pembelajaran yang kreatif dan sejajar dengan keperluan abad ke-21. Boud dan Falchikov (2007) menyatakan bahawa integrasi teknologi bukan sahaja memperkaya proses penilaian, tetapi juga menggalakkan pelajar mengembangkan kemahiran digital yang diperlukan dalam dunia sebenar.

Walaupun keberkesanannya terbukti, pelaksanaan *authentic assessment* tidak terlepas daripada cabaran. Antaranya ialah keperluan masa dan tenaga yang tinggi oleh pensyarah untuk mereka bentuk tugasan yang bermakna serta menilai hasil kerja pelajar secara menyeluruh. Dalam masa yang sama, pelajar juga mungkin menghadapi kekeliruan atau kebimbangan terhadap tugasan yang kurang berstruktur atau terlalu terbuka. Herrington dan Herrington (2006) menegaskan bahawa kegagalan memahami konsep sebenar *authentic assessment* boleh menyebabkan pelaksanaannya tidak mencapai objektif yang diharapkan, justeru memerlukan latihan, sokongan dan komunikasi yang jelas.

3 Metodologi Kajian

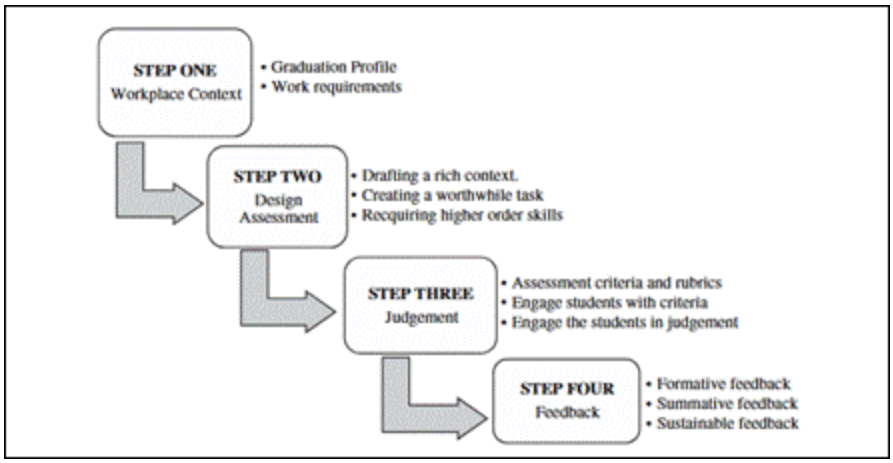
Kajian ini adalah berbentuk kaedah penyelidikan kualitatif dan kuantitatif. Kajian kualitatif yang dibuat adalah berdasarkan analisis dapatan daripada kaedah pemerhatian. Kajian kuantitatif pula adalah hasil daripada pengumpulan data dan input daripada responden, menyusun data dan menganalisis data yang diperoleh melalui soal selidik yang dibuat terhadap 109 orang pelajar yang mengambil Kursus Integriti dan Antirasuah (MPU2352). Kaedah pengumpulan data adalah menerusi soal selidik dan analisis pemarkahan rubrik KIAR.

Berdasarkan pemerhatian yang dilakukan terhadap pembentangan pelajar, terdapat pelajar yang kurang memahami tugasan yang diberi dan kurang berkeyakinan ketika membuat pembentangan. Selain memahami masalah yang dihadapi oleh pelajar, pensyarah juga perlu mengambil inisiatif untuk mencari punca dan penyelesaian terhadap masalah yang dihadapi. Sehubungan itu, kami menukar pendekatan penilaian dengan menukar arahan tugasan yang ringkas kepada arahan tugasan yang lebih terperinci untuk memastikan pelajar lebih memahami arahan yang diberikan dan pelajar dapat melakukan pembentangan dengan baik. Oleh itu, kajian tindakan dilakukan bagi meneliti impak kaedah *authentic assessement* terhadap kefahaman dan keyakinan pelajar. Pendekatan *authentic assessment* digunakan bagi merekabentuk dan membina arahan tugasan terutama arahan tugasan pembentangan pelajar.

Authentic assessment ialah strategi yang mengaitkan pembelajaran dan pekerjaan serta mencipta hubung kait antara apa yang dinilai di universiti dan apa yang pelajar perlu lakukan di tempat kerja (Gulikers, Bastiaens dan Kirschner, 2004). Pendekatan ini memperkenalkan tugasan yang sama yang dihadapi dalam kehidupan realiti atau pekerjaan. Terdapat tiga prinsip dalam *authentic assessment.* Antaranya ialah *realism, cognitive engagement* dan *evaluative judgement*. Untuk membuat arahan tugasan pembentangan KIAR, kami memilih prinsip *realism.* Dalam *authentic assessment, realism* ialah realistik yang mana maklumat menggambarkan situasi atau masalah yang datang daripada situasi sebenar atau kehidupan professional. Konteks realistik boleh dipersembahkan dalam peperiksaan dan tugasan bertulis seperti analisis kes, penyelesaian masalah, soalan esei pendek atau panjang yang melibatkan dunia sebenar. Selain itu, cara untuk mencipta *realism* ialah melalui tugasan berasaskan prestasi, iaitu pelajar menghasilkan kerja atau demostrasi pengetahuan, memahami dan berkemahiran dalam aktiviti yang berkaitan dengan profesion atau bidang.

3.1 Model Pembinaan Arahan Tugasan

Model yang digunakan untuk menghasilkan arahan tugasan bagi Pembentangan Kajian Kes KIAR ialah model untuk membina *authentic assessment* yang telah dibuat oleh Villaroel et.al (2020).



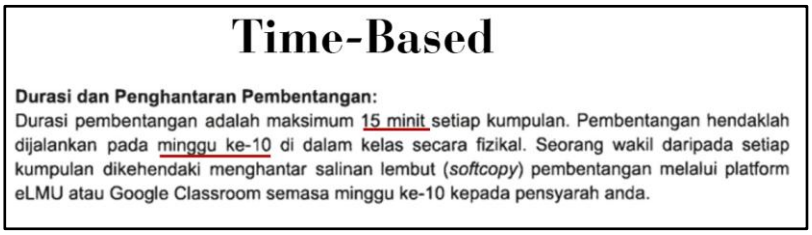
Rajah 1: Model untuk membina *authentic assessment* oleh Villaroel et. al (2020)

Terdapat empat langkah yang dilakukan untuk menghasilkan arahan tugasan dalam bentuk *realism* yang mengikut kepada pendekatan *authentic assessment*. Langkah pertama ialah konteks tempat kerja. Bagi membentuk soalan atau arahan tugasan kepada pelajar, pensyarah perlu memahami atau tahu berkenaan latar belakang pengijazahan program yang disumbangkan oleh kursus yang kini dipanggil *Programme Learning Outcome* (PLO) atau hasil pembelajaran program. Selain itu, keperluan pekerjaan juga perlu diambil kira. Perkembangan kemahiran juga hendaklah menjadi sebahagian daripada subjek yang membentuk kurikulum. Langkah pertama bagi arahan tugasan pembentangan yang dibuat ialah melalui tinjauan awal terhadap pembentangan pelajar dan kaitan tugasan kepada kemahiran profesional dan keperluan tugasan yang dibuat oleh pelajar. Langkah kedua ialah merangka arahan, yang mana pengajar merangka konteks, mencipta tugasan yang berfaedah, dan keperluan kemahiran peringkat tinggi. Melalui langkah ini, pensyarah membentuk arahan tugasan pembentangan yang melibatkan kajian kes. Kajian kes yang dipilih ialah kajian kes rasuah yang berlaku yang memberi kesan kepada individu, masyarakat dan organisasi. Langkah ketiga ialah penilaian. Penilaian dibuat adalah dengan menyediakan kriteria tugasan dan rubrik, melibatkan pelajar dengan kriteria serta melibatkan pelajar dalam penilaian. Rubrik yang dibuat mestilah mempunyai penilaian dari pelbagai aspek yang berkaitan dengan arahan tugasan temasuklah, keyakinan diri, persediaan pelajar, elemen perbincangan dalam pembentangan, percambahan idea, gaya pembentangan, alat bantu pembentangan dan pengurusan masa. Langkah yang terakhir ialah langkah keempat iaitu maklum balas. Dalam model ini, memberi maklum balas kepada pelajar adalah untuk memupuk komunikasi dengan mempertimbangkan penilaian pelajar. Maklum balas tersebut bertujuan untuk membantu menjelaskan kriteria yang ditetapkan dan rubrik yang dinilai kepada pelajar serta memberi maklum balas penambahbaikan yang perlu dilakukan oleh mereka. Maklum balas dibuat adalah dengan semakan draf tugasan pelajar, penilaian kepada pemarkahan pelajar, serta soal selidik kepada pelajar terhadap kefahaman arahan tugasan yang diberikan.

3.2 Intervensi & Pelan Tindakan di Dalam Kajian

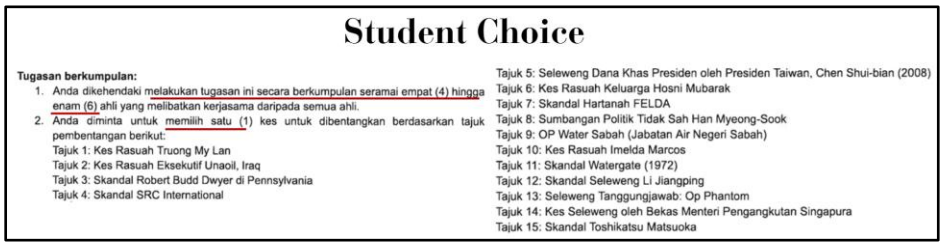
Penggunaan pendekatan *authentic assessment* dalam arahan tugasan pelajar memerlukan beberapa pemboleh ubah *authentic assessment* yang dimasukkan dalam arahan tugasan agar arahan tersebut memenuhi prinsip yang diketengahkan oleh kaedah ini.

Bagi tujuan kajian ini, dua pemboleh ubah telah digunakan bagi memastikan bahawa kajian ini sejajar dengan prinsip *realism* yang telah diketengahkan. Pemboleh ubah tersebut ialah *time-based* dan *student choice*. Kedua-dua pemboleh ubah ini telah dimasukkan di dalam arahan tugasan, seperti di Rajah 2 dan Rajah 3 di bawah.



Rajah 2: Penggunaan pembolehubah *time-based* di dalam arahan tugasan

Berdasarkan arahan tugasan pelajar telah ditetapkan tempoh bagi pembentangan bagi setiap kumpulan. Melalui arahan tersebut, pelajar dapat menguruskan masa pembentangan dan menghuraikan topik yang dibincangkan mengikut kepada kesesuaian masa. Selain itu juga, arahan tugasan juga jelas telah menetapkan tempoh tugasan perlu dihantar dan bagaimana tugasan tersebut perlu dihantar.

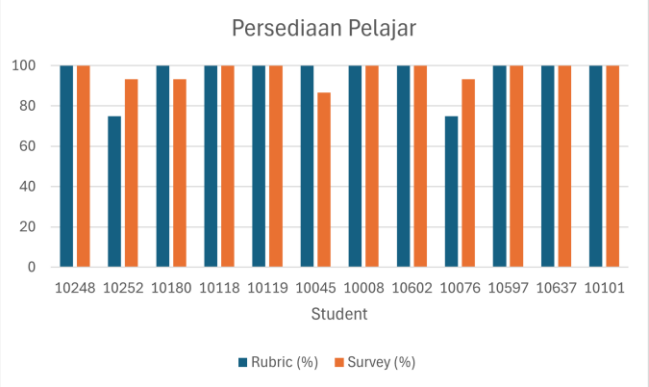


Rajah 3: Penggunaan pembolehubah *student choice* di dalam arahan tugasan

Manakala berdasarkan Rajah 3 di atas, pemboleh ubah *student choice* atau pilihan oleh pelajar diletakkan dengan membenarkan para pelajar untuk membuat pemilihan mereka tersendiri bagi penetapan ahli kumpulan dan tajuk pembentangan yang telah disenaraikan. Ini memberi peluang untuk pelajar mengembangkan idea mereka di dalam keadaan yang lebih fleksibel, supaya pelajar dapat membuat pembentangan yang lebih selari dengan rubrik dan pembentangan yang lebih berkeyakinan.

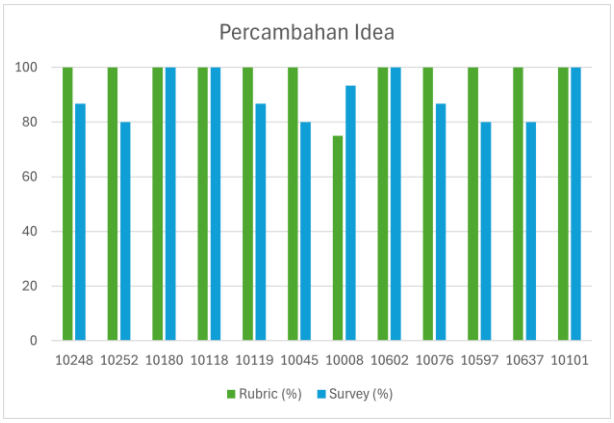
4 Dapatan & Analisis Kajian

Untuk menganalisis dapatan daripada kajian yang dibuat berdasarkan soalan tinjauan yang diberikan kepada pelajar-pelajar, dua belas (12) responden daripada seratus sembilan (109) responden diambil sebagai contoh bagi kajian. Bagi menganalisa kesan keberkesanan metod *authentic assessment* ini, analisis dilakukan dengan membuat perbandingan antara tinjauan yang diberikan kepada responden dan hasil daripada pemarkahan oleh pensyarah-pensyarah terlibat berdasarkan rubrik yang digunakan.



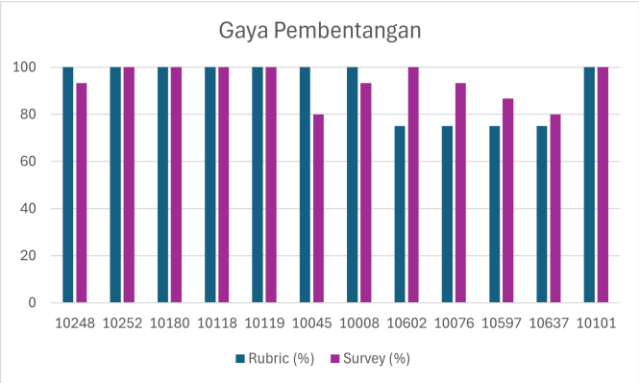
Rajah 4: Persediaan Pelajar untuk Pembentangan

Dalam Rajah 4, didapati bahawa arahan soalan pembentangan yang dibuat melalui kaedah *authentic assessment* ini memberikan peluang kepada pelajar untuk lebih memahami tugasan yang diberikan. Jadi, pelajar-pelajar lebih bersedia di dalam memastikan pelaksanaan tugasan pembentangan tersebut dilakukan dengan sempurna. Persediaan pelajar-pelajar ini juga ditunjukkan berdasarkan markah yang diberikan oleh pensyarah-pensyarah yang sejajar dengan persediaan mereka. Rajah 4 menunjukkan bahawa terdapat perbandingan yang setara antara tinjauan yang diberikan kepada pelajar dengan markah yang diberikan oleh pensyarah.



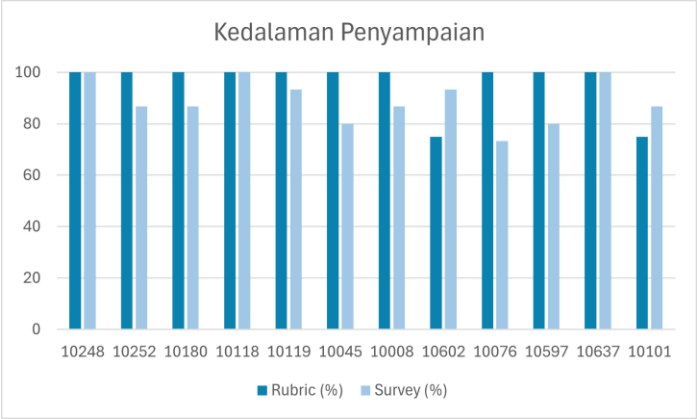
Rajah 5: Percambahan Idea Pelajar bagi Pembentangan

Bagi mengukur dari aspek Percambahan Idea pelajar-pelajar, berdasarkan Rajah 5, didapati bahawa terdapat hubung kait di antara persediaan pelajar berdasarkan arahan soalan Pembentangan yang dibuat melalui kaedah *authentic assessment* ini memberikan keyakinan pelajar untuk membuat percambahan idea yang sejajar dengan kehendak dan keperluan tugasan. Malahan, percambahan idea daripada pelajar ini ditunjukkan berdasarkan markah yang diberikan oleh pensyarah yang sejajar dengan dapatan daripada pelajar-pelajar.



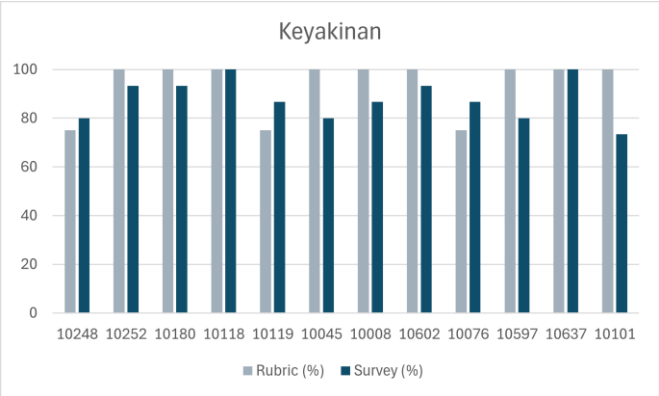
Rajah 6: Gaya Pembentangan Pelajar

Berdasarkan Rajah 6, didapati juga bahawa persediaan pelajar dan percambahan idea pelajar juga akan memberikan kesan yang positif terhadap Gaya Pembentangan mereka. Berdasarkan daripada dapatan yang dibuat daripada survey, didapati bahawa penggunaan ar*ahan authentic assessment* bukan sahaja memberi kesan kepada pemahaman pelajar, malahan arahan ini juga akan memberi impak terhadap keyakinan pelajar untuk memberi pembentangan dengan gaya yang bersesuaian dengan kehendak subjek dan rubrik. Dapatan ini juga disokong bersama markah yang diberikan kepada pelajar oleh pensyarah berdasarkan rubrik yang digunakan.



Rajah 7: Kedalaman Penyampaian Pembentangan Pelajar

Rajah 7 di atas pula menunjukkan bagaimana penggunaan *authentic assessment* di dalam arahan tugasan Pembentangan mampu memberikan pelajar keyakinan yang membolehkan pelajar memberi penyampaian pembentangan yang lebih mendalam dari aspek perbincangan yang dilakukan. Hasil daripada dapatan tinjauan menunjukkan bahawa *authentic assessment* di dalam arahan tugasan berjaya memberikan pelajar keyakinan untuk membentangkan idea mereka secara berkesan sejajar dengan percambahan idea mereka berdasarkan rubrik yang diberikan. Dapatan ini juga disokong dengan pemarkahan daripada rubrik tersebut oleh pensyarah-pensyarah yang memberi markah yang sejajar dengan input daripada tinjauan.



Rajah 8: Tahap Keyakinan Pelajar di Dalam Pembentangan

Akhir sekali, kesan penggunaan *authentic assessment* dilihat daripada perspektif keyakinan pelajar sendiri. Rajah 8 di atas menunjukkan penggunaan *authentic assessment* di dalam arahan tugasan Pembentangan mampu melahirkan pelajar yang mempunyai keyakinan yang tinggi di dalam pembentangan mereka, yang membolehkan pelajar memberi penyampaian pembentangan menarik, perbincangan yang mendalam dan mampu menghasilkan pembentangan yang mempunyai percambahan idea yang bernas. Seperti di Rajah 8, pelajar yang lebih memahami arahan akan melahirkan pelajar yang berkeyakinan. Dapatan ini turut disokong daripada pemarkahan yang dibuat oleh pensyarah-pensyarah yang selari dengan hasil daripada tinjauan yang dibuat terhadap pelajar-pelajar.

Oleh itu, berdasarkan daripada hasil dapatan kajian yang dibuat, didapati terdapat trend peningkatan yang setara di antara pemarkahan dari rubrik oleh pensyarah-pensyarah kursus dengan data berdasarkan soalan tinjauan yang diberikan kepada pelajar. Maka, terdapat kesinambungan yang positif mengenai penggunaan kaedah *authentic assessment* dalam memastikan agar pelajar lebih memahami arahan tugasan, lalu mampu memberikan hasil tugasan yang lebih positif dan menyeluruh mengikut standard yang ada di dalam rubrik.

5 Kesimpulan

Kesimpulannya, hasil daripada pembentukan atau rekabentuk arahan tugasan yang mengikut kepada pendekatan *authentic assessment* menunjukkan impak yang positif kepada hasil pembentangan dan markah pelajar. Pelajar lebih memahami arahan tugasan yang diberikan dan pelajar lebih yakin melakukan pembentangan kajian. Pihak pendidikan tinggi seharusnya perlu menilai kecekapan pelajar dengan pemikiran kritikal melalui kajian kes, penyelesaian masalah dan kajian isu semasa situasi sebenar supaya kemahiran tersebut dapat menjadikan pelajar seorang yang profesional dan individu yang bersedia menghadapi dunia pekerjaan yang akan diceburi. Tambahan lagi, penggunaan pendekatan *authentic assessment* perlu diperkukuhkan lagi di peringkat pengajian tinggi terutamanya kepada subjek Mata Pengajian Umum (MPU). Hal ini kerana selain dapat menghasilkan graduan yang berkualiti dan berkeyakinan berhadapan dengan dunia luar, pelajar akan lebih bersedia menghadapi cabaran dalam dunia pekerjaan sebenar.

6 Pengakuan

Dalam penghasilan kajian ini, kami selaku para pengkaji, ingin mengucapkan ribuan terima kasih yang tidak terhingga kepada semua pihak yang terlibat secara langsung atau tidak langsung, seperti ahli-ahli jabatan di Jabatan Pengajian Umum (JPU) di Kolej Poly-Tech MARA, Kuantan, terutamanya kepada Puan Nurul Atikah binti Mustafa (Pensyarah Bahasa Inggeris) yang menjadi rujukan utama kami di dalam menghasilkan kajian ini. Tidak dilupakan juga Ketua Jabatan kami, Puan Intan Noorazlina binti Abdul Rahim yang memberikan sokongan kepada kami dalam menyiapkan kajian ini. Kami juga ingin berterima kasih kepada

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Implementing 'Student-led Clinical Reasoning (SCR) Exercise' as a Learning Method

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ABSTRACT

Introduction: Clinical Reasoning as a summative assessment tool, helps to evaluate students on their ability to holistically manage patients by using their critical thinking and reasoning ability in a clinical setting. It would be interesting to find out if a student-led clinical reasoning exercise would help in improving their clinical reasoning skills and their performance in the summative assessment. Aim: To provide a framework for the conduct of Student-led Clinical Reasoning (SCR) and explore the potential of Student-led Clinical Reasoning in enhancing the clinical reasoning skills among dental undergraduate students. Method: 122 final year DDS students were divided into subgroups, with each group guided by two supervisors. Each group developed a clinical reasoning case scenario according to a given structured template. Two groups were randomly chosen to conduct a structured viva based on the scenario created by the respective groups. Student satisfaction and experience with the SCR approach were assessed using an 8-item questionnaire. Results: Both students and lecturers agreed that the case scenarios developed were stimulating and thought provoking and that this experience will help in improving the students' performance in the summative assessment. Conclusion: SCR has the potential to be an effective teaching tool to enhance clinical reasoning which involves a process of diagnosis and management planning.

KEYWORDS: Assessment, Case-based reasoning, Clinical reasoning, Critical thinking, Clinical Judgement.

1 INTRODUCTION

Problem solving and decision making are essential aspects of daily life, regardless of profession. In clinical practice, these skills are critical, as accurate diagnosis and appropriate therapeutic decisions form the cornerstone of safe and effective patient care. Central to this is the development of clinical reasoning and analytical thinking skills among healthcare professionals.

Clinical reasoning encompasses the cognitive processes through which clinicians observe, gather, interpret and analyse information, ultimately arriving at a diagnosis and treatment plan. Clinical reasoning has been defined as a complex cognitive process that uses formal and informal thinking strategies to gather and analyse patient information, evaluate the significance of this information and weigh alternative actions (Simmons, 2010; Jay et al., 2024). Despite its importance, the internal cognitive steps a clinician undertakes when faced with a clinical problem are largely invisible. It is a complex professional skill that is difficult to acquire and, once developed, challenging to articulate. This abstract nature makes it particularly difficult to teach, especially at the undergraduate level. Nevertheless, the increasing complexity of healthcare and the constant evolution of medical knowledge, necessitates the cultivation of higher-order thinking skills among students.

However, it remains a key challenge for educators of dental professionals in defining the core competencies needed to meet the immediate demands of clinical reasoning upon graduation (Khatami et al., 2012). Over the years, several strategies have been proposed to teach clinical reasoning effectively (ten Cate et al., 2018). These include drawing on experience by recalling similar cases, which helps students build a mental repository of clinical scenarios. Another approach involves constructing a framework for differential diagnosis using knowledge of anatomy, pathology, and organ systems, guided by semantic qualifiers. Learners are also encouraged to differentiate between common diagnoses and less likely but critical conditions, fostering prioritization and risk assessment skills. Additionally, generating self-explanations during the problem-solving process has been shown to enhance understanding and retention.

Engaging in collaborative discussions, such as those that occur during morning reports using oral and written patient data, further supports the development of reasoning by promoting peer learning and reflective thinking (Koshy et al., 2017; Eskiyurt & Özkan, 2024; Lee et al., 2025). However, these strategies are often more suitable for advanced learners. Undergraduate students typically lack the foundational knowledge and clinical exposure necessary to apply such methods effectively. This highlights the need for structured and targeted training in clinical reasoning at the undergraduate level.

With the need to incorporate clinical reasoning especially in challenging situations of teaching the undergraduate, varying methods have been used, each complete with differences in terminologies for Clinical Reasoning incorporated teaching methods. But whatever methods used, Clinical Reasoning incorporated in various teaching methods have shown to contribute towards the enhancement of learning outcomes which include an increase in confidence, discussion among students and higher examination scores (Sartania et al, 2022; Colonello et al, 2024).

In many schools, Clinical Reasoning has been incorporated into case -based discussions complete with scenarios, focussed questions, very objective answers incorporating best diagnosis and management. Such Case-based Clinical Reasoning (CBCR) was originally designed at the Academic Medical Center of University of Amsterdam in 1992 (ten Cate et al., 2018) and has been used in the medical curriculum ever since. Case-based clinical reasoning (CBCR) has been adopted as an assessment tool in medical education across several countries such as United Kingdom (Jay et al., 2024), Netherlands (Keemink et al., 2018), Canada (Cameron et al., 2024), Iran (Sadeghi et al., 2019), Libya (Gerriw et al., 2024), Italy (Colonnello et al., 2024), Australia and Indonesia (Findyartini et al., 2016). Additionally, there is a growing body of evidence in its usage in dental education in Canada (Khatami et al., 2012), Indonesia (Chrismawaty et al., 2023), Iran (Owlia et al., 2022) and South Africa (Postma & White, 2015). However, there is no evidence of published literature of a CBCR conducted in Malaysian universities. To address this gap, we modified the CBCR into a teaching tool called Student-led Clinical Reasoning exercise (SCR). It was recognized that knowledge on variations in students' conceptualizations of subject matter is important for teaching. Thus, teaching becomes a rational activity only when the instructor understands what and how students discern or conceptualize the phenomenon being taught (Hendrick et al., 2009). Hence, the aim of this study was to provide a framework for the conduct of Student-led Clinical Reasoning. Furthermore, we aimed to explore the potential of Student-led Clinical Reasoning in enhancing the clinical reasoning skills among dental undergraduate students.

2 METHODOLOGY

2.1 Case-based Clinical Reasoning (CBCR) Framework – The assessment tool

The framework of CBCR assessment (Fig 1a) consists of a case scenario that includes multiple vignettes (minimum of 3), clinical pictures, radiographs and/or models. Under each vignette, 2-3 must-know questions are asked related to the case scenario. The questions are mostly reasoning based questions (C3 to C4 levels - Blooms Taxonomy). There is an examiner's guide (Fig 1b) which consists of the expected correct answers for each question and some prodding questions to guide the student, in situation where the student is unable to answer the question. Time and marks are allotted for each question. Marks for each question are based on the degree of correctness of the answers and if the prodding questions were used or not. An assessment rubric (Table 1) is prepared for marking the answers. After the preparation of the CBCR case, it is calibrated among all the examiners prior to the examination. The CBCR assessment is in the format of a viva, and the entire assessment runs for 14-15 minutes for each student and hence a stipulated time is allotted for answering each question. The students are divided into groups for the viva. Within each group, each student will be examined by 2 lecturers. The conduction of CBCR is shown in the flowchart (Figure 2).

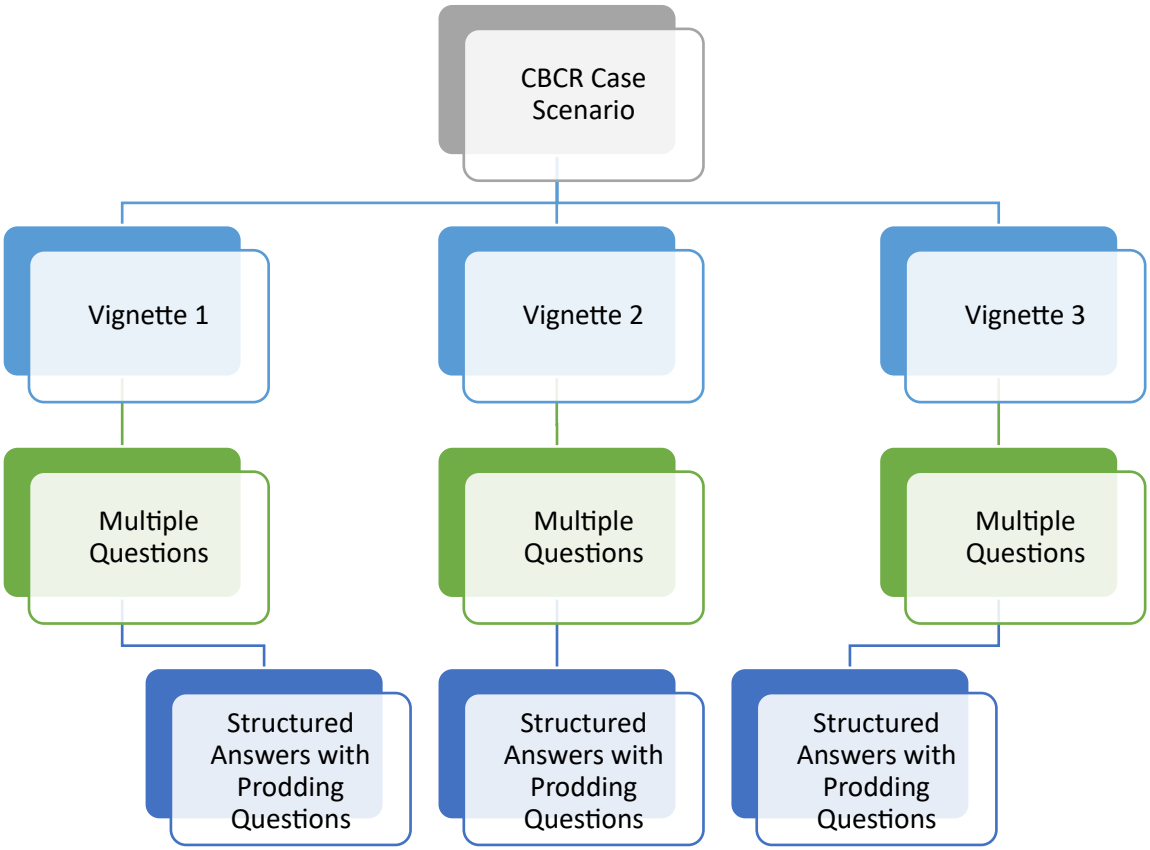


Figure 1a: The framework of CBCR Case scenario

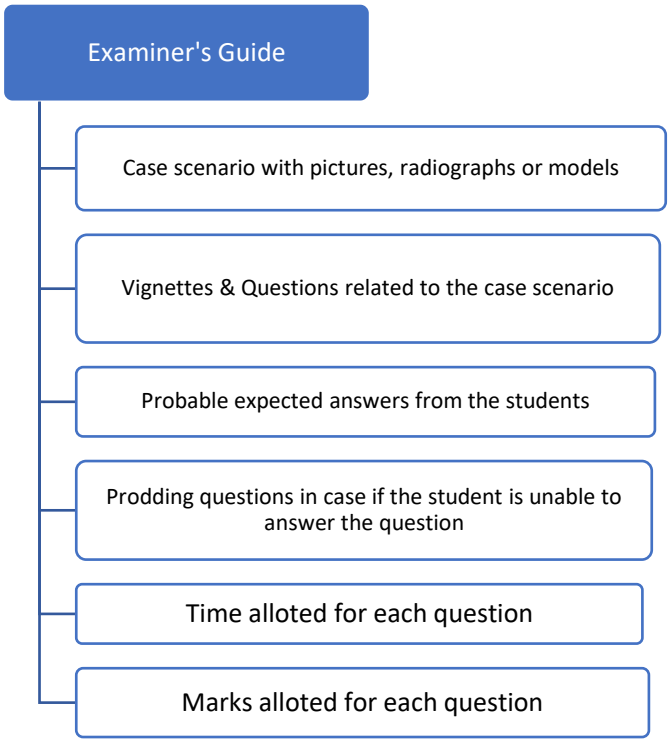


Fig 1b: The framework of the CBCR Examiner's Guide

Table 1. Assessment Rubrics

Students Response	Description	Marks
Did not answer correctly after prodding	No effort made to answer and did not give any answers, after prodding	**0**
	Effort made to answer, but has given the wrong answers, after prodding	**1**
Answers correctly after prodding	Answers less than 50% of the required answers, after prodding.	**2**
	Answers more than or equal to 50% of the required answers, after prodding.	**3**
	Answers all in full after prodding.	**4**
Answers correctly without prodding	-	**5**

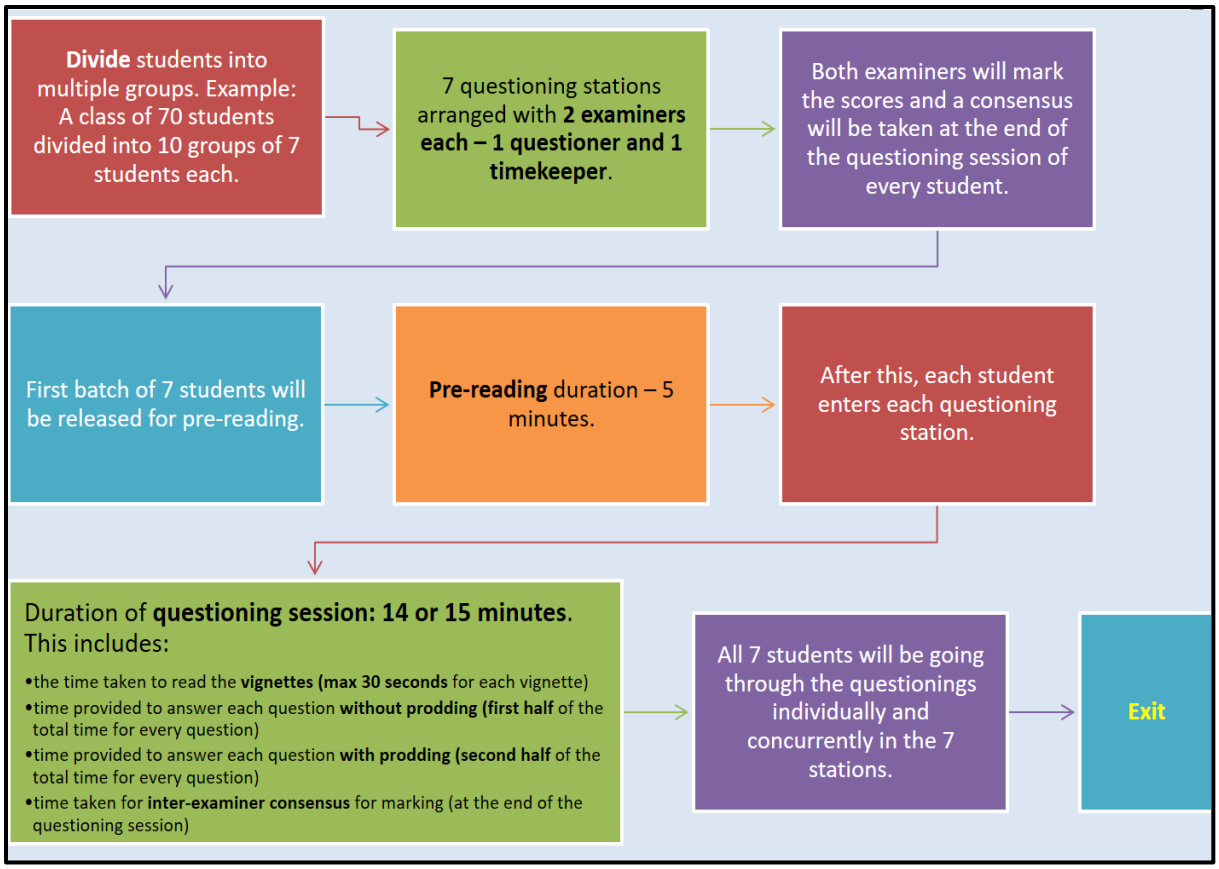


Figure 2. Flowchart of CBCR

2.2 Student-led Case-Based Clinical Reasoning (SCR) Framework: The teaching tool

At the Faculty of Dentistry, MAHSA University, we adapted the CBCR assessment framework into an educational intervention named Student-led Clinical Reasoning (SCR). In this method, students actively participate in the full cycle of the CBCR process—designing case scenarios, formulating vignettes and questions, identifying expected answers and prodding questions, using/familiarizing the CBCR assessment rubric, conducting peer assessments(viva) and evaluating the responses. This process is facilitated and supervised by designated supervisors, who are the clinical teaching staff of the faculty.

A total of 122 final year undergraduate dental students were divided into small groups of 10-12 students per group, based on the class size. The conduction of SCR is shown in the flowchart (Figure 3). To ensure clarity, the teaching faculty conducted a role-play demonstration of the SCR process prior to implementation. Each group, described as the case design action group (CDAG) was given four weeks to develop a comprehensive CBCR case, which was reviewed and approved by two designated faculty supervisors (Figure 4). Two students from another group (non-CDAG) volunteered or were randomly selected to undergo a viva assessment (Figure 5). Meanwhile, two students from CDAG served as examiners. The remaining students (non-CDAG), along with five supervisors, evaluated the responses using the prepared CBCR assessment rubric. The clarity and quality of the questions was assessed through a focussed discussion of similarities in the scoring of the two non-CDAG examiners, the other non-CDAG evaluators and the supervisors. Based on the outcome of the focussed discussion, appropriate suggestions would be given by the teaching faculty. The CDAG students' performance were formatively evaluated by the supervisors for leadership skills, active participation, ability to create the full case with questions, answers and prodders, with an endpoint of understanding the

focussed discussions through making the relevant corrections to the Case scenario that was developed and implemented.

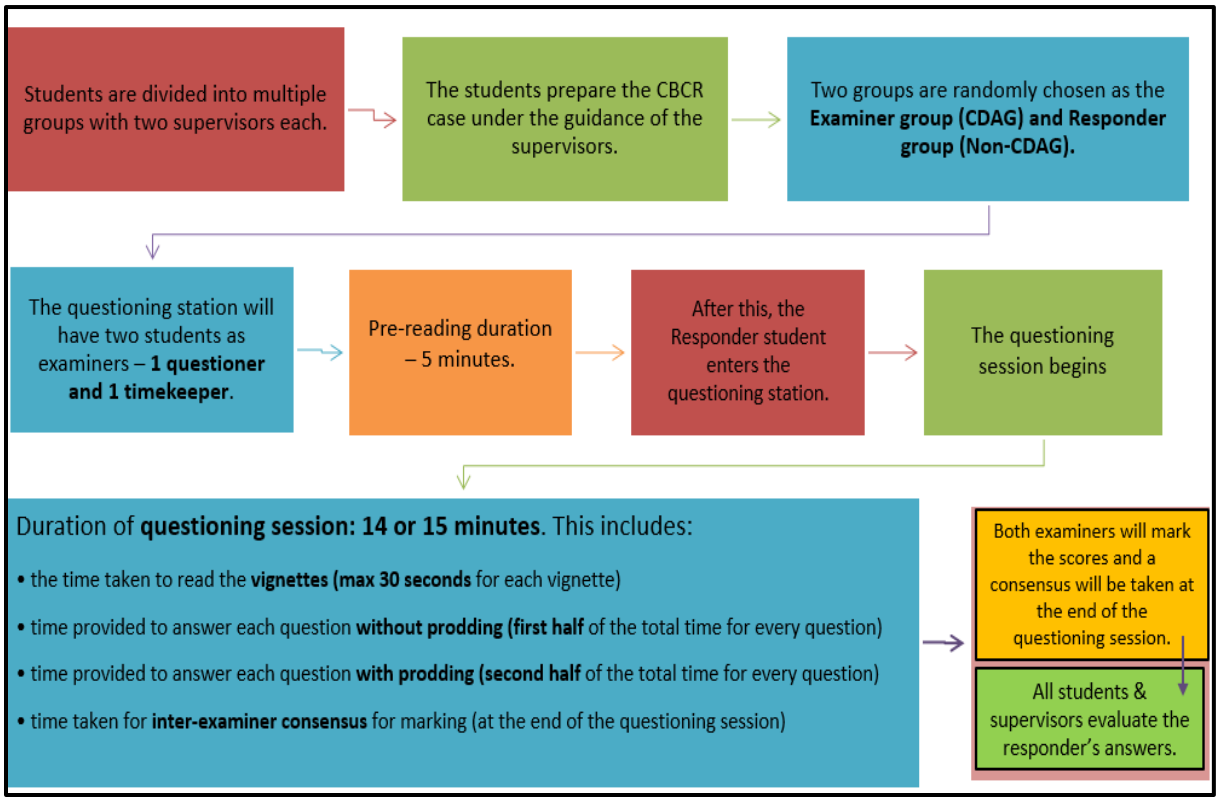


Figure 3. Flowchart of SCR



Figure 4. Supervisors discussing the case scenario with a student group

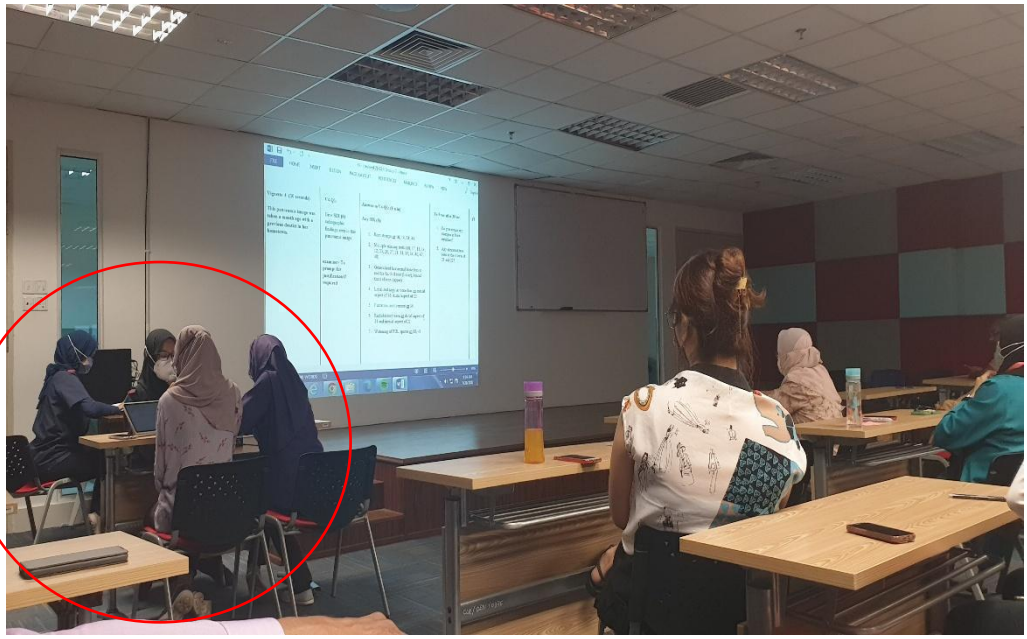


Figure 5. Viva being conducted by CDAG group to non-CDAG group (red circle), in the presence of the supervisors

2.3 Student Satisfaction and Supervisor feedback

Student satisfaction and experience with the SCR approach were assessed using an 8-item questionnaire. The questions were rated on a Likert scale to quantify overall satisfaction. Some open-ended questions were

also included at the end of the questionnaire to elicit in-depth information. The same questionnaire was provided to the lecturers who had been supervising the SCR exercise.

3 RESULTS

A total of 122 students (Table 2) and 16 lecturers (Table 3) provided their feedback on the SCR. Overall, both groups viewed the SCR positively, with notable similarities and some differences in their responses. The majority of students (80.3%) and lecturers (81.3%) agreed that the SCR improved clinical reasoning skills. Similarly, 84.4% of students and 87.5% of lecturers believed the experience would enhance students' performance in the final CBCR assessment. High levels of agreement were reported regarding the allocation of two supervisors per group, with all lecturers (100%) supporting this approach and 82.8% of students agreeing that the presence of two supervisors was helpful in developing the SCR. Regarding discussions during the development of vignettes, questions, and prodding prompts, 78.7% of students agreed that these were adequately conducted with their supervisors. Among lecturers, 62.5% agreed with this statement, while 31.3% were neutral and 6.3% disagreed. Clarity on the SCR process and case selection was similarly rated by both groups, with 71.3% of students and 75.0% of lecturers agreeing that the process was clear and suitable cases were selected. Time allocation to develop the case histories was identified as a potential area for improvement. While 60.7% of students agreed that the time provided was sufficient, only half of the lecturers (50.0%) felt the same. Perceptions of teamwork also varied. A total of 76.2% of students agreed that their group collaborated effectively and accepted their team leader. In comparison, only 56.3% of lecturers felt that students worked well as a team, while 18.8% disagreed, indicating a possible gap between student self-perception and lecturer observation. Both students (80.3%) and lecturers (81.3%) found the case histories developed through the SCR process to be stimulating and thought-provoking, suggesting high levels of engagement and educational value.

Table 2. Feedback from students (n=122)

Question	Agree, n (%)	Neutral, n (%)	Disagree, n (%)
1. Overall, CBCR can improve my clinical thinking skills (reasoning capabilities)	98 (80.3)	19 (15.6)	5 (4.1)
2. The allocation of TWO (2) supervisors to my group was helpful to assist us in developing the SCR	101 (82.8)	18 (14.8)	3 (2.5)
3. As a group, we were clear about the process of SCR and a suitable case was selected.	87 (71.3)	31 (25.4)	4 (3.3)
4. Adequate discussions with supervisors were conducted to develop the vignettes, questions and answers including the appropriate prodding questions.	96 (78.7)	23 (18.9)	3 (2.5)
5. The time given was appropriate to develop a good case history between	74 (60.7)	37 (30.3)	11 (9.0)

the initial preparation and the presentation date allotted.			
6. The students in my group worked as a team and the team leader was accepted by all members.	93 (76.2)	23 (18.9)	6 (4.9)
7. The case histories that we developed together with the supervisors were stimulating and thought provoking.	98 (80.3)	24 (19.7)	-
8. The experience in doing the SCR will help in improving my performance in the final CBR assessment.	103 (84.4)	16 (13.1)	3 (2.5)

3.1 Qualitative Feedback by students for improvement

Students expressed appreciation for the SCR experience and acknowledged its role in enhancing their confidence and preparedness for the final CBCR assessment. Many students found the activity helpful, with some noting that it served as a supportive experience during the high-stress examination period. However, several suggestions were offered to improve the overall experience and workflow. A frequently mentioned recommendation was to conduct the SCR in semester nine instead of semester ten, as students reported being overwhelmed with multiple academic commitments toward the end of the term. However, the other students noted that conducting it in semester ten remained beneficial for final exam preparation. Several students recommended allocating more time for key stages of the SCR process, particularly for case selection, supervisor consultation and preparation for the presentation. Concerns about consistency among supervisors were raised, particularly when the two supervisors for a group were unable to meet at the same time. To address this, students recommended either maintaining one supervisor per group throughout the process or standardizing expectations across all supervisors. Some students also suggested forming smaller groups to ensure equal participation. Others proposed clearer task allocation within the group to promote fairness and accountability. In summary, students valued the SCR as an effective and meaningful learning activity. Their suggestions centered on improving the timing, structure, and consistency of the process to optimize learning and reduce end-of-program stress. Many expressed gratitude for the efforts of their lecturers and supervisors, emphasizing their overall positive experience with the SCR.

Table 3. Feedback from lecturers (n=16)

Question	Agree, n (%)	Neutral, n (%)	Disagree, n (%)
1. Overall, CBCR can improve students' clinical thinking (reasoning capabilities)	13 (81.3)	2 (12.5)	1 (6.3)
2. The allocation of TWO (2) supervisors to a student group was acceptable.	16 (100.0)	-	-
3. Students were clear about the process of SCR and suitable cases were selected.	12 (75.0)	4 (25.0)	-

4. Adequate discussions with supervisors were conducted to develop the vignettes, questions and answers including the appropriate prodding questions.	10 (62.5)	5 (31.3)	1 (6.3)
5. The time given was appropriate to develop a good case history between the initial preparation and the presentation date allotted.	8 (50.0)	4 (25.0)	4 (25.0)
6. The students in your group worked as a team.	9 (56.3)	4 (25.0)	3 (18.8)
7. The case histories developed by the students were stimulating and thought provoking.	13 (81.3)	3 (18.8)	-
8. The experience in doing the SCR will help in improving their performance in the final CBR assessment.	14 (87.5)	1 (6.3)	1 (6.3)

3.2 Qualitative Feedback by lecturers for improvement

Lecturers provided several constructive suggestions for improving the SCR process. A common recommendation was to initiate the SCR earlier in the semester to allow sufficient time for preparation and reflection. The current exercise was conducted during the semester 10 (The final semester of the program). Some lecturers proposed starting the activity in semester nine of the undergraduate dental program. Lecturers observed that students often selected similar or repetitive cases, and emphasized the need for supervisors to play a more active role in guiding students toward diverse and meaningful case choices. It was also suggested that critical thinking be better promoted through question framing, incorporating prompts such as "give reasons," "reflect," or "state your observations." Lecturers also recommended evaluating students during the SCR preparation phase to reinforce accountability and participation. Additional recommendations included the standardization of vignette presentation, particularly the reading pace and timing of prodding questions, to ensure consistency across groups. Overall, while lecturers affirmed that the SCR is an excellent learning tool, they highlighted several areas where implementation and assessment practices could be refined for greater effectiveness.

4 DISCUSSION

SCR has been used in the Faculty of Dentistry, MAHSA University as a teaching tool for clinical reasoning. The SCR ensures that students follow the processes used by lecturers in preparation for the CBCR assessment tool. As explained earlier, students had to make an introductory clinical scenario and create related case vignettes. Questions and answers incorporating reasoning on patient-based clinical problems were developed in relation to the scenario and vignettes created. This process of creating the case scenario, questions and answers was also being reviewed and corrected by the supervisors. This introduced a corrective feedback mechanism which has been shown to be a powerful method in enhancing the students learning. de Beer & Martensson, (2015) in their study on occupational therapy students' clinical reasoning found that these clinical reasoning skills improved through corrective feedback when accompanied by suggestions on how to improve their input. Another study conducted in a Dental University Hospital in Ireland showed that 77% of the students reported an enhancement in their clinical performance due to the feedback received (Davis et al., 2022).

SCR included a variety of processes that students had to go through with their supervisors on developing clinical reasoning for the management of their case. Hence, this explains the results that 'the majority of students agreed

that SCR improved their clinical reasoning skills and believed it would enhance their performance in the final CBCR assessment. These findings of the students' views that SCR improved their clinical reasoning and can enhance their final CBCR performance, was also consistent with the lecturers' perspective that 'a high proportion agreed that SCR improved students' clinical reasoning while also can contribute to better performance in the final assessment'. da Bove Rybertt et al., (2022) reported in their qualitative study, that both students and teachers perceived that clinical reasoning as an analysis process is indispensable for both Kinesiology and Dentistry careers.

Additionally, a second aspect of the ability to enhance clinical reasoning skills is the implementation of the viva, where the student examiners' feedback encourages the students to discuss on issues with regards the case. This is further supplemented by the presence of 5 lecturers during the session, who also contribute as content experts. It was recommended that the case was to involve more than 2 disciplines, thus incorporating interactive processes between many disciplines. Studies have shown that interdisciplinary approach increased students' appreciation of the complexity of patient care and helped in formulating a patient-centered approach to diagnosis and treatment planning (Richards & Inglehart, 2006). While this model may use actual patient cases or mock-up cases, it gives the ability to integrate many factors while identifying and solving problems in a real or hypothetical situation. This validates the need for the 5 additional lecturers as experts of different disciplines, to ensure that updated issues in any of the disciplines are being highlighted during the final discussion session after the viva.

The presence of the two supervisors was reported to be helpful by many students where there was a high level of agreement. This was further explained by the findings that 78.7% of students agreed that there were adequate discussions with supervisors during the processes of development of case-based reasoning scenarios, questions, answers and the prodders, thus reflecting strong supervisory engagement and guidance. This finding was consistent with the lecturers' perspective that the 'allocation of two supervisors per group was unanimously supported'. Further support to the students' perception that there were adequate discussions with supervisors, was the findings that 'a majority of the lecturers (62.5%) agreed that adequate discussions were conducted during case and vignette development.' However, a notable proportion (31.3%) were neutral, and 6.3% disagreed which may reflect some shortcomings such as inexperienced lecturers, lecturers not being the content expert for the scenario being developed and inadequate training of the lecturers in supervising an SCR student group. Therefore, this indicates the need to choose the experienced lecturers, to train the less experienced lecturers and to invite additional co-supervisors with the relevant content expertise.

Through this teaching method where cases and vignettes were developed, most of the students (71.3%) agreed that they were clear about the SCR process and case selection. This is again similar with the lecturers' perspective where most lecturers (75.0%) agreed that students had a clear understanding of the SCR process and that suitable cases were selected. Again, there is several students and lecturers who were neutral with regards to this issue. This again reflects on the possibility that these students may not be actively involved, which has been seen in many group-based teaching methods (Burke, 2011). Similarly, there may be lecturers who may not be fully aware that they should be totally involved in making suggestions if cases were felt to be unsuitable. However, it maybe that the time of 4 weeks are too short to ensure re-development of suitable cases. This was evidenced by the fact that 'time allocation was identified as a potential area for improvement, where only 60.7% of the students agreeing that the time provided was sufficient'. From the lecturers' perspective, only 50% felt that there was sufficient time given to develop case histories, thus supporting some of the students' perception of needing more time, especially in situations where supervisors felt that cases/vignettes first developed were unsuitable. Increasing time to develop the case/vignettes would allow for further enhancement of the clinical reasoning process, where reasons for non-suitability of the case can be seen as positive feedback to the students learning process. Time constraints was similarly cited in two other studies by Davis et al. (2022) and Gerriw et al. (2024) in a similar quantitative study in Libya.

Another aspect of SCR was the development of leadership and teamwork which is one of the important factors in group-based teaching (Healey, 2024; Burke, 2011). The majority of students regarded teamwork positively, with 76.2% agreeing that their group collaborated effectively and accepted their team leader. However, from the teacher's perspective, it was reported lower percentage (56.3%) of the students worked well as a team, with some suggesting inconsistency in group dynamics. Group dynamics and teamwork is especially important in SCR, as developing clinical reasoning requires good reasoning strategies which include 'collaborative learning'. 'Collaborative Learning' is defined as when students achieve a common learning goal, they compete in a group and are responsible for each other's learning (Cheng et al., 2021). Collaborative learning is especially useful in the context of clinical reasoning where enhancing clinical reasoning requires recognizing past experiences and integrating the similarities and differences in each member's personal frame of reference for identifying and interpreting information (Khatami et al., 2012; Lee et al., 2025).

It was however quite encouraging that 81.3% of the teachers found the student-developed case histories to be stimulating and thought-provoking which explains the fact that 80.3% of the students also found the case histories they developed to be stimulating and thought-provoking. These findings lend support to SCR as one of a teaching method to encourage and enhance clinical reasoning while embarking on problem solving and planning of case management. Notably, among medical students in Libya, approximately three-quarters of the sample, endorsed the use of CBCR with their peers and colleagues. Almost all respondents agreed that CBCR helps them make informed decisions in their daily practice (93%) and boosts their confidence in advancing their medical careers (86.8%) [Gerriw et al., 2024].

5 CONCLUSION

The findings of this study show that SCR has the potential to be an effective teaching tool to enhance clinical reasoning, which involves a process of diagnosis and management planning. Implementing this exercise in the dental curriculum can help the students in enhancing their performance in their clinical practice.

6 RECOMMENDATIONS

Based on the feedback obtained, lecturers with a higher experience could be chosen as the supervisors and the less experienced lecturers can be provided additional training to be efficient supervisors. Additionally, it is also recommended that the time taken to develop the case/vignettes can be increased to allow for further enhancement of the clinical reasoning case development process. Further study would be required to evaluate the effectiveness of student-led clinical reasoning by adding a focus group discussion, to gain deeper insights into the challenges encountered.

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Digital Literacy and English Language Learning: TikTok's Contribution to Developing Multiliteracies

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ABSTRACT

The rapid rise of social media platforms has transformed the way individuals interact with content and communicate globally. TikTok, a video-sharing platform characterized by short, engaging videos, has gained immense popularity among young users, becoming a cultural phenomenon. Beyond its entertainment value, TikTok is increasingly recognized as a potential tool for educational purposes, including language acquisition. Its dynamic, user-generated content fosters authentic language exposure, engagement, and interaction—critical components of language learning. This conceptual paper reviews the intersection of digital literacy and English language acquisition through the lens of TikTok as a multimodal platform. Grounded in multiliteracies theory, it synthesizes existing literature to explore how TikTok facilitates the development of diverse literacies, including linguistic, visual, and cultural competencies. The paper highlights the platform's potential to enhance language learning through interactive, participatory, and culturally relevant content, while also addressing the challenges of navigating a rapidly evolving digital ecosystem. TikTok's user-driven nature offers authentic, real-world language exposure and opportunities for interaction—elements vital for effective language learning. This shift aligns with the principles of multiliteracies theory, which emphasize the importance of diverse communication modes and cultural contexts in contemporary literacy practices.

KEYWORDS: TikTok, English Language Learning, English Language Acquisition, Digital literacy, Multiliteracies Theory.

1 INTRODUCTION

In the digital age, literacy extends beyond the ability to read and write traditional texts; it now encompasses a range of skills required to navigate, interpret, and produce multimodal content (Yap & Gurney, 2023). Today's communication landscape—driven by rapid technological advancements and the widespread use of digital devices—demands that individuals not only decode written language but also understand and critically engage with texts that integrate visuals, audio, gestures, and interactive elements. This broader concept of literacy, often referred to as multiliteracies, includes digital, visual, and socio-cultural competencies that are essential for effective communication in contemporary society (Yap & Gurney, 2023). These literacies are necessary for functioning in academic, professional, and everyday settings, where information is presented in multiple formats such as text, images, videos, sound, and interactive media. Multiliteracies empower individuals

to become active participants in the digital world rather than passive consumers. They encourage learners to be creators, collaborators, and critical thinkers who can adapt to the changing technological landscape. As a result, education systems are increasingly called to integrate multiliteracies into curricula, moving beyond traditional literacy instruction to prepare students for success in an interconnected, digital society.

Among the various digital platforms that support the development of multiliteracies, TikTok has emerged as a powerful tool for both entertainment and education, especially in English language learning. With its global popularity and user-friendly design, TikTok offers learners immediate access to a variety of short videos that blend humor, storytelling, and instructional content. According to Wang and Lin (2021), TikTok's short-form videos can be used to deliver educational material in an interactive and engaging way that meets the needs of today's learners. The platform provides rich sources of authentic language, cultural insights, and opportunities for meaningful communication, making it a valuable supplement to traditional classroom instruction (Condoy, 2024; Harrison & Thomas, 2009). As a video-sharing platform, TikTok allows users to interact with content through audio-visual storytelling, text overlays, and participatory culture (Vera et al., 2024). Consequently, it offers unique opportunities for learners to develop multiliteracies by combining linguistic, visual, and digital communication skills (Jimola, 2023). As platforms like TikTok continue to shape informal learning, their role in supporting language acquisition and multiliteracies development becomes increasingly relevant to both educators and researchers.

English language learners (ELLs) benefit greatly from exposure to authentic language, real-world contexts, and peer interaction; elements that can enhance proficiency in ways traditional methods may not fully provide. Conventional language instruction often relies on structured grammar lessons, textbook dialogues, and standardized tests, which, while useful, may not reflect the dynamic, contextualized nature of real-life communication (Jabir, 2021). The concept of multiliteracies, introduced by the New London Group (1996), emphasizes the multiple communication channels and the cultural and linguistic diversity of the digital age. It argues that traditional literacy, which focuses mainly on reading and writing print text, is no longer sufficient. Learners must also develop digital, visual, spatial, and cultural literacies to understand and create meaning in various contexts. TikTok, with its multimodal content, provides a unique way for learners to engage with language in diverse and meaningful ways (Condoy, 2024). Digital literacy involves the skills needed to navigate, assess, and create information using digital tools (Kumar, 2023; Eshet-Alkalai, 2004). In the context of language learning, digital literacy also includes the ability to use digital platforms to improve language skills. Integrating TikTok into English language education aligns with broader trends in educational technology, which emphasize interactive, engaging, and learner-centered approaches (Condoy, 2024; Kukulska-Hulme & Shield, 2008).

Despite TikTok's growing popularity among young users globally, its integration into formal language education remains notably limited. While the platform has demonstrated potential in engaging learners through short-form, user-generated content, there is still a significant gap in understanding how such digital tools can be systematically and effectively employed to support English language acquisition and multiliteracies development (Eleyana Abdullah et al., 2023; Hu & Du, 2022; Tan et al., 2022). Much of the current discourse focuses on informal learning or entertainment value, with less emphasis on pedagogical frameworks that could support intentional learning outcomes in academic settings.

Multiliteracies, which encompass linguistic, visual, digital, and cultural competencies, are increasingly essential in today's media-saturated, globally connected environment (Afrilyasanti et al.,2025). As such, addressing this research gap is critical; not only to enhance language proficiency but also to ensure that learners are equipped with the broader communicative competencies needed for participation in digital, academic, and professional contexts (Condoy, 2024). The integration of platforms like TikTok, if guided appropriately, could help students develop multimodal literacy skills, foster learner autonomy, and enhance engagement through authentic, context-rich language use.

However, this potential remains largely untapped due to several barriers. As noted by Cassidy et al. (2021), educators continue to face significant challenges in integrating technology into literacy instruction. These include uncertainties about the pedagogical value of emerging platforms, limited training in digital tools, and a lack of evidence-based strategies to guide effective implementation. Moreover, institutional constraints and concerns over content appropriateness and quality control often hinder meaningful adoption in the classroom.Therefore, this conceptual paper aims to:

(1.) Explore how TikTok supports multiliteracies development in English language learners.
(2.) Analyze TikTok's role in promoting digital and linguistic competencies
(3.) Identify challenges and limitations of TikTok as an educational tool.

2 LITERATURE REVIEW

2.1 The Evolution Of Literacy In The Digital Age

The concept of literacy has significantly evolved in response to the technological, cultural, and communicative changes of the 21st century. Traditionally defined as the ability to read and write printed text, literacy is now recognized as a multifaceted concept that extends beyond written language. It includes a range of digital, visual, and multimodal skills essential for effective communication in today's society (Nabhan, 2021).

The New London Group (1996) played a key role in redefining literacy by introducing the multiliteracies framework, which emphasizes the need for learners to develop proficiency in various modes of meaning-making (Cazden et al., 1996). This framework views literacy not as a single, universal standard but as something shaped by cultural, linguistic, and technological diversity. Multiliteracies include linguistic, visual, spatial, gestural, and audio modes, reflecting how people engage with information in digital environments (Cazden et al., 1996).

As digital technologies have become widespread, digital literacy has emerged as a core aspect of modern literacy education. Falloon (2020) describes digital literacy as a broad set of cognitive and technical skills required to operate effectively in digital spaces, including evaluating information, understanding multimedia, and communicating online. Kumar (2023) further emphasizes that digital literacy is fundamental for academic and professional success, as it enables individuals to think critically about digital content, collaborate online, and engage in virtual communities.

In response to these changes, scholars have increasingly examined how digital tools and platforms can support the development of multiliteracies. Traditional literacy instruction must be reimagined to reflect the complex, multimodal nature of today's communication (Cope & Kalantzis, 2009, 2023). This involves integrating digital media into classrooms and teaching students how to navigate, analyze, and create multimodal texts (Cope & Kalantzis, 2009, 2023).

Recent studies have also highlighted the influence of social media and digital platforms on literacy practices. For instance, Bernier (2020) emphasizes the role of participatory culture in developing digital literacy, where learners are active producers and sharers of content rather than passive consumers. This shift from passive to active engagement aligns with the goals of multiliteracies pedagogy, which encourages learners to be critical thinkers, culturally aware, and technologically skilled.

TikTok is a popular short-form video platform, exemplifies the blending of multimodal communication and participatory culture. According to Jimola (2023), TikTok promotes both linguistic and visual literacy by enabling users to engage with content through video, text overlays, sound, and gesture. It provides opportunities for authentic language use, creativity, and social interaction; particularly for younger learners who are already active in digital environments. Alharthy (2025) adds that platforms like TikTok can enrich traditional teaching by offering culturally relevant, engaging learning experiences that reflect real-world communication.

Despite these advancements, challenges remain in integrating digital literacy into formal education. Falloon (2020) points out the lack of clarity around what constitutes effective digital pedagogy, noting that many educators struggle to connect technology use with meaningful literacy outcomes. Additionally, digital inequality remains a significant barrier, as access to technology and digital skills is still uneven across different populations (Helsper, 2021).

In conclusion, the evolution of literacy in the digital age represents a broader shift toward multimodal, participatory, and technology-driven communication. As literacy increasingly transcends traditional reading and writing, it becomes imperative for educators and policymakers to adopt frameworks that nurture both multiliteracies and digital literacy. From my perspective, this shift not only reflects changing modes of

communication but also challenges us to rethink what it means to be "literate" in today's world. Learners must now be equipped not only with linguistic competence but also with the ability to interpret, produce, and critically evaluate diverse forms of digital content. This calls for educational environments that are flexible, inclusive, and responsive to evolving technologies. I believe that bridging this gap requires intentional curriculum design, teacher training, and the integration of emerging platforms such as TikTok and other social media into meaningful pedagogical practices. Ultimately, the responsibility lies with both researchers and practitioners to ensure that our teaching methods remain relevant and empowering. Only through sustained inquiry and innovation can we prepare students to navigate, contribute to, and thrive in an increasingly complex and digital global society.

2.2 Understanding Multiliteracies And Language Learning

The concept of multiliteracies, introduced by the New London Group (2000), has significantly influenced language education by emphasizing the need for learners to engage with diverse modes of communication beyond traditional print literacy. This framework recognizes the multiplicity of communication channels and cultural contexts in the digital age, advocating for pedagogical approaches that enable learners to interpret and create meaning across various semiotic modes (Zou et al., 2024).

Recent research highlights the relevance of multiliteracies in enhancing language learning. Mirhosseini and Emadi (2022) investigated the application of multiliteracies pedagogy in Iranian EFL classrooms and found that such approaches promote learner engagement, autonomy, and ownership of language use. Their study emphasized the value of designing learning experiences that are personally meaningful and encourage active participation. Similarly, Kim et al. (2020) examined the use of multiliteracies pedagogy in international second-language teaching contexts. Their findings suggest that integrating multiliteracies supports more inclusive teaching practices and advances educational equity by accommodating diverse linguistic and cultural backgrounds.

Despite its pedagogical promise, the implementation of multiliteracies pedagogy is fraught with practical and contextual challenges that warrant closer scrutiny. Paesani and Allen (2020) critically examined postsecondary language programs and identified significant barriers, such as limited access to professional development and a widespread lack of conceptual clarity among educators regarding the principles of multiliteracies. These findings suggest that without a clear and shared understanding of the framework, educators may struggle not only to implement it effectively but also to recognize its value within traditional curricular structures. Their call for structured institutional support is crucial, yet it also reveals a deeper issue: the gap between theoretical innovation and real-world application in language education.

In the Malaysian context, Puteh-Behak et al. (2015) extended the conversation by highlighting socio-cultural constraints that complicate the adoption of Western-informed multiliteracies pedagogies. While their study acknowledges the value of these approaches, it also raises important questions about the cultural and educational relevance of importing pedagogical models developed in different contexts. The challenge here is not merely technical or procedural—it is epistemological. There is a pressing need to decolonize and localize multiliteracies pedagogy so that it resonates with learners' lived experiences, identities, and cultural practices.

Critically, both studies underscore a fundamental tension between global educational innovations and local realities. While multiliteracies pedagogy emphasizes diversity, multimodality, and student agency, its implementation often clashes with entrenched educational norms, resource limitations, and hierarchical power structures within institutions. Therefore, rather than viewing multiliteracies as a one-size-fits-all model, educators and researchers must approach it as a flexible, culturally sensitive framework that evolves in dialogue with the communities it serves. Only through such a critically reflexive lens can the true transformative potential of multiliteracies be realized. The role of multiliteracies in promoting inclusivity in language education has also gained attention. Chin (2024) explored multiliteracies pedagogy in second-language writing classrooms, highlighting its potential to create inclusive learning environments that support diverse student needs. The study showed that using multimodal resources and valuing students' linguistic repertoires can enhance both engagement and learning outcomes.

The literature reflects a growing recognition of the importance of multiliteracies in language education. While challenges remain particularly in terms of teacher preparedness and cultural adaptability the potential of multiliteracies to improve learner engagement, inclusivity, and critical communication skills is clear. Future research and professional development efforts should focus on equipping educators with the necessary tools and frameworks to effectively integrate multiliteracies into language learning contexts.

2.3 Digital Literacy And Its Role In Language Education

Digital literacy has become a cornerstone of modern education, especially in the field of language learning. It involves the skills and competencies needed to effectively navigate, evaluate, and create information using digital technologies. In language education, digital literacy includes the ability to use digital tools to support language acquisition, enhance communication, and foster cultural understanding. The integration of digital platforms has transformed traditional teaching methods, requiring educators to reassess both pedagogy and learning outcomes. Feng and Sumettikoon (2024) emphasize that digital literacy in language education encompasses information literacy, data literacy, network literacy, and innovative thinking—skills essential for effective teaching and learning in digital environments.

The COVID-19 pandemic accelerated the adoption of digital technologies in education. Giannikas et al. (2022) describe how the sudden shift to online learning in Cyprus exposed gaps in teachers' digital competencies, highlighting the urgent need for targeted professional development. The pandemic demonstrated the critical role of digital literacy as teachers and students adapted to new platforms and tools to maintain learning remotely. As a result, integrating digital literacy into teacher education programs has gained importance. Aslan et al. (2025) explored the relationship between Technological Pedagogical Content Knowledge (TPACK) and digital literacy, finding that digital literacy significantly enhances the effectiveness of TPACK in teaching 21st-century skills. This underscores the importance of strengthening digital literacy among pre-service teachers to improve modern language instruction.

Governments and educational institutions have acknowledged the significance of digital literacy in language education. In Malaysia, the Ministry of Education introduced the Digital Education Policy (2023–2030) to embed digital technology into the learning ecosystem and promote a digitally literate generation. Similarly, the ASEAN Digital Literacy Programme (2022–2024) focuses on capacity building, awareness campaigns, and the development of e-learning platforms to improve digital skills across member states (ERIA, 2023).

Despite these efforts, challenges remain in implementing digital literacy effectively. Mastam, Mokhtar, and Zaharudin (2024) highlight the digital divide in Malaysia, especially among inclusive students who face obstacles such as limited access to technology and insufficient support. Addressing these inequalities is essential to ensure equitable access to digital learning resources and opportunities for all students.

Nevertheless, digital literacy plays a pivotal role in enhancing student engagement and improving language learning outcomes. Arjang et al. (2024) assert that digital tools facilitate interactive and personalized learning experiences, allowing learners to access authentic language materials and engage in real-time practice. This aligns with contemporary understandings of effective language acquisition, which emphasize contextualized, meaningful use of language. Similarly, Mahendra (2024) highlights the connection between digital literacy and increased learner motivation, autonomy, and language proficiency, suggesting that technology can empower students to take greater control of their learning processes.

However, while these benefits are well-documented, it is important to approach such claims with a critical lens. The effectiveness of digital tools is highly dependent on how they are integrated into pedagogical practices. Simply incorporating technology into the classroom does not guarantee improved outcomes; rather, it requires thoughtful instructional design and a deep understanding of both the affordances and limitations of digital platforms. In my view, one of the key challenges lies in ensuring equitable access and fostering digital competence among both students and educators. Without targeted training and support, even the most advanced digital tools may fall short of their intended impact.

Moreover, there is a risk of over-reliance on technology at the expense of pedagogical substance. Educators must strike a balance between leveraging digital innovations and maintaining sound instructional principles grounded in communicative and learner-centered approaches. In this regard, digital literacy should not be viewed merely as a technical skill, but as an essential component of a broader multiliteracies framework that prepares students to navigate the complexities of language, media, and communication in the 21st century. Only through such a nuanced and critical integration can we fully harness the transformative potential of digital tools in language education.

Looking ahead, the role of digital literacy in language education will continue to expand. Continued research is needed to evaluate the effectiveness of digital tools in language learning and to establish best practices for teacher training and curriculum development. In addition, educational policies must continue to address the digital divide to ensure all learners have access to the resources and support required for success in digital environments.

2.4 Tiktok As An Educational Platform For Language Learning In Malaysia

The rapid development of digital technologies has transformed education worldwide. Among these innovations, TikTok is a short-form video platform that has become a notable tool for language learning. In Malaysia, a multilingual country, both educators and learners have increasingly adopted TikTok to support English as a Second Language (ESL) education. Its shift from an entertainment-focused platform to an educational resource is particularly evident in Malaysia. For example, TikTok's #TikTokGuru initiative gained over 14.3 billion views, signalling strong interest in educational content (TikTok Newsroom, 2022). Educators such as @SheikhRaffie and @sir_asai have used the platform to improve vocabulary and pronunciation in both Bahasa Malaysia and English, catering to diverse linguistic needs.

TikTok's interactive features have played a key role in boosting student engagement and motivation. Eleyana et al. (2023) found that during the COVID-19 pandemic, 81.4% of Malaysian undergraduates used TikTok to watch educational videos related to English learning, suggesting the platform served as an academic coping tool. It's entertaining and accessible format contributed to its popularity among students. Similarly, a study by Zuraini et al. (2024) involving 110 diploma students found that while TikTok has many benefits, its use should be moderated. Students appreciated its user-friendly interface and engaging content but noted the importance of integrating it carefully into formal learning contexts.

TikTok has also shown promise in improving speaking skills among ESL learners. Annapis (2024) conducted a study with 50 EFL students and found that the platform supported speaking proficiency, vocabulary development, and pronunciation. The short video format allowed students to practice in a low-pressure environment, building confidence and fluency. In Malaysia, Rajan and Ismail (2022) used TikTok in literature assignments with 150 Form Two students. Their study reported higher engagement and better content understanding, demonstrating TikTok's potential for creative language instruction.

Teachers play a vital role in the effective use of TikTok for language education. Xiuwen and Razali (2021) analyzed TikTok videos created by Malaysian secondary school teachers for ESL purposes and identified several successful strategies. These included fun and interactive content, relevance to current issues, and the use of local dialects. Their study highlighted the importance of aligning educational goals with entertainment-driven approaches to fully utilize TikTok's potential.

Despite these advantages, challenges remain. Concerns about content quality and potential distractions are common. Liu (2023) pointed out that educational content on TikTok varies widely in quality, stressing the need for educators to assess the credibility of the material. In addition, there is no established framework for creating pedagogically sound content on the platform. Aslan (2024) emphasized the limited academic research on how language teachers use social media for instructional purposes, suggesting the need for clear guidelines to support effective integration.

The use of TikTok for language learning in Malaysia reflects a broader shift toward digital tools in education. Its popularity among students demonstrates its potential as a supplementary learning tool. However,

to ensure its effectiveness, educators must adopt structured frameworks that align with teaching objectives and address the platform's limitations.

Between 2020 and 2025, TikTok's role in Malaysian language education has grown considerably. Its engaging, short-form video format supports student motivation and enhances speaking skills, offering creative methods for ESL instruction (Astano, 2025; Feiyue et al., 2025 & Waroh et al., 2025). However, here are notable drawbacks, particularly concerning language accuracy and quality. Many TikTok videos feature informal or non-standard English, which may expose learners to grammatical errors, slang, or code-switching practices that are inappropriate for formal or academic contexts (Al-Jarf, 2025; Verheijen & Spooren, 2021). Additionally, the algorithm-driven nature of the platform may lead learners to consume entertaining rather than educational content, limiting its pedagogical value if not guided properly (Alharthy, 2025). As such, content reliability and the lack of structured implementation pose challenges for educators aiming to incorporate TikTok meaningfully into curriculum design. Future research should focus on establishing clear, evidence-based frameworks to help educators curate and integrate high-quality TikTok content effectively, ensuring its full potential is realized in the Malaysian educational setting.

2.5 Challenges And Critiques Of Using Tiktok In Education

TikTok, a short-form video platform, has rapidly gained popularity among younger users, prompting educators to explore its potential as a teaching tool. While some studies highlight its benefits in boosting student engagement and supporting microlearning, others raise concerns about its overall suitability for educational settings.

One major concern involves the impact of TikTok's fast-paced format on cognitive functioning. Chiossi et al. (2023) found that the rapid context-switching typical of TikTok videos can impair users' prospective memory, which affects their ability to remember and complete intended tasks. This suggests that frequent and prolonged use of the platform may reduce students' attention spans, making it more difficult for them to engage in sustained language learning activities. Similarly, Olayemi et al. (2023) reviewed literature indicating that excessive TikTok use correlates with lower academic performance. Their study revealed that 87.5% of students spent more than two hours daily on social media, leading to distractions, procrastination, and poor study habits.

Another challenge relates specifically to the nature of language input on TikTok. The platform is dominated by informal, often grammatically incorrect content, where slang, abbreviations, and code-switching are prevalent (Nani, 2024). While this might reflect real-world, conversational English, it may also lead to the reinforcement of inaccurate language forms among ESL learners who lack strong foundational grammar (Matiso, 2023). Furthermore, there is a lack of content moderation with regard to educational quality. Since anyone can post videos, students may encounter misleading or oversimplified linguistic explanations, which can hinder rather than help language acquisition.

However, it is important to acknowledge the pedagogical potential of TikTok when used strategically. Its interactive features such as duets, stitched responses, and short challenges can foster collaborative learning, boost confidence in speaking, and help overcome language anxiety, especially for students who are hesitant to speak in traditional classroom settings (Dewi, 2023). TikTok's visual and auditory affordances also cater to diverse learning styles, potentially benefiting auditory and visual learners. In my view, the effectiveness of TikTok in language education hinges on intentional, guided use rather than passive consumption. Educators must play a proactive role in curating appropriate content, designing purposeful tasks, and guiding students in distinguishing between casual and academic language. Rather than banning or ignoring the platform, it may be more productive to teach digital literacy alongside language skills, helping students critically assess the content they consume while leveraging the platform's motivational advantages. Ultimately, while TikTok cannot replace formal instruction, it can complement it, if embedded within a structured, pedagogically sound framework.

Although TikTok offers creative ways to present information, its capacity to support deep learning is limited. Feiyue and Ali (2025) conducted a systematic review of 30 studies on TikTok's educational use and concluded that, while the platform successfully grabs students' attention, it does not sufficiently promote critical

thinking or deep understanding due to its entertainment-oriented design. In the context of language learning, Kusuma et al. (2022) examined the use of TikTok as a speaking practice tool for EFL students. Their findings pointed to issues such as distractions from non-educational content, lack of teacher guidance, and limited interactive feedback—all of which hinder meaningful language development. These challenges highlight the importance of structured teaching strategies when using TikTok in education.

Privacy and data security are also significant concerns. TikTok's privacy policy states that it collects extensive user data, including usage patterns, IP addresses, device IDs, and biometric data such as faceprints and voiceprints (Wikipedia, 2025). These practices have led to regulatory responses. For example, the UK Information Commissioner's Office fined TikTok £12.7 million in 2023 for mishandling children's data. In the United States, several state governments have banned TikTok on official devices due to national security concerns. Some universities have also restricted access to TikTok on campus Wi-Fi and university-owned devices, which affects research and instruction involving the platform (Wired, 2023).

TikTok's integration into education also faces structural and institutional barriers. Feiyue and Ali (2025) noted that unequal access to technology and reliable internet particularly in underserved communities worsens the digital divide, limiting the platform's inclusivity. Moreover, many educators lack formal training in using TikTok for instructional purposes. Without this support, teachers may struggle to align TikTok content with learning goals, potentially reducing the educational value. Additionally, TikTok's algorithm-driven content raises concerns about exposure to inappropriate material, underlining the need for effective moderation and content control.

In conclusion, while TikTok offers innovative ways to engage students and deliver bite-sized learning, its use in education presents several challenges. These include cognitive distractions (Ye et al., 2025) limitations in promoting deep learning (Feiyue & Ali, 2025), data privacy risks (Duong et al., 2024), and institutional constraints (Obreja, 2024). Educators and policymakers must carefully consider these issues and implement clear strategies to manage potential risks. Doing so will help ensure that TikTok, if used, supports meaningful learning without compromising student well-being or data security.

2.6 Conceptual Framework

This conceptual paper is grounded in two key theoretical frameworks: multiliteracies theory and digital literacy theory. These frameworks provide a foundation for understanding how digital platforms like TikTok can be meaningfully used to support English language learning, especially in today's increasingly multimodal and media-rich learning environments.

The Multiliteracies Framework, developed by the New London Group (1996, 2000), broadens the traditional understanding of literacy to include multiple modes of meaning-making. Rather than focusing solely on reading and writing printed text, this framework emphasizes the importance of visual, audio, spatial, gestural, and linguistic modes. It also considers the cultural and social contexts in which communication occurs. In language education, multiliteracies theory promotes the idea that students should engage with diverse forms of media and communication to become effective and adaptable communicators.

This framework is particularly relevant in analyzing how learners interact with TikTok, a platform that blends video, sound, text overlays, gestures, and social feedback mechanisms. Learners are not just passive viewers; they are also producers of content who engage in creative practices such as storytelling, pronunciation practice, peer collaboration, and multimodal self-expression (Cope & Kalantzis, 2009, 2023). These practices reflect the shift from a static, text-based model of literacy to a dynamic, participatory model aligned with contemporary communication needs.

Complementing this is the theory of Digital Literacy, which refers to the ability to use digital technologies to locate, evaluate, produce, and communicate information effectively. Eshet-Alkalai (2004) describes digital literacy as encompassing cognitive, technical, and social-emotional skills necessary to function in digital environments. In the context of language learning, digital literacy also includes the ability to critically assess online language input, navigate digital tools for learning, and produce meaningful digital content. It involves understanding not only how to use technology but also how to use it intentionally and ethically for learning purposes (Falloon, 2020; Kumar, 2023).

Together, these two frameworks offer a comprehensive lens through which to examine the role of TikTok in English language education. Specifically, they help to:

(1) **Understand how TikTok promotes the development of visual, linguistic, cultural, and digital skills.**
Learners engage with content that integrates images, music, spoken dialogue, text captions, and cultural references, fostering a broader set of literacy skills than traditional classroom materials.

(2) **Explore how learners use TikTok to practice English in authentic, creative, and socially relevant ways.** TikTok's short-form, user-generated videos create opportunities for informal, real-world language use, allowing learners to experiment with vocabulary, pronunciation, and grammar in meaningful contexts. This aligns with communicative and constructivist approaches to language learning.

(3) **Identify the challenges and limitations associated with using social media for educational purposes.** These include concerns about content accuracy, exposure to informal or incorrect language, limited teacher control over content, and potential distractions due to the platform's entertainment-driven design. By applying a critical digital literacy lens, educators can guide learners to engage more thoughtfully with content and develop discernment about language use online.

By using the multiliteracies and digital literacy frameworks, this paper positions TikTok as more than a social or entertainment app. It is viewed as a potentially valuable learning space—one that supports the development of 21st-century competencies such as creativity, collaboration, cultural awareness, and critical thinking. However, these benefits can only be fully realized when the platform is integrated within a pedagogically sound framework, supported by educators who understand both the possibilities and limitations of digital media in the language classroom.

4 DISCUSSION & CONCLUSION

The findings and synthesis of recent literature highlight TikTok's growing role in fostering multiliteracies and supporting English language learning, particularly in the Malaysian context. As a dynamic, user-generated platform, TikTok offers unique pedagogical opportunities to develop learners' linguistic, visual, cultural, and digital skills. Its multimodal format aligns with the multiliteracies framework, allowing students to engage with language through various semiotic channels (Cope & Kalantzis, 2023; Jimola, 2023).

However, the educational use of TikTok is not without challenges. One critical concern is the quality and accuracy of language content shared on the platform. Given that much of TikTok's content is created by non-experts, there is limited vetting or quality control, raising questions about the reliability of language models and exposure to non-standard or informal English (Ibrahim et al.,2023 & Rininggayuh et al.,2024). This unfiltered environment may inadvertently reinforce grammatical errors, slang, or misinformation, especially among learners who lack a strong foundation in standard English. Moreover, the algorithmic nature of the platform may prioritize entertainment over educational value, leading students to consume content that is engaging but linguistically shallow. Therefore, while TikTok can complement traditional language instruction, educators must provide guidance and critical literacy skills to help students evaluate content credibility and maintain language accuracy.

This paper confirms that TikTok's short-form content boosts learner motivation, autonomy, and authentic language exposure—key factors in second language acquisition. Empirical studies from Malaysia show positive outcomes among ESL learners, including improved vocabulary, pronunciation, and speaking confidence (Annapis, 2024 & Eleyana et al., 2023). These results support the idea that TikTok is more than a social platform; it serves as a space for microlearning and participatory culture that enriches language education (Bernier, 2020 & Condoy, 2024;).

However, integrating TikTok into formal education comes with several significant challenges that must be critically examined to gauge its true effectiveness. One key concern is cognitive overload: the rapid, visually stimulating, and fast-paced nature of TikTok videos may overwhelm learners and hinder deep, reflective learning (Chiossi et al.,2023 &Wang et al., 2024). Additionally, the platform's algorithm-driven feed prioritizes viral and entertaining content rather than accuracy or educational value, resulting in inconsistent content quality. Without a standardized vetting process, students may encounter linguistically inaccurate or culturally inappropriate material, which can be especially problematic in language learning (Ibrahim et al., 2023; Rininggayuh et al.,2024 & Wang et al., 2024). Moreover, the platform's addictive design with endless scrolling and instant gratification may reduce students' attention spans and lead to passive consumption rather than active learning. Educators also face difficulties due to a lack of pedagogically guided content and limited training on how to meaningfully incorporate TikTok into curriculum design (Aslan, 2024). This knowledge gap restricts the platform's potential to support structured language development.

Furthermore, digital inequality remains a substantial barrier: not all students have equal access to smartphones, stable internet connections, or the digital literacy required to use the app effectively (Mastam et al., 2024; Helsper, 2021). Institutional resistance and concerns over privacy, data protection, and screen-time policies also complicate efforts to formalize TikTok's role in the classroom. These factors suggest that while TikTok has pedagogical potential, its effectiveness as a language learning tool is highly context-dependent and requires robust frameworks for guidance, curation, and equitable access. To overcome these challenges, clear frameworks are needed for using TikTok in language instruction. Teacher training programs should include digital literacy and content creation to equip educators with the skills to design engaging, effective, and culturally relevant lessons. National policies, such as Malaysia's Digital Education Policy 2023–2030, should be used to support equitable access to technology and infrastructure (ERIA, 2023).

In conclusion, TikTok has strong potential to support English language learning and the development of multiliteracies. While it complements traditional teaching with engaging and multimodal experiences, its use should be informed by pedagogy and adapted to the educational context. Future research should focus on identifying best practices for integrating social media into teaching and assessing its long-term effects on language proficiency and digital competence. A balanced approach that considers both the strengths and limitations of TikTok will ensure its meaningful and responsible use in language education.

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Total Quality Management (TQM) Application on Teaching Arabic to non-native speakers: A Descriptive Analytical Study

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ABSTRACT
This research aims to investigate the impact of Total Quality Management (TQM) principles on teaching Arabic to nonnative speakers. Language instruction therefore needs beneficial strategies that will improve educational outcomes, and these can be derived from the Total Quality Management, which is a comprehensive management approach geared towards improving quality and performance. This study relates the TQM principles (customer focus, leadership and strategic planning, process management, continuous improvement, fact-based decision making) to Arabic language programs, to overcome common challenges and maximize teaching practices. This research utilizes a combination of survey data and interviews and analyses the extent to which TQM application influences instructional quality and student satisfaction. The key findings suggest that institutions that implemented TQM principles did gain significant improvement in teaching effectiveness, curriculum relevance and overall program quality. Personalized instruction, systematic feedback and continuous improvement did equip students with much improved engagement and satisfaction. Additionally, this study sets forth challenges of implementing TQM including balancing flexibility and standardization and managing resource constraints. Based on successful applications of TQM principles, recommendations are given to educational institutions for stronger focus on customers, leadership support, process optimization, continuous improvement, and data driven decision making. The findings of this research contribute to the further understanding of how TQM could be used effectively in language education and provide practical insights of how institutions can effectively improve the quality of instructed Arabic for non-native speakers.
Keywords: TQM, Arabic for non-native speaker, Language teaching

1 INTRODUCTION

In an increasingly globalized world, the ability to communicate in multiple languages is an invaluable asset, and Arabic comes to play as a vital language with such a rich historical and cultural legacy. For non-native speakers, the demand for Arabic language skills is becoming increasingly high, across business, diplomacy, education and other sectors, and there is a need for effective and high quality Arabic language instruction.

A structured framework, based on a comprehensive management approach, known as Total Quality Management (TQM), which aims to improve quality and performance in all organizational processes such as language teaching, is described. TQM emerges from manufacturing and service industries, and the basic theory of continual improvement, customer focus, and systematic process management are all applicable to educational contexts.

The purpose of this study is to examine the use of TQM principles when applied to an aspect of the teaching Arabic to non-native speakers. The research takes a descriptive analytical approach to explore how TQM strategies can be integrated in the language teaching practice for the best results in education. The primary

goal is to discern which aspects of TQM can address the unique difficulties of instruction in the Arabic language and provide an improved pedagogical learning experience for students and better teaching for the faculty.

This study was carried out based on the observation that, although immense contributions have been made in the area of teaching language methodology, a gap exists in the systematic application of quality management principles to the language teaching field. The integration of TQM to language teaching is a potential solution for curricula development, teaching effectiveness, learner satisfaction and instructional quality.

Based on this, this study endeavours to shed some light on how TQM could be applied to Arabic language teaching, and hence, making a contribution to enrich and improve educational practices and outcomes. Existing methods and frameworks will be studied, their matching with TQM principles will be analysed, and strategies for improving the Arabic language's teaching quality through structured and quality-oriented approach will be proposed.

Precisely, this research will attempt to fill the gap between quality management theories and practical applications of handling language teaching and learning, and will notably address and examine how TQM can apply to Arabic language teaching to non-native speakers by transforming it to an effective and satisfying teaching and learning.

1.1 Statement of the Problem

Teaching Arabic to non-native speakers presents several challenges, including diverse learner needs, varying levels of proficiency. Traditional language teaching approaches may not be sufficient to deal with this kind of challenge, which creates uneven educational results and student resentment. Total Quality Management (TQM) principles oriented toward harnessing continuous improvement, customer satisfaction and process optimization represent a possible framework for improving the quality of Arabic language instruction. Even so, research is scarce on how these principles be applied to Arabic teaching and how this might affect Arabic. This research aims at filling this gap through exploring how the principles of TQM can be incorporated into Arabic language programs to enhance the teaching practices and learners' outcomes.

1.2 Research Questions

1. How can Total Quality Management (TQM) principles be effectively applied to teaching Arabic to non-native speakers?
2. What impact do these principles have on instructional quality and student outcomes?

1.3 Research Objectives

1. To Examine the Application of TQM Principles in Arabic Language Instruction.
2. To Evaluate the Impact of TQM Implementation on Instructional Quality.
3. To Analyze Student Satisfaction and Outcomes.
4. To Identify Challenges and Best Practices.
5. To Provide Recommendations for Enhancing Quality in Arabic Language Instruction.

1.4 Literature Review

1.4.1 Total Quality Management (TQM): Principles and Framework

Total Quality Management or TQM is the name of a holistic management approach first used in manufacturing, but applied to any process of delivering value, that relies on the participation of all its members, aims at continuous improvement, involves all functional groups in a company, emphasizes customer satisfaction, anticipates potential problems and seeks to prevent problems from occurring during the manufacturing process. Key principles of TQM include:

Customer Focus: The efforts of adopting customer service and by extension ISO 9001 as an organizational requirements management system is to prioritize and consider the needs and expectations of customers (or students in education) so as to meet their satisfaction and happiness (Juran, 1999).

Leadership: Leadership capability to set the strategic direction for the company, and create the culture of quality that will drive continuous improvement.

Employee Involvement: Undertaking participation from all levels of an organization in order to engender a quality of culture and of shared responsibility (Crosby,1979).

Process Management: Well defined efficient processes are stressed as crucial to obtain predictable quality outcomes (Ishikawa, 1985).

Continuous Improvement: Efforts to improve all aspects of processes, products, and services of an organization (Deming, 1986).

Fact-Based Decision Making: Using data and evidence to drive decision and performance improvement.

TQM has been applied widely to many industries and its impact is to improve quality and efficiency. Deming (1986, p. 39) and Juran (1999) point to the utility of TQM in creating a quality-based culture of continuous improvement, which is a concept that can support education.

1.4.2. TQM in Educational Settings

As education institutions struggle to promote quality teaching and learning, TQM has taken root in the application in education. Educational researchers have explored how TQM principles can be adapted to suit the needs of academic environments:

Systematic Quality Improvement: Importantly, TQM in education asserts the need for regular evaluation and feedback mechanism to foster the development of teaching practices and curriculum design (Murgatroyd & Morgan, 1993). According to studies, TQM leads to more structured and effective educational processes (Sallis, 2002).

Student-Centered Learning: TQM defines the students as customers thus focusing on student needs and on learning outcomes. Associations have also been made between this approach and improved student satisfaction and academic achievement (Vazzana & Winter, 1997).

Collaboration and Stakeholder Engagement: TQM implementation in education is effective when educators, administrators, students, and others who make up the education stakeholders could work together. Hence, this kind of collective effort supports continuous improvement and accountability (Kanji & Tambi, 1999).

1.4.3. TQM in Language Education

In this way, the integration of TQM into language education promises to help improve instructional quality and reaching good enough learning outcomes. Several studies highlight the benefits of applying TQM principles in language programs:

Quality Assurance in Language Instruction: The research shows that TQM could influence the quality of language teaching by determining definite standards and applying systematic evaluation methods. This means performance benchmark setting, standardized assessment tool development and the regular curriculum effectiveness review (Smith, 2015).

Enhancing Language Learning through Continuous Improvement: the basic aim of TQM is to continuously improve, which matches with language learning in an iterative nature of language learning. Findings of studies shown that the TQM approach can make language instruction more effective in that teachers can refine their teaching strategies in light of the real time performance data or feedback obtained from students (Hutchinson, 1995).

Challenges in TQM Implementation: The benefits of TQM in language education are apparent, but challenge lies ahead. As a result, these include the lack of training intensity of educators, the difficulty to evaluate language learning outcomes, and educational institutions' reluctance to change (Hunt, 1996).

1.4.4. Teaching Arabic to Non-Native Speakers: Challenges

Arabic, as a language, presents unique challenges for non-native speakers, which TQM principles may help to address:

Complex Grammar and Script: However, for learners, Arabic is complicated by its complex grammar and use of a non-Latin script. To be effective, these complexities must be simplified to make learning Arabic more effective for students (Al-Batal, 2006).

Cultural Context: The cultural understanding of Arabic language learning is quite deep. Such instruction needs to integrate and operate within the learner's cultural context to be effective (Ryding, 2005).

Diverse Learner Needs: For non-native Arabic learners are from varied backgrounds linguistically and culturally so differentiated instructional approaches are necessary. The customer (learner) focus and continuous improvement of TQM would help to develop teaching methods suited specifically to the needs of each learner (Alosh, 1997).

Teaching Arabic faces several challenges that stem from the overlap of, what is perceived as, complex grammar, script, and phonology and multiple learner motivations and backgrounds. However, to overcome these challenges, emphasized strategies include personalized instruction, culturally relevant materials, and adaptive instruction (Khalifa, 2012).

1.4.5. The integration of TQM into Arabic Language Teaching

The integration of TQM principles into teaching Arabic involves:

Customer Focus: To know the needs and aims of the non-native students that one can provide instructional help specifically. According to the study conducted by Miller (2001) and Smith (2015), it is necessary to synchronize teaching practices based on learner needs and expectations.

Leadership and Strategic Planning: A strategic plan for TQM implementation in language programs (through curriculum design, professional development and assessment practices, Brown, 2004).

Process Management: Streamlining teaching and administrative processes to be operated with efficiency and effectiveness. According to Griffiths (2006) and Fitzgerald (2008), process optimization has benefits for educational settings.

Continuous Improvement: Mechanisms for ongoing evaluation and refinement of their teaching practices based on feedback and performance data (Kirkpatrick, 1998).

Finally, the review of literature shows that there is an increasing acceptance of TQM principles in enhancing the quality of education. Implementing these principles in teaching Arabic to non-native speakers has potential to improve instruction. Integrating TQM into language teaching practices in Arabic language education requires efforts to encourage the use of data to better manage aspects of the language education to enhance its quality.

2 RESEARCH METHODOLOGY

This section of the study explores detailed account on the methodological approach of the study to apply TQM principles into the teaching of Arabic to nonnative learners. This research work uses a descriptive analytical research method to identify how TQM can be applied in Arabic language teaching /learning and determine the effectiveness of the principles in improving the quality of teaching and learning.

2.1 Research Design

To provide a full view on how to apply the TQM principles in Arabic language teaching, the study has adopted descriptive analytical approach. The reason for choosing this design is to gain comprehensive insight into current practices and what improves without altering the variables by design. The final purpose of the

research is to describe and analyze current practices, to identify areas for further improvement, and to develop actionable strategies based on TQM principles.

2.2 Data Collection Methods

To gather relevant data, the study utilizes a combination of qualitative and quantitative methods, including:

Surveys: Language instructors, students, and Arabic language program administrators answer structured questionnaires. The goal of the surveys is to gather information concerning the teaching practices currently adopted, how quality is perceived and what comes to the extent to which TQM principles are designed into teaching. Areas of focus include instruction, curriculum designing, developing assessments, and satisfaction with the learning experience.

***Interviews*:** A select group of instructors, program coordinators, and educational administrators are invited to participate in semi structured interviews. Additional information is gained from interviews about the implementation of TQM principles, challenges, and ideas for improving upon it. Each interview is intended to collect qualitative data detailing participants' experiences, best practices as well as perceptions of the effectiveness of TQM in language teaching.

Classroom Observations: An attempt is made to test how the TQM principles are applied in real life by making direct observations in Arabic language classes. It's observations of teaching methods, classroom management, student engagement and instructional materials. This method presents real time insights into the application of TQM concepts with their impact on the learning environment.

Document Analysis*:* Review of curriculum guides, assessment rubrics, and quality assurance reports from the programs. This analysis assists in reviewing how TQM principles are ingrained into program policies and practices and identify areas for alignment with TQM standards.

2.3 Participants

The study involves a range of participants to ensure a comprehensive understanding of the application of TQM principles:

Instructors: Teachers of Arabic language to nonnative speakers in different educational institutions.

Students: Language program participants, enrolled in different language programs, who were non-native Arabic speakers.

Administrators: Program coordinators who are responsible for curriculum development and quality assurance and educational managers responsible for, overall, program management.

Purposive sampling is used to choose the participants, so that people with relevant experience and insight into teaching and management of Arabic language programs are included.

2.4 TQM Framework for Analysis

The analysis focuses on the following TQM principles:

Customer Focus: To evaluate learning in terms of how students' needs and expectations are understood and responded to in language teaching practices.

Leadership and Strategic Planning: To assess the role of leadership in implementing and supporting TQM principles within Arabic language programs.

Process Management: To analyze teaching and administrative processes to better identify processes needing improvement and help streamline the business.

Continuous Improvement: Exploring mechanisms for continuing evaluation and enhancement of teaching practices in view of feedback and performance data.

2.5 Data Analysis

Data analysis involves both qualitative and quantitative techniques:

Quantitative Analysis: Survey data is analyzed using statistical methods, descriptive statistics to summarize the response and inferential statistics to identify significant patterns and correlations related to application of TQM principles.

Qualitative Analysis: Interview transcripts and observational notes are interpreted by means of thematic analysis. This was achieved by examining common themes, patterns and insights which can be associated with the application of TQM principles in teaching Arabic language.

Document Analysis: Program documents are reviewed, and written policies and practices are evaluated through a content analysis approach to establish the alignment of program to TQM standards.

2.6 Ethical Considerations

The study adheres to ethical standards, including:

Informed Consent: Participation is preceded by informing participants fully about the purpose and procedures, and rights, and asking for consent to participate.

Confidentiality: That all data collected is strictly confidential and only used during research.

Anonymity: Anonymizing survey responses, interview transcripts and observational data to protect the identities of participants.

2.7 Limitations

Potential limitations of the study include:

Sample Size: Conclusions may be limited by the size and representativeness of the sample offered in the study.
Subjectivity: Subjective interpretations of qualitative data such as by interviews and observations may be included.

Contextual Factors: Findings of such studies may not generalize across institutional contexts or teaching practices.

Summary

This methodology presents a total approach to the study of the possibility of using TQM principles in teaching Arabic to nonnative speakers. The study employs both surveys and interviews and observational and document analysis with the aim of offering a detailed and nuanced understanding of how TQM can lead to better practice in language teaching and better learner outcomes.

3 ANALYSIS AND DISCUSSION

The paper aims at proposing Total Quality Management (TQM) principles as a framework for enhancing the quality of teaching Arabic to non-native speakers. This part of the paper presents the results of case studies and data, with respect to how TQM has influenced Arabic language teaching, and presents common trends, successes, and failures.

3.1 The features of TQM principles in Arabic language teaching.

Customer Focus

Analysis:

Needs Assessment and Personalized Instruction: The case studies reveal a high focus on the identification and meeting of the needs of the non-native learners. The American University in Cairo and Qatar University for example did needs assessment and based on this information they had to adjust the teaching and learning strategies and materials. Individual instruction and tutoring as well as other support services were used to improve students' learning outcomes.

Feedback Mechanisms: Frequency of receiving feedback from students was a standard procedure among the institutions. The feedback received helped capture the students' understanding of the extent to which teaching strategies, and the curriculum were effective.

Discussion:

Impact: Those institutions that put a lot of emphasis on customer focus received an improvement in student satisfaction and involvement. The present study identified significant strategies for improving the quality of Arabic language teaching, including differentiating instruction to address learners' needs and using feedback to make changes.

Challenges: Although customer centricity is useful in that it guarantees that all feedback is captured and addressed, it may be costly to have all feedback collected and addressed. The other challenge that learning experts face is on how to meet individual needs while at the same adhering to the curriculum.

Leadership and Strategic Planning:

Analysis:

Vision and Mission: Organizational control and strategy management were crucial factors in the successful use of TQM. Case studies portrayed the importance of vision and mission in providing direction of quality strategies. American University in Cairo as well as the Qatar University has created strategic plans to set the quality targets and performance measures.

Performance Monitoring: Performance against set goals was checked on a routine basis and institutions ensured that data formed the basis of decisions made and changes implemented.

Discussion:

Impact: Better leadership and planning of the TQM strategies ensured that there was proper and well-coordinated application of its principles. Those organizations which had clear quality objectives and had strong leadership commitment had a better implementation of TQM in their programs.

Challenges: Strengthening and implementing a strategic plan needs time and effort to be exerted on a regular basis. It is not always easy to make all the stakeholders to be on the same page with the vision and goals.

Process Management

Analysis:

Standardization and Optimization: Some of the examples include the University of Jordan and Language Center at Qatar University to name but a few which made it mandatory to have standard lesson plan and assessment. This standardization facilitated the enhancing of the standard and reliability in the provision of instructions.

Resource Management: Resource management in relation to teaching was also underlined as well as improvement of the learning environment.

Discussion:

Impact: In this regard, standardization of procedures and the enhancement of resource utilization led to enhanced teaching and learning strategies. Institutions indicated enhanced compliance in instruction and enhanced resource adequacy against teaching requirements.

Challenges: The use of standardized processes may reduce the level of flexibility that is required when addressing the needs of learners. It also means that the processes must be reviewed and if necessary, altered as often as is feasible.

Continuous Improvement

Analysis:

Quality Assurance and Professional Development: Quality assurance frameworks and on-going staff development were a key feature of the TQM approach and the continuous improvement model. Feedback mechanisms and evaluation processes were developed to identify areas that required enhancements.

Innovation: The use of new technologies and teaching materials as well as the promotion of innovative approaches was also typical for the studied institutions.

Discussion:

Impact: The institutions that subscribed to the model of continuous improvement enjoyed improvements in teaching and learning standards and student achievement. Continual staff development and commitment to change ensured that teaching strategies were up to date and appropriate.

Challenges: Culture of constant improvement is not something that one can develop and forget, it takes time and resources to nourish. Therefore, trying to achieve innovation alongside following the best practices in the field can be challenging.

Fact-Based Decision Making

Analysis:

Data Utilization: All case studies showed the application of appropriate data usage for decision making. Institutions gathered and assessed information about students' results, perceptions, and achievements as students to support their planning and changes.

Evidence-Based Practices: Evidence-based strategies supported the development of effective strategies and improvement of teaching and learning processes in institutions.

Discussion:

Impact: Decision making based on facts helped in making better and more efficient changes in the teaching methods. Illogical institutions that used data in decision making to a certain extent were able to set teaching practices that met the needs of students.

Challenges: Data gathering and processing is a costly process, and the correctness and up-to-datedness of data is an essential factor. Some of the stakeholders may also resist data-driven changes that are to be made to the organization.

3.2 Synthesis of Findings

Patterns and Successes:

The institutions that have applied TQM principles to the letter improved on the quality of teaching and learning, student satisfaction, and learning achievement.

Specific accomplishments involved the following: teaching was more closely aligned to student need; there was more consistency and efficiency in teaching; and there was a focus on ongoing improvement.

Areas for Improvement:

Resource Allocation: Meeting the needs for individualized approach and prescription practices implies effective management of resources.

Feedback Implementation: It is often difficult, but important to guarantee that feedback is collected, assessed, and utilized in a regular manner.

Flexibility vs. Standardization: This paper reveals that to some extent standardization of LMSs is essential while at the same time taking into consideration the learners' variability.

3.3 Implications for Practice

Recommendations:

Enhance Customer Focus: The institutions should therefore embrace assessment of students and delivery of services to the students as a continuous process to meet their needs.

Strengthening Leadership: Leadership is the key for managing TQM and achieving quality objectives since leadership is important in TQM. Further information and assistance should be available.

Optimize Processes: Wherever it is useful, make sure that processes are standardized, but remember that learning occurs differently. Ensure that processes are reviewed on a normal basis to ensure that they are still as effective as they were when they were implemented.

Promote Continuous Improvement: Encourage organization development to embrace common assessment, training, and creativity as organizational habits.

Leverage Data: Make proper use of data to inform decisions and impacts to be demonstrated by evidence.

3.4 Summary

The analysis and the discussion of TQM principles in teaching Arabic to non-native speakers support the proposition that the application of TQM principles can greatly improve the quality of education. Those institutions that effectively embraced TQM principles had enhanced quality in teaching, and learning, and improved student satisfaction, and better learning outcomes of programs. However, issues such as resource allocation, definition of the implementation of feedback and the balance between flexibility and conformity must be properly handled. Through customer orientation, leadership, process management, continuous improvement and data analysis educational institutions can develop an efficient and high-quality learning environment for learners of the Arabic language.

4 RECOMMENDATIONS

Based on the analysis and discussion of applying Total Quality Management (TQM) principles to teaching Arabic to non-native speakers, the following recommendations are proposed to enhance the quality and effectiveness of language instruction:

4.1 Strengthen Customer Focus

Conduct Regular Needs Assessments: Conduct ongoing surveys to know how the non-native learners are changing, what they want and what they find difficult. To ensure that you get all-inclusive feedback, conduct surveys, interviews and focus group discussions.
Enhance Personalization: Produce unique learning tracks according to learners' skills, preferences, and cultural values and present them to learners. Offer other support services including group and one on one tutorials, language development facilities and online materials for the learners.
Implement Feedback Mechanisms: Put in measures for feedback that are easy to use and can be done frequently to get feedback from students. Utilize this information to make proper modifications on the teaching strategies, teaching resources and the teaching curriculum.

4.2. Promote Effective Leadership and Strategic Planning

Develop a Clear Vision and Mission: Define a set of goals and objectives that reflect the aims of Arabic language programs in terms of quality, learner orientation, and improvement. It is equally important to enforce these goals to all the stakeholders.
Create a Strategic Quality Plan: Develop a strategic plan that will contain specific quality goals and measures, action plans and performance standards. It should also be noted that the plan should be periodically revised and updated according to the performance indicators and the feedback received.
Support Leadership Development: Providing more training in leadership for educational administrators and program coordinators to enable them effectively support and promote TQM.

4.3 Optimize Process Management

Standardize Best Practices: Establish and enforce a set of guidelines for the following key activities: planning of lessons, teaching, and evaluation. It is also important that these standards are maintained throughout different courses and with different instructors.

Improve Resource Allocation: Optimize resources for teaching and learning purposes with a view to improving the instructional environment. Track the use of resources and change it as necessary to improve support for teaching and learning process.

Streamline Administrative Processes: Enhance the business operations of the program management, student enrollment, and assessment to enhance performance.

4.4 Foster Culture of Continuous Improvement

Establish a Quality Assurance Framework: Put in place quality assurance measures that entail often assessment of teaching and learning, curriculum and the achievement of the students. Here is how the results should be used to drive continuous improvements.

Encourage Professional Development: Continuous staff training and development to ensure that the instructors get to know the new trends in teaching, learning, technologies and TQM. Development of culture of learning and innovation.

Support Innovation in Teaching: Instructing instructors to try new teaching methods, technologies and other resources. Build places for faculty members to share best practices and innovation.

4.5 Enhance Fact-Based Decision Making

Utilize Data Effectively: Gather all information concerning students' performance, feedback and program accomplishment. Embrace statistical tools and conduct qualitative analysis to make recommendations in order to try coming up with solutions to problematic scenarios.

Implement Data-Driven Practices: Driving base decisions on data allows you to choose the approaches to curriculum design, instructional methods, and program changes. Data should be used to see where improvements can be made and how changes have affected it.

Ensure Data Accuracy and Relevance: Check data collection processes each so one can ensure accuracy and date. Ensure your informed and actionable insights are reliable and maintain the highest data quality possible.

4.6 Address Specific Challenges

Balance Standardization with Flexibility: Standardizing process can increase consistency, but maintain the flexibility to meet the various learners' needs. Create ways to teach and teach students that can be modified as situations evolve.

Ensure Systematic Feedback Implementation: Develop clear procedures of acting on feedback from students and other stakeholders. Feedback should be analyzed, and meaningful change regarding teaching practices and program design should be made based on feedback.

Manage Resource Constraints: Identify the resource constraints as constraints to the use of TQM principles. Choose the most important areas to focus on improving and ask for additional support or funding if that's needed.

4.7 Summary

Based on this checklist, educational institutions can successfully adopt the TQM principles in teaching Arabic to the non-native speakers, to achieve higher quality in the language instruction as well as higher level of learners' outcomes. To accomplish these, they would need to strengthen customer focus, promote effective leadership, optimise their process management, foster continuous improvement as well as use data driven decision making. The successful integration of TQM principles into Arabic language programs will also be addressed in terms of specific challenges and offering standardization in balance with flexibility.

5 CONCLUSION

Through application of Total Quality Management (TQM) principles in teaching Arabic to non-native speakers, a robust framework is constructed to improve the educational quality and accentuate the outcomes of the learners. Based on this study, which is a descriptive analytical one, the present study investigates how TQM principles of customer focus, leadership and strategic planning, process management, continuous improvement, and fact-based decisions can be successfully institutionalized in language instruction in order to grapple with the problems faced by language instructors and optimize language teaching practices.

Summary of Key Findings

1.Customer Focus:

The ones who were able to, obviously, adopt that customer approach, they also saw significant improvements in, you know, student satisfaction and engagement. Instruction was tailored to fit the unique skills of nonnative learners and regular feedback techniques were instituted as necessary to improve the learning experience.

2.Leadership and Strategic Planning:

Strong leadership and strategic planning were necessary for successful implementation of TQM principles. TQM implementation was more coherent and better implemented in institutions with a clear vision, well defined quality goals and supportive leadership.

3.Process Management:

Standard practice in teaching and the allocation of resources resulted in a more consistent and efficient language instruction for teachers to use. Nevertheless, meeting the need for flexibility to enable learners with a diverse need continues to be a major challenge, along with standardization.

4.Continuous Improvement:

With a culture of continuous improvement (through regular evaluation, professional development and innovation) teaching quality improved and outcomes for students improved. Those that understood continuous improvement embraced the use of data and the ability to make data driven decisions and continue to respond to changing educational needs.

5.Fact-Based Decision Making:

Through strategies of utilizing data for decision making, institutions were able to make well informed changes in teaching practices and program design. Data driven approaches were used to identify areas in need of improvement and to view the measureable impact of implemented changes.

Implications for Practice

The results emphasize the necessity of using a top to toe TQM perspective to enhance Arabic language instruction. Educational institutions should focus on:

Enhancing Customer Focus: We should assess and address the needs of nonnative learners regularly, personalize instruction and institute robust feedback systems.

Strengthening Leadership and Planning: Develop a clear vision and communicate readily, set strategic quality goals, and help support leadership in TQM effort.

Optimizing Processes: Continue to standardize best practices but allow for flexibility in meeting diverse learner needs and manage resources efficiently.

Fostering Continuous Improvement: Develop a culture of ongoing evaluation, professional development and innovation to move quality forward.

Leveraging Data: Incorporate data driven insights in decision making and have changes made based on evidence.

It also lists future direction and challenges.

The integration of TQM principles offers great benefits; however, it is still full of challenges related to balancing standardization with flexibility, standardizing the implementation of systematic feedbacks and aggressive control of resource constraints. Future research could explore:

Long-Term Impact: The long-term influence of TQM implementation on student outcomes and program quality.

Scalability: How TQM can be scaled to other different educational contexts and language programs.

Technology Integration: The investigation of the support emerging technologies can make to TQM practices and improving language teaching.

Finally, the application of TQM principles in the teaching language to non-native speakers has great potential for improvement in the educational quality. Educational institutions can create a more effective and responsive learning environment by focusing on customer needs, leading with customer needs, process and introducing standardized processes, continuous improvement practices and data driven decisions. Further development of the methodological directions will address the challenges and broaden the horizons of possibilities for the use of the TQM principles in language education.

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Bridging Communication Gaps: Understanding Language Barriers in Early Childhood and Their Impact on Behaviour

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ABSTRACT

Language development in early childhood is crucial for effective communication, emotional regulation, and social interaction. However, when young children (aged 2–3) encounter challenges in expressing themselves, it often leads to frustration and tantrums. The period between two and three years of age is often misunderstood and labelled as the "terrible twos," overlooking the profound developmental milestones occurring during this stage. This paper challenges the negative connotation associated with this label, focusing on the critical role of language acquisition in shaping behaviour and communication.

Using case studies and observational insights, this research highlights common scenarios where language misunderstandings between children and adults exacerbate behavioural issues. It discusses how a lack of awareness of nonverbal cues and developmental needs while emphasizing how adult interactions can foster language development and emotional regulation. Additionally, the paper explores practical strategies for caregivers and educators to bridge communication gaps and foster holistic growth in young learners. By shifting the narrative from "terrible twos" to recognizing this period as a sensitive and to create a supportive environment that nurtures language skills, minimizes behavioural challenges and prepare children for the demands of 21st-century learning.

KEYWORDS: Language pedagogy, early childhood education, communication barriers, behavioural challenges, Montessori, language development, parenting strategies

1 INTRODUCTION

Early childhood (ages 2–3) is a critical period for language development. Toddlers rapidly expand their vocabulary and begin to combine words into simple sentences – for example, two-year-olds often speak around 200 words. These emerging communication skills enable children to express needs, engage socially, and regulate emotions. When language development lags or misunderstandings occur, however, children can become frustrated. Research shows that young children with limited expressive language frequently exhibit more intense tantrums and aggressive outbursts compared to peers with typical language skills. In other words, behaviour often becomes a form of communication: a speech-delayed child may “act out” when unable to articulate wants or comprehend others. Severe or frequent tantrums in toddlers – especially beyond the expected range – can thus signal underlying language gaps.

Understanding this issue is especially important in Malaysia's multicultural, bilingual context. Many children are exposed to different languages at different places (English at pre-school, mother tongue at home) making their early linguistic environment uniquely complex. These factors mean that communication delays may affect one or more languages and can easily go unrecognized. Under this setting which strong emphasis on multilingual proficiency and emerging digital media use, it is crucial to bridge these communication gaps to support children's emotional well-being and learning.

This study therefore investigates how early language barriers contribute to behavioural dysregulation for 2–3 year-olds children. Drawing on these case studies, we observe how language delays or misunderstandings relate to tantrums, frustration, and emotional outbursts. The theoretical framework combines Montessori pedagogy (sensitive period, absorbent mind) with modern digital-age education principles, to explore both traditional and technology-enhanced strategies for learning and communication. By integrating these perspectives, we aim to clarify the significance of language-behaviour and inform interventions. In particular, we seek to answer: How do communication gaps manifest in toddler behaviour and what educational approaches (Montessori methods, digital tools, or their combination) can help prevent minor delays from escalating into emotional crises?

In this qualitative case-study approach, we closely document each child's interactions and environment. This method allows rich contextual insight into how specific misunderstandings trigger stress and how responsive teaching strategies (e.g. visual aids, patience, encouragement) can alleviate dysregulation. The significance of the study lies in highlighting under-recognized language-communication issues and in suggesting practical Montessori-inspired and digital interventions to support emotional regulation. Such insights can aid educators and parents in pre-empting and managing tantrums that stem from purely communication-related frustrations.

2 LITERATURE REVIEW

Foundational theories of language learning offer contrasting views on how children acquire speech and communication. Noam Chomsky's nativist theory posits that humans have an inborn "language faculty" or Language Acquisition Device (LAD). This concept holds that children are born with innate grammatical knowledge that allows them to infer complex language rules from limited input (Chomsky, 1965). In this view, children naturally pick up syntax and vocabulary with remarkably little explicit teaching, as if a specialized mental module is "hard-wired" for language. By contrast, B.F. Skinner's behaviourist perspective argues that language is learned through imitation, reinforcement, and conditioning. Skinner (1957) suggested that children mimic adults' words and receive praise or rewards when they produce correct utterances. In this model, each successful attempt to communicate is reinforced by positive feedback (e.g. a caregiver's smile, approval, or by granting the child's request), while errors fade away. Thus, language emerges gradually as a set of reinforced behaviours.

Montessori education provides a complementary pedagogical lens. Although Maria Montessori did not develop an explicit language theory like Chomsky or Skinner, her concepts of the Absorbent Mind (Montessori, 1995) and Sensitive Periods (Montessori, 1966) offer deep insight into natural language acquisition. According to Montessori (1966), young children (particularly from birth to age six) possess an Absorbent Mind, enabling them to effortlessly internalize language simply by living in a linguistically rich environment. Within this phase, she identified a Sensitive Period for language—a specific window of heightened receptivity when children unconsciously and rapidly acquire vocabulary, phonetics, and grammatical structures from their surroundings. During this time, language development occurs spontaneously, without the need for formal instruction or reinforcement. Montessori materials such as sandpaper letters and object boxes support this natural process by aligning with the child's developmental readiness. In sum, while Chomsky (2006) highlights innate structures and Skinner (1957) highlights reinforcement, Montessori emphasizes the child's intrinsic capacity to absorb language during optimal developmental periods.

Researchers such as Lieven and Tomasello (2008) have shown that toddlers extract grammatical patterns through repeated use; for instance, children form two-word "telegraphic" sentences (e.g. "mommy go") once they have a small lexicon to draw on. These normative patterns indicate what can be expected if development

proceeds smoothly. Delays may appear as markedly smaller vocabularies, reliance on gestures over words, or a prolonged single-word stage.

When toddlers cannot communicate effectively, behavioural problems often ensue. As noted earlier, frustration from an unmet need tends to be expressed as tantrums, aggression, or withdrawal. Clinical observers have long noted that "children with less expressive language have more severe temper tantrums" (Manning et al., 2019). For instance, a large-scale study found that "late talkers" (toddlers with limited spoken vocabulary) were nearly twice as likely to exhibit frequent, intense tantrums as peers with typical speech (Belden et al., 2008). These tantrums often occur when a child cannot say what she wants (e.g. "help" or "milk") or cannot understand a request (leading to confusion). The tantrum may look like misbehaviour, but it is often a communication breakdown. Head Start guidance notes that "children communicate so much through their behaviour," especially when they are new to a language, and that even monolingual children with speech delays "might act out due to frustration" (U.S. Department of Health and Human Services, 2017).

In developmental psychology, such behaviour is viewed as dysregulation stemming from cognitive mismatch: the child's emotional state is high but language skills are low. Without enough words, a toddler may hit, scream, or noncompliance because it is the only way she knows to express anger or request help (Cole et al., 2010). Research also suggests that disruptive behaviours can in turn impede language growth, by making interactions aversive for caregivers (Al-Harbi, 2019). Thus, communication gaps and behavioural issues can create a negative feedback loop. Recognizing this link is key: often "the disruptive behaviours may be more immediately salient to the parent than the language delays". Parents and educators may focus on the tantrum, not realizing it signals a linguistic need. This underscores the significance of our study: by understanding how exactly misunderstandings manifest in behaviour (tantrums, emotional dysregulation, defiance), we can better support the child in regaining self-control through improved communication opportunities.

Modern early childhood education increasingly involves digital media and technology. Recent research underscores that how toddlers use media matters for language development. One study found that U.S. children (17–30 months) now average nearly two hours of video per day, and that passive video watching was negatively associated with vocabulary growth (Zimmerman et al., 2007). In that study, children who were largely soothed or "babysat" with videos developed fewer phrases and shorter sentences. However, not all screen time is equally harmful: the same researchers noted that when screens are used interactively – for education or social connection (e.g. video chatting with relatives) – the negative impact is greatly reduced (Roseberry et al., 2014). In other words, toddlers can benefit from digital play if it is active and scaffolded (e.g. an app that responds to the child's input, or a parent narrating and discussing content), whereas hours of passive background TV tend to stunt language.

There is also growing evidence that well-designed digital games and tools can enhance language learning. A recent review of educational game research concluded that carefully crafted digital games facilitate academic skills – including language – when they incorporate feedback, incentives, and adaptive challenges (Granic et al., 2014). For example, interactive e-books and word-learning apps can engage young children in vocabulary practice while providing visual and auditory cues. Moreover, teachers report that children raised with technology often attend more readily to dynamic digital stimuli.

In summary, the literature indicates that early language skills and behaviour are tightly linked: toddlers who cannot express or comprehend language well often show tantrums or aggression as a form of communication. Theoretical models (innate, behavioural, Montessori) and empirical milestones guide our interpretation of these cases. Meanwhile, the rise of digital play offers new tools for intervention. We synthesize these strands to explore how educators can bridge communication gaps before they become emotional crises.

3 METHODOLOGY

Tantrums in children aged 2–3 years are a natural part of early development. The tantrums of the sensitive periods are external manifestation on an unsatisfied need, expression of alarm over danger or of something being out of space. Tantrums also often reflect the child's growing personality, independence, and challenges in communication. Understanding the reasons behind these behaviours and responding with empathy is crucial

for fostering emotional regulation and self-confidence in children. Table 1 shows some examples for different causes of child tantrums.

Table 1 Causes of Child Tantrums (Ages 2–3)

Cause	Example
Unsatisfied Needs	The child is hungry or tired and cries when asked to do something.
Sensitive Period Response	The child gets upset when their usual bedtime routine is skipped, or a toy is moved.
Expression of Alarm	The child screams when a stranger approaches or hears a sudden loud noise.
Something Feels "Out of Place"	A meltdown happens because their favorite cup is unavailable, or furniture is rearranged.
Developing Independence	The child insists on putting on their own shoes, fails, and throws a tantrum.
Communication Challenges	The child wants a specific snack but can't name it, so they cry and throw objects.

Dr. Maria Montessori observed that children pass through "Sensitive Periods" — specific developmental phases when they are especially receptive to certain stimuli in their environment. These periods are transient but play a crucial role in a child's effortless and natural learning process. Rather than attributing growth solely to heredity, Montessori emphasized the importance of guided effort during these phases. Children interact with the world vividly and meaningfully when their sensitivities are honoured, allowing them to focus intensely and joyfully on certain elements in their surroundings until they move on to a new developmental stage.

One of the most significant sensitive periods involves language development. Montessori noted that language emerges not through direct teaching but as a spontaneous process guided by the child's "absorbent mind." From as early as three weeks old, babies begin making expressive sounds. By three months, they recognize that human voices come from the mouth and start to imitate lip movements. Over the following months, their vocalizations evolve into syllabic sounds. Around ten months, babies realize that these sounds have meaning and are directed at them, marking a critical turning point in their language comprehension and expression.

By the age of one, children typically say their first intentional word and understand several more. At around 18 months, they begin recognizing that every object has a name, forming basic phrases and gradually acquiring grammar and sentence structure. While developmental timing may vary slightly among individuals, Montessori's timeline for language acquisition has proven remarkably consistent across cultures. Her insights highlight the universality of these sensitive periods and the profound natural capacity children have for learning when nurtured at the right time.

Integrating technology in Montessori-style education is a nuanced challenge. Traditional Montessori pedagogy originally emphasized tangible, manipulative materials; yet many modern Montessori programs now use tablets and multimedia as supplementary tools. The key is to preserve child-led exploration and sensory learning even when media are involved. Thus, our framework blends Montessori's focus on self-paced, hands-on learning with 21st-century digital pedagogies. For instance, an interactive storytelling app can complement a child's language work with Montessori language objects. However, we also consider teacher training needs: if educators recognize the potential of digital play for language but lack appropriate content or training (a common issue), even the best intentions may fall short.

4 CASE STUDY ANALYSES: TANTRUMS AS COMMUNICATION STRUGGLES

4.1 Case 1: Ethan (Age 1½)

Ethan looked at the ball and wanted to get it from the shelf. He made a cooing sound to get attention from his parents, as he could not reach to get the ball from the shelf. The mother was busy on the phone and she does not realize that Ethan was trying to get her attention. Ethan walked to his mother and pulled her shirt towards the shelf. He pointed at the ball and made again the cooing sound. The mother took the truck next to the ball and passed to him. Ethan threw away the truck and started to cry and even shouted, as he wanted the ball instead of the truck. The mother comforts him and asked, "What do you want?" Ethan pointed at the ball. The mother asked, "You want the ball? Say: ball" He nodded his head and replied "ah ah ah" to the mother. The mother does not continue to encourage Ethan to mimic the word. She passed the ball to Ethan and walked away.

Analysis: Ethan's tantrum was triggered by a breakdown in communication. At 18 months, children rely heavily on non-verbal cues such as pointing, eye gaze, and sounds to communicate (Berk, 2022). At his developmental stage, non-verbal cues are primary tools for communication, and when these fail, frustration escalates into emotional outbursts. The mother's distraction and lack of attuned response disrupted the opportunity for a meaningful language exchange. Montessori (1995) emphasized the importance of attentiveness and responsiveness in language development, encouraging adults to name objects and guide children in mimicking sounds during natural interactions. Ethan's mother missed a valuable moment to support emerging speech by reinforcing the word "ball" and engaging in a responsive exchange.

4.2 Case 2: Zhi Kang (Age 3)

Zhi Kang wanted to build a tower with blocks. His mother, however, told him to put away the toy cars first before using the blocks. Zhi Kang did not want to stop playing and, unable to express his feelings in words, laid down on the floor, screaming and crying. His mother recognized that this was not defiance but a defensive reaction—he was struggling to express his emotions and needs. Once, he calmed down, she patiently waited for him to calm down, then gently said, "Keep the toy and we build tower." She held his hand and guided him to tidy up the toy cars before they began building the tower together

Analysis: At age 3, children are still developing emotional regulation and expressive language skills. Zhi Kang's emotional reaction stemmed from his limited verbal capacity to negotiate or express resistance. His mother's patient and emotionally responsive approach helped him to regulate his emotions and understand expectations. This response reflects Montessori's (1966) principle of respecting the child's developmental rhythm. By using clear, simple language and modelling appropriate behaviour, she supported both his independence and communication.

4.3 Case Study 3: Yan Yan (Age 2½)

At a family restaurant, Yan Yan sat in her highchair watching cartoons on a tablet while her parents and I shared a meal. Her younger sibling needed attention, so her father focused on helping the baby while her mother briefly stepped away to take a phone call. Suddenly, Yan Yan spotted a dog outside the restaurant window. Her eyes widened with excitement as she pointed and exclaimed, "Da! Da! Da!"—trying to get her father's attention. However, preoccupied with the younger child, he didn't notice. Frustrated and ignored, Yan Yan began to scream and stomp in her seat. Her father, flustered by the noise and public setting, scolded her for misbehaving without realizing she had been trying to communicate.

Analysis: Yan Yan's tantrum resulted from a communication breakdown. While excitedly trying to label the dog, her father was distracted by her younger sibling and did not respond. This lack of acknowledgment led to frustration, which manifested in the tantrum. A more responsive approach, where her father acknowledged her attempt by saying, "Yes, you see a dog! That's a dog!" would have not only validated her effort but also provided a language model that could help her expand her vocabulary. In addition, if technology had been used more interactively—such as a tablet app that allows for verbal responses or engagement—this could have further supported her language development.

4.3 Summary

The case studies of Ethan, Zhi Kang, and Yan Yan illustrate that tantrums often arise from communication struggles rather than intentional misbehaviour. For young children, the ability to express their needs and emotions is still developing, and when communication is not recognized or understood, frustration can quickly escalate into emotional outbursts. These cases emphasize the importance of responsive parenting and adult involvement in fostering language development. Montessori's principles of attentiveness, respect for the child's developmental stage, and the modelling of language can help bridge the gap between children's needs and their ability to express them. Moreover, the use of digital tools, when used interactively, can complement traditional methods of language development by engaging children in meaningful exchanges. Ultimately, these strategies align with current research on language development, underscoring the need for active interaction and responsive, empathetic communication in early childhood education.

5 STRATEGIES AND DISCUSSION FOR SUPPORTING LANGUAGE DEVELOPMENT

Montessori's writings highlight several key strategies for supporting a child's language development. The child will often become frustrated when trying to communicate and is not understood. Lacking the full capacity for language, he expresses his exasperation through emotional outbursts. It is important to recognize these efforts as the beginning of language construction, and respond with patience and attentiveness (Montessori, 1995). The child does not need direct instruction in language; instead, he requires encouragement and a supportive environment where his efforts to speak are acknowledged and gently guided. A key part of this process is exposing the child to meaningful speech, not just through direct communication with him, but also by engaging in conversation with others around him. This immersion in speech helps the child naturally absorb the rhythm, tone, and structure of language. Even if the child's responses are unclear, we must speak to him as if he understands, using real words and complete sentences. This demonstrates trust in his capacity to understand and fosters a desire to communicate.

Additionally, it is crucial to listen actively to the child's early speech attempts, interpreting his early vocalizations and baby talk. Doing so makes the child feel heard and valued, motivating further language use. Montessori emphasized that, "When we wish to perfect the speech, it is first necessary that the speech exist" (Montessori, 2002). Therefore, the child should be allowed to explore language imperfectly before expecting correctness. Finally, it is important not to assume that constant interaction will necessarily speed up speech development. While engagement is important, the quality and richness of language exposure are what truly influence how accurately and expressively the child will speak when he is ready. The child needs help in his development, and with encouragement from adults, he will gradually learn to communicate effectively, recognizing the power and possibility of language.

A strategic approach to supporting language development in early childhood involves the intentional integration of digital play into classroom practices. As noted by Van der Westhuizen and Hannaway (2021), digital play serves as an effective pedagogical tool that significantly increases student engagement compared to traditional teaching methods. Incorporating digital games and interactive visual tools into language lessons not only makes learning more engaging but also fosters deeper participation. Furthermore, when children are encouraged to connect digital visuals—such as images or scenes from educational games—to their own personal experiences, they are more likely to contextualize their learning, which enhances vocabulary growth and communication skills. The value of digital play in language teaching is further supported by Pepler (2015), who asserts that digital technology offers rich opportunities for vocabulary expansion, sentence structuring, and semantic understanding. Learners retain language better when they can both see and hear the content simultaneously—a point echoed by Berschorner and Hutchinson (2013), who highlight the positive impact of technology on recall, comprehension, and retention. Moreover, technology enhances learner independence and encourages exploration; however, the effectiveness of this strategy depends on the teacher's willingness to empower students to use these tools meaningfully (Van der Westhuizen & Hannaway, 2021).

The use of passive screen time, such as watching a cartoon on a tablet without interaction, can contribute to frustration and hinder language development in young children. When children are not provided with opportunities to actively engage with the content, they may become upset, as their communication attempts go unrecognized or unsupported. This is especially critical during the sensitive period for language acquisition when active interaction is key for developing verbal skills.

A more effective strategy involves integrating interactive technology that encourages communication and language practice in a way that aligns with Montessori principles. While Montessori education emphasizes hands-on, sensory learning, modern digital tools can complement this approach when they promote active learning. For example, an interactive storytelling app or language learning game could provide positive reinforcement when children attempt to communicate, saying things like "Yes, that's a ball!" and prompting further language use.

This integration of interactive digital tools allows children to actively engage with their language development while adhering to Montessori principles. The key lies in adult guidance—whether through direct conversation, word modelling, or interactive technology—ensuring that children receive the feedback needed to connect their thoughts and expressions.

Research supports the use of active technology (e.g., apps, e-books, video chatting) as a valuable tool for language growth, in contrast to passive screen time, which can impede verbal development (Berk, 2022). By using these interactive tools, children's emotional and communication needs can be met, while technology serves as an enhancement rather than a replacement for essential social interactions with family and peers.

6 CONCLUSION

Language development in early childhood is a foundational process that requires intentional support, sensitivity to developmental needs, and the use of effective strategies. This paper has shown how traditional, Montessori-inspired practices—such as naming objects, observing the child's cues, and creating a rich verbal environment—can support early communication. From acknowledging a child's earliest attempts to communicate to offering rich, meaningful language exposure and incorporating digital play, educators can play a pivotal role in shaping a child's linguistic growth. The integration of digital play, as supported by recent research, has shown to enhance engagement, vocabulary acquisition, and memory retention—especially when visuals are linked to children's personal experiences.

Understanding and supporting language development is not about overwhelming the child with input, but about building a respectful, responsive environment. Montessori reminds us that language grows through trust, interaction, and the child's freedom to explore. By combining classic developmental insights with evidence-based digital tools, educators and caregivers can help children move from frustration to expression—nurturing confident, emotionally resilient communicators for the future.

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Evaluating the Effectiveness of Collaborative Strategic Reading (CSR) in Enhancing Reading Comprehension in ESL/EFL Context

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ABSTRACT

Among the various skills involved in English language learning, reading remains one of the most challenging for second or foreign language learners. Effective reading requires both comprehension and motivation; elements often lacking in many students. Collaborative Strategic Reading (CSR) is a pedagogical approach designed to enhance reading comprehension through the integration of collaborative group activities and specific reading strategies. This method helps students decode, understand and retain information from texts more effectively. This study aimed to evaluate the efficacy of CSR in an English as a Second/Foreign Language (ESL/EFL) classroom within a higher education context. The research involved 35 students from four groups, all from engineering disciplines, who use English as their second or third language. Employing a mixed-mode research design, the study compared the participants' pre-test and post-test scores. Additionally, a focus group interview was conducted to explore students' perceptions of their experiences with CSR. The results indicated a significant improvement in students' post-test scores following the implementation of CSR. Consequently, the thematic analysis of the interview data revealed a generally positive response to the CSR approach.

KEYWORDS: Collaborative Strategic Reading, Reading Comprehension, Reading Skills, ESL, EFL

1 INTRODUCTION

Reading remains a challenging skill set for many students of Generation Z, particularly in an era dominated by short-form video content. This generation is often characterised as having shorter attention spans, limited patience and a preference for immediate outcomes. Such traits are inherently misaligned with the cognitive demands of reading comprehension, which requires sustained attention, critical thinking and intrinsic motivation.

Effective reading involves both comprehension and motivation, but these components are frequently lacking among students, especially those learning English as a second or foreign language. Based on the researcher's classroom observations, many students demonstrate initial interest in reading texts but gradually lost motivation. This is contributed to their limited comprehension which often impedes participation and engagement in discussion. Eventually, this diminishes their motivation to read and learn further.

To address these challenges, the researcher implemented Collaborative Strategic Reading (CSR) as an instructional intervention aimed at enhancing both comprehension and motivation. This study investigated the effectiveness of CSR among 35 engineering students enrolled in an English proficiency course. The study aimed

to provide valuable insights for educators in selecting and applying effective reading strategies that cater to the learning needs of Generation Z students in higher education contexts.

2 LITERATURE REVIEW

Collaborative Strategic Reading (CSR), developed by Klingner and Vaughn (2000), is an instructional approach aimed at improving reading comprehension through a combination of Reciprocal Teaching (Palincsar & Brown, 1984) and cooperative learning strategies (Johnson & Johnson, 1987). Based on the principles of scaffolding and social constructivism, CSR enables learners, especially those with diverse linguistics and learning background, to collaboratively engage with texts in structured group settings.

Previous research has indicated the effectiveness of CSR across diverse learners. For example, Klingner and Vaughn (2000) highlighted CSR's suitability for English language learners, emphasising on the safe and cooperative learning environment that promote active discussion and comprehension. Peer assistance helps learners' approach complex texts more confidently. This was further reinforced in studies by Fan (2010) and Xiao (2010), where EFL learners showed distinct improvements in comprehension scores following CSR implementation. Similarly, Rattanasaeng (2011) found that with adequate training, students gained fluency in CSR strategy use and could work independently in small groups. Kuttiya (2001) and Kongkool (2005) also reported positive outcomes. Their findings revealed not only enhanced reading understanding but also improved vocabulary acquisition, summary writing skills and social interaction.

The findings of Klingner and Vaughn (1998, 2000) consistently support CSR's effectiveness across multiple grade levels. For example, in a study with 7th and 8th graders with low learning abilities, CSR significantly improved reading comprehension (Klingner & Vaughn, 1998). Likewise, CSR has shown positive outcomes in ESL science classes and among fourth and fifth graders (Klingner, Vaughn & Schumm, 2000), where students outperformed control groups in vocabulary acquisition and text engagement.

However, not all studies indicated positive outcomes. Zoghi et al. (2014) observed no statistically significant improvements in reading scores, although qualitative data indicated students' enjoyment and positive perceptions of CSR. This suggests that while affective engagement is valuable, it may not always translate to measurable academic performance. Similarly, Bryant et al. (2000) combined CSR with other instructional strategies in inclusive classrooms, finding gains in word recognition and fluency but limited improvement in comprehension. These findings showed that CSR may be more effective when used thoughtfully within broader, multi-component literacy interventions.

Other studies explored CSR alongside metacognitive and cognitive strategy instruction. Mokhtari and Sheorey (2001) and Imtiaz (2004) found that proficient readers, especially among ESL learners, employed more reading strategies, including those who adapted CSR. Yet, Monos (2005) reported no significant correlation between metacognitive awareness and reading proficiency. This may suggest the need for further investigation into how strategic awareness impacts comprehension outcomes. Phakiti (2006) showed that cognitive strategies such as comprehension monitoring and memory recovery were directly linked to reading performance, lending further support to CSR's emphasis on peer scaffolding and strategy sharing, all using structural equation modelling.

Wang (2008) and Huang (2004) explored CSR's impact on affective factors like motivation, critical thinking and self-directed learning. While quantitative gains were mixed, students reported that CSR enhanced their engagement, encouraged autonomy, and fostered deeper textual analysis. Fitri (2010) resonated these findings in a quasi-experimental study in Indonesia, concluding that CSR significantly improved students' reading comprehension achievement compared to conventional approaches.

Overall, the body of literature supports the implementation of CSR as a powerful tool for improving reading comprehension, particularly among linguistically and cognitively diverse learners. While quantitative outcomes vary across contexts, CSR's consistent contribution to learner engagement, peer collaboration and strategic reading habits is evident. However, the literature also suggests that CSR's effectiveness may depend

on variables such as teacher training, group dynamics and integration with other instructional strategies. Future research should continue to explore how CSR can be optimised across educational settings and learner profiles.

2.1 Collaborative Strategic Reading

Collaborative Strategic Reading (CSR) is a reading comprehension strategy that integrates elements of Reciprocal Teaching (Palincsar & Brown, 1984) and Cooperative Learning (Johnson & Johnson, 1987). Principally, CSR's strategies aim to assist students in understanding complex texts whilst working collaboratively. The strategies include previewing the text, giving ongoing feedback by deciding "click" (I get it) or "clunk" (I don't get it) at the end of each paragraph, "getting the gist" of the most important parts of the text and "wrapping up" key ideas (Abidin and Riswanto, 2012). These strategies are adapted and illustrated in Figure 1 below:

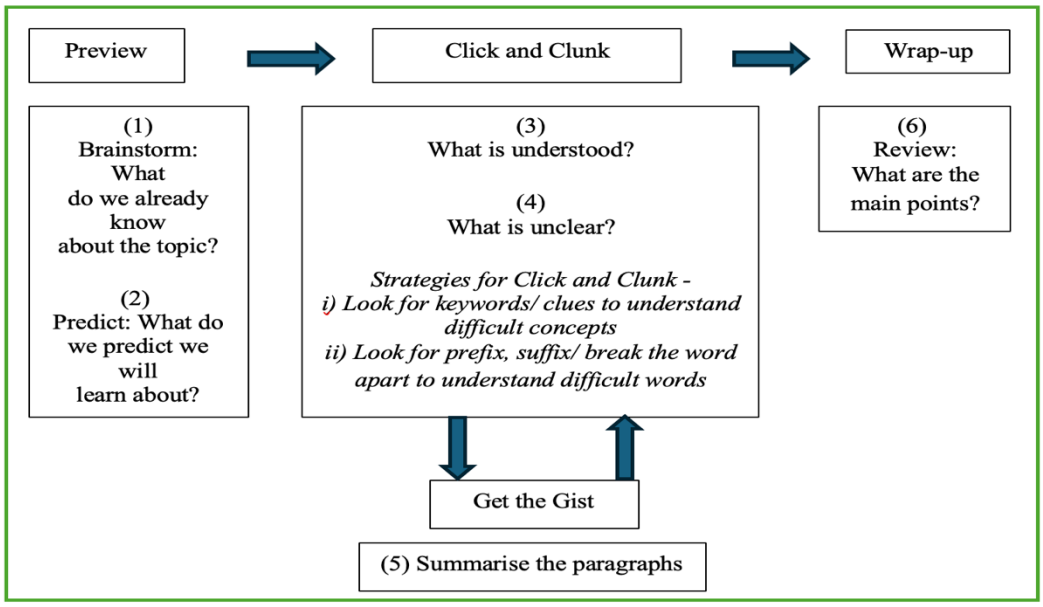


Figure 1: Strategies of Collaborative Strategic Learning (Adapted from Abidin and Riswanto, 2012)

Preview

This first step requires students to quickly skim the passage before reading in depth. In two to three minutes, students examine titles, headings, visuals and key terms to activate prior knowledge and anticipate content. This process builds interest and prepares the reader to engage actively with the text. Teachers often introduce this step by comparing it to watching a movie trailer, previous experiences or knowledge and asking prompt questions to help students predict the content.

Click and Clunk

While reading, students monitor their understanding by identifying "clicks" (parts they understand) and "clunks" (parts that confuse them). This strategy teaches students to recognise breakdowns in comprehension and apply "fix-up" strategies to resolve them. Fix-up strategies include rereading surrounding sentences to look for clues, analysing word parts (prefixes/suffixes) or breaking words into familiar chunks. Teachers initially guide this process, but students gradually learn to apply it independently in group discussions.

Get the Gist

After reading a section, students summarise the main idea in their own words. This helps them focus on key information, improving comprehension and retention. Teachers prompt learners to identify the most important person, place or idea in a paragraph and then express its significance concisely, avoiding unnecessary details.

Wrap Up

In this final stage, students consolidate their learning by generating and answering questions using prompts like "who", "what", "when", "where", "why" and "how." This reflective step deepens understanding and encourages metacognitive thinking. Students are also encouraged to write key takeaways in their CSR logs and share insights, enabling teachers to assess comprehension and learning progress.

3 RESEARCH METHODOLOGY

3.1 Participants

This research involved 35 students from four groups, all from engineering disciplines, who use English as their second or third language. All students were male students, studying in a local private university, aged between 19 to 21 years old. All students underwent primary and secondary education where English was taught as a second or foreign language. Earlier, the students had also undertaken the English subject at the Sijil Pelajaran Malaysia (SPM) level and all students obtained at least a pass (Grade E) in the English subject as stated in the minimum entry requirement guideline for the engineering courses at this institution. Students were briefed about the research prior to the implementation. 35 students agreed to participate in the research and signed the consent form.

3.2 Data Collection

The students undertook a pre-test consisting of 40 comprehension questions based on three passages. The test was adapted from a public IELTS reading practice available on the internet and converted into a Google Form format. Students were given a link via Google Classroom and were given one hour to complete the test. A timer was set to automatically stop accepting submission after one hour. The administration was done in a computer lab with a typical examination setting and rules applied. Two invigilators were on duty to invigilate the students. All computers were equipped with Safe Exam Browser plugins which disabled access to other websites or applications and prevented screen capturing. This also ensured that students could only access the test page, therefore preventing cheating cases. The same procedures were implemented whilst conducting the post-test.

The reading test used for pre-test and post-test was carefully chosen to suit the students' background in science and engineering to avoid disadvantages. It also covered the general reading skills that were required in reading comprehension. The topic of each passage is summarised in Table 1 and the reading skills assessed in the test is presented in Table 2:

Table 1: Summary of Article in Pre-Test and Post Test

Sections	Title of Article	Summary of Article	Item Number
Section 1	Dino Discoveries	The article highlights the interesting procedures in dinosaur recovery, which were often being found by those who were not trying to find them. They often encounter challenges which usually lead to either false discovery or false interpretation.	1 to 13
Section 2	Art to the Aid of Technology	The article talks about what caricatures can teach us about facial recognition technology. It also highlights the interesting innovation and possible problems in facial recognition technology.	14 to 26
Section 3	Mind Readers	The article summarises the history of research and findings on electrical activity in the human brain. It also highlights that in the future, it might be possible to eavesdrop on another person's inner voice.	27 to 40

Table 2: Pre-Test and Post-test Question Types and the Reading Skills Assessed

Question Types	Reading Skills Assessed	Item Number
Multiple Choice	Skimming for main ideas, scanning for details, understanding writer's opinion and inference	37, 38, 39, 40
True/False/Not Given / Yes/No/Not Given	Scanning for specific information, identifying explicit vs. implicit meaning, inference	1, 2 ,3 ,4 ,5 ,6 , 27, 28, 29, 30, 31, 32
Matching Headings	Skimming for main ideas and themes, identifying topic sentences, distinguishing key ideas	14, 15, 16, 17, 18, 19
Matching Information	Scanning for specific details, recognizing paraphrasing, locating information	20, 21, 22, 23
Identifying Information (Short Answers)	Scanning for details, paraphrasing, summarizing key facts	24, 25, 26
Sentence Completion	Understanding context, word recognition, grammar awareness, scanning for specific info	33, 34, 35, 36
Diagram/Label Completion	Scanning for technical details, matching text to visual information, interpreting visuals	7, 8, 9, 10, 11, 12, 13

3.3 Implementation of CSR

The implementation of CSR was done in a period of 6 weeks. Week 1 was used for Pre-test administration while Week 6 was used for Post-Test administration. Four weeks were used for the implementation of CSR. Each class session was only 2 hours and once a week, which totalled to 8 hours. the summary of lesson plan for each class is presented below in Table 3:

Table 3: Lesson Plan for the CSR Implementation

Week	Details of Lesson Plan	Duration	Venue
Week 1	Briefing and Administration of Pre-Test	2 hours	Computer Lab (Room CC214)
Week 2 (Lesson 1)	**Warm-Up Discussion (20 mins)** ● Ask students questions such as "What are your reading habits?", "Do you prefer reading alone or in groups?", "Why?", "What are your challenges when reading a text?". ● Encourage students to share their experience and struggles in reading. **Introduction to CSR (20 mins)** ● Explain CSR with visual aids and examples. **Strategy 1: Preview (30 mins)** ● Brainstorm and predict the article using headings, titles etc ● Practice using a short article (Title of Article: The New Way to be a Fifth Grader (Adapted from Wired Magazine) **Strategy 2: Click & Clunk (30 mins):** ● Teach students to identify words/concepts they understand (Click) or don't (Clunk). ● Practice using vocabulary tools (context clues, word parts). **Group Practice (20 mins):** ● Divide students into groups of three or four. ● Read the article again and apply both Preview and Click & Clunk.	2 hours	Room M101
Week 3 (Lesson 2)	**Recap and Icebreaker Quiz on CSR (20 mins)** **Strategy 3: Get the Gist (30 mins)** ● Teach how to summarise paragraphs in 10 words. ● Practice with the article entitled 'The Three Theories' adapted from National Geographic. **Assign & Practice Group Roles (30 mins)** ● Students receive role cards and practice a short CSR session in groups. **Group Practice Session (40 mins)** ● Read a slightly longer article (Title of article: ● Apply Preview, Click & Clunk, Get the Gist. ● Rotate roles.	2 hours	Room M101
Week 4 (Lesson 3)	**Strategy 4: Wrap Up (30 mins)** ● Summarise the text ● Teach how to ask and answer comprehension questions. **Full CSR Cycle Simulation (60 mins):** ● Assign group roles.	2 hours	Room M101

	● Groups go through all 4 strategies using an academic text. **Feedback & Reflection (30 mins):** ● Groups present their summaries and questions. ● Self-assessment on CSR participation.		
Week 5 (Lesson 4)	**Review CSR with a Quiz (20 mins)** **CSR Group Reading Task (60 mins)** ● Use an IELTS-style passage (Title of Article: The Earth and Space Foundation, adapted from The Earth and Space Foundation) ● Complete all CSR steps **Peer Assessment & Feedback (20 mins)** ● Groups assess each other's summaries and participation **Whole Class Reflection & Wrap-Up (20 mins)** ● Discuss: "How has CSR helped your reading?"	2 hours	Room M101
Week 6	Post Test and Focus Group Interview	2 hours	Computer Lab (Room CC214)

3.4 Focus Group Interview

In Week 6 of the lesson, students were interviewed in a focus group format. A total of 6 prompt questions were asked to the students who were put in groups of five. The interview questions were adapted and selected from Bermillio & Verto (2022). The interview was recorded and later transcribed using Google Doc Voice Typing tool. The transcription was later validated by an anonymous transcriber and a reviewer. The data from the focus group interview was later analysed using Nvivo software to obtain the themes. Table 4 summarises the prompts used in the interview, focusing on students' experiences, perceived benefits and possible challenges.

Table 4: CSR Focus Group Interview

Areas	**Questions/ Prompts**
A. Engagement and Motivation	Do you feel more motivated when using CSR strategies in your reading? Do you think CSR made reading lessons more interesting and enjoyable? Why?
B. Comprehension and Strategy Use	Which CSR strategies are helpful to you? Why? Are you able to apply the strategies in your reading?
C. Collaboration and Peer Learning	Do you like working in groups? Why? Do you find it helpful to work with peers during CSR sessions?
D. Confidence and Skills Improvement	Has your reading comprehension improved as a result of CSR? Can you use CSR strategies on your own?
E. Additional Comments	Do you have any concerns or unpleasant experiences?

3.5 Research Questions

Ultimately, this research was designed to answer the following research questions:

1. Do students' comprehension understanding improve after the implementation of CSR?
2. What are students' perspectives towards the implementation of CSR?

4 FINDINGS

4.1 Pre-Test and Post Test

This study investigated the effectiveness of Collaborative Strategic Reading (CSR) in enhancing reading comprehension among 35 ESL/EFL engineering students at a Malaysian private university. Over a period of four weeks, students underwent CSR-based reading instruction integrated into their classroom routine. The impact of the intervention was assessed using a pre-test and post-test design, with scores measured on a 100-point scale (100%) and evaluated using a standardised grading rubric.

Table 5: Results of Pre-Test (Before the Implementation of CSR) and Post Test (After the Implementation of CSR)

Percentage Range	Grade	Pre-Test Result		Post-Test Result	
		Frequency (No of Students)	Percentage	Frequency (No of Students)	Percentage
90 to 100	A+	0	0%	0	0%
80 to 89	A	0	0%	1	2.9%
75 to 79	A-	0	0%	1	2.9%
70 to 74	B+	1	2.9%	10	28.6%
65 to 69	B	6	17.1%	6	17.1%
60 to 64	B-	4	11.4%	4	11.4%
55 to 59	C+	4	11.4%	7	20.0%
50 to 54	C	4	11.4%	1	2.9%
0 to 49	F	16	45.8%	5	14.2%
	Total	35	100%	35	100%
	Mean	-	48.14%	-	61.59%

Table 5 provides an overview of the students' reading comprehension levels before and after the implementation of CSR. A marked improvement in reading comprehension following the CSR intervention is observed. The mean pre-test score was 48.14, which increased to 61.59 in the post-test, yielding an average gain of 13.44%. This suggests that CSR positively influenced students' engagement and reading proficiency. Correspondingly, the number of students in the failing category (below 50%) declined sharply from 16 to 5, reflecting a 68.75% reduction in underperformance. Students scoring in the B+ to A range increased from 1 to 12, highlighting improvements at the higher performance end. These results support the effectiveness of CSR, particularly in helping lower-performing students increase their academic performance.

Several students exhibited marked improvements, illustrating CSR's differentiated impact. For instance, Student 25 achieved the most significant gain of 32.5%, moving from a failing score of 2% to 57.5% (C+). Similarly, students 9, 24, 2, 11 and 29 improved by 25% or more, successfully exiting the failing range. These improvements suggest that CSR is especially effective for at-risk learners through its structured reading phases and peer-assisted approach. In contrast, students who initially performed well (e.g., Students 6, 18, 23, and 26) demonstrated smaller yet consistent gains (between 2.5 to 7.5%), indicating that CSR can also reinforce and slightly enhance the reading abilities of higher achievers. These notable observations are illustrated in Table 6 below:

Table 6: Notable Observations from the Pre-Test and Post Test Results

Student	Pre-Test Result	Post-Test Result	Difference in Improvement of Marks
Student 25	25%	57.5%	32.5%
Student 24	20%	45%	25%
Student 9	7.5%	35%	27.5%
Student 2	30%	55%	25%
Student 11	47.5%	72.5%	25%
Student 29	30%	55%	25%
Student 6	67.5%	70%	2.5%
Student 18	65%	70%	5%
Student 23	65%	70%	5%
Student 26	65%	67.5%	2.5%
Student 25	25%	57.5%	32.5%
Student 24	20%	45%	25%

4.2 Focus Group Interview

Following four weeks of Collaborative Strategic Reading (CSR) implementation, a focus group interview was conducted to explore students' experiences, perceived benefits and challenges associated with the CSR approach. Thematic analysis of the transcribed data revealed four main themes: enhanced confidence and comprehension, positive collaborative learning dynamics, increased metacognitive awareness and concerns regarding group participation and pacing.

Theme 1: Enhanced Confidence and Reading Comprehension

Most participants reported noticeable improvements in their reading comprehension and a stronger sense of confidence when engaging with academic texts. Students expressed that CSR had helped them break down complex texts into manageable parts, making it easier to identify main ideas, clarify difficult vocabulary, and summarize content. One student shared:

> *"Before, I always feel* [felt] *lost when reading long texts, but now I know what to focus on. The 'Get the Gist' and 'Click and Clunk' steps really help me understand better."*

Another participant echoed this by stating:

> *"I used to guess the answers when* [during] *reading tests, but after using CSR, I can understand what I read and can be more prepared."*

Participants also noted increased self-efficacy in answering reading comprehension questions during class assessments and exercises. Several students attributed their improved performance to the structured reading process introduced through CSR.

Theme 2: Positive Peer Interaction and Collaborative Learning

Another recurring theme was the value of group collaboration. During the four weeks of the implementation of CSR, students were put in groups and found working with their peers as supportive and engaging, particularly highlighting how peer explanations often made content easier to understand than teacher-led instruction. This phase was repeatedly cited as an enjoyable and beneficial component of the process. A participant remarked:

"Sometimes my friends explain things in a way that makes more sense to me. It's nice to learn from each other and not feel embarrassed when [I] *don't understand something."*

Another student added:

"When [we work*] in groups, I feel more motivated to read and more motivated to finish the task. It's less boring and more fun when we learn together."*

The safe, non-threatening environment fostered by CSR helped students actively participate and contribute to group tasks, which they found motivating.

Theme 3: Increased Metacognitive Awareness

Some students also highlighted improved awareness of their own reading processes. They reported being more conscious of strategies such as predicting, questioning, clarifying and summarising while reading, even outside CSR tasks. Some students mentioned that they began applying the strategies independently during other academic readings:

"Now I automatically ask myself questions while reading. [It feels] *like I'm talking to the text."*

This growth in metacognitive strategy use suggests that CSR not only supports comprehension during group activities but also fosters transferable reading skills.

Theme 4: Minor Challenges and Concerns

Despite overall positive experiences, some students raised concerns about uneven group participation and time management. A few noted that certain group members tended to dominate discussions, while others were more passive. One student commented:

"It's a good method, but sometimes not everyone contributes [equally]. *Sometimes some are too quiet, and others end up doing all the talking."*

Additionally, there were concerns about the pace of the sessions, with some students feeling that the time allocated for each CSR stage was either too short or too long depending on the text's difficulty.

In conclusion, the findings from the focus group show that Collaborative Strategic Reading help students read and engage better. Students' level of confidence was also reported to be improved. The findings also show that students appreciated the structured, step-by-step process and apreciated the opportunity to work collaboratively in a supportive environment. There were some concerns raised, such as unbalanced participation and pacing, but the overall response to CSR was encouraging. The data also suggest that CSR is not only an effective approach but also one that students may likely use beyond the classroom.

5. DISCUSSION

This study was designed to answer two primary research questions: (1) whether students' reading comprehension improves following the implementation of Collaborative Strategic Reading (CSR) and (2) what students' perspectives are toward CSR as a reading comprehension strategy. The results from both the quantitative and qualitative data suggest that CSR is an effective instructional approach that enhances comprehension and is positively received by students in an ESL/EFL engineering context in a private university in Malaysia.

In response to **Research Question 1**, the quantitative findings clearly indicate that CSR had a significant impact on improving students' reading comprehension. The mean score increased from 48.14% in the pre-test to 61.59% in the post-test and this reflects a notable academic improvement. Additionally, the distribution of scores showed a clear decrease in the number of failing students and a notable shift toward higher performance bands. These findings support the effectiveness of CSR in supporting comprehension development among ESL learners. The results are also consistent with earlier mentioned studies by Klingner and Vaughn (2000), Fan (2009) and Xiao (2010), who have emphasised CSR's structured and interactive approach as beneficial for diverse learners. Importantly, the study demonstrated significant improvements among lower-performing students, including individual cases such as Student 25, who improved by more than 30%. This suggests that CSR's cooperative and metacognitive strategies are particularly powerful for scaffolding struggling learners, resonating the social constructivist framework underpinning the method. Through the Preview, Click and Clunk, Get the Gist and Wrap-Up phases, students are gradually guided to become more independent and strategic readers. The structured nature of CSR helps explicate challenging academic texts by teaching students how to approach unfamiliar vocabulary, summarise content and monitor their understanding as they read. These results support earlier research by Rattanasaeng (2011) and Kuttiya (2001) that CSR not only boosts comprehension but also enhances learners' confidence in understanding academic materials.

Regarding **Research Question 2**, the qualitative data gathered through focus group interviews provided important information into students' experiences and attitudes toward CSR. Most participants expressed that CSR positively impacted their confidence, motivation and overall engagement with reading tasks. They reported feeling more in control of their reading processes and less intimidated by challenging texts, which are consistent with previous findings by Wang (2008) and Huang (2004), who highlighted improved learner autonomy and critical thinking through CSR.

A particularly encouraging theme that emerged from the data was increased metacognitive awareness. Students shared that they started to apply CSR strategies, such as summarising and questioning, even outside the academic reading sessions. This strategic transfer suggests a deeper internalisation of CSR principles and supports Mokhtari and Sheorey's (2001) notion that metacognitive reading strategies are transferable and becomes the foundation to comprehension success. Unlike Monos (2005), who found limited correlation between metacognitive awareness and comprehension, this study provides evidence that CSR can play a transformative role in embedding these strategies into learners' reading habits.

Nevertheless, the study noted some challenges. Issues related to unequal contribution and time constraints were discussed by the students in the focus group interview. Several students mentioned that more vocal students dominated the discussions while introvert students remained quiet. Some students felt rushed during certain phases, particularly when attempting to formulate and answer wrap-up questions. Bryant et al. (2000) and Zoghi et al. (2014) had previously highlighted these two issues and emphasised on the need for careful group dynamic and sufficient scaffolding to ensure equitable participation and effectiveness.

Furthermore, while most students showed improvement, the achievements of high-achieving students were comparatively modest. This may suggest a ceiling effect. Additionally, these good students may require more advanced or distinguished applications of CSR or other reading approaches to improve their performance. This observation contributes a new understanding to the literature, which has traditionally focused on CSR's impact on low to average-performing students.

The successful implementation of CSR in a Malaysian private university contributes valuable context-specific knowledge to a body of literature which has been largely centered on Western and East Asian settings. The findings imply that CSR is both pedagogically and culturally effective in ESL tertiary education, especially in technical fields such as engineering. The results suggest that CSR is not only culturally adaptable but also pedagogically effective in ESL tertiary education, particularly in technical disciplines such as engineering.

In conclusion, this study shows that CSR significantly enhances reading comprehension and is perceived positively by students. However, to maximise its impact, future implementations should address

group dynamics, time-related challenges and consider alternative comprehension approaches for high performers. It is also worth noting that an integration with digital platforms may provide beneficial outcomes for future implementation. These enhancements can further strengthen CSR's role in fostering strategic, independent readers across diverse academic contexts.

6. CONCLUSION

This study aimed to evaluate the effectiveness of Collaborative Strategic Reading (CSR) in enhancing reading comprehension among ESL/EFL engineering students at a private university in Malaysia. The findings reveal significant improvements in students' reading scores, supported by both quantitative and qualitative data.

CSR was found to be beneficial not only for struggling readers but also for high-achieving students, given its structured, interactive framework. It is recommended that CSR be integrated into English language proficiency subjects in higher education, with sufficient support for the lecturers. As for the direction of future research, it is recommended that large sample sizes, control groups and longitudinal tracking are considered in examining the impact of CSR. Furthermore, adapting CSR for blended and digital learning environments may increase its applicability and reach in contemporary educational contexts.

In conclusion, CSR offers a strategic, learner-centered approach to reading instruction that improves comprehension, fosters collaboration and promotes academic confidence, making it an asset in equipping students for success in linguistically demanding academic environments.

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Influencing Factors on English Mispronunciation Among Secondary-Level Students and Their Perception of Impact on Second Language Acquisition

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ABSTRACT

Effective communication relies heavily on accurate pronunciation. When sounds are articulated correctly, mutual understanding is facilitated, leading to smoother two-way conversations. Conversely, mispronunciation can cause misunderstandings, making it more challenging to connect with others. For language learners, precise pronunciation is essential for comprehension and confidence, positively affecting overall language skills. Therefore, this study investigates the factors influencing second-language learners' mispronunciation, focusing on English pronunciation among secondary-level students at Sekolah Menengah Kebangsaan Saujana Indah in Nibong Tebal. The research examines how native language interference, exposure to English, and teaching methods shape pronunciation challenges. A mixed-method approach was adopted, combining quantitative data from questionnaires completed by 60 participants and qualitative insights from interviews with six students. The quantitative analysis employed descriptive statistics to identify patterns and correlations, while the thematic analysis described perspectives on students' experiences. The findings reveal that native language significantly impacts pronunciation, with interference leading to persistent errors. Additionally, the school environment, including teacher feedback and practice opportunities, was identified as a key determinant in improving pronunciation. Besides, students claimed that mispronunciation lowers their confidence, classroom participation, and enthusiasm to study English, limiting their Second Language Acquisition (SLA) growth. These findings highlight the importance of targeted pedagogical practices that address pronunciation challenges, create a supportive learning environment, and effectively use corrective feedback. This study also emphasises the importance of pronunciation in SLA and offers tangible ideas for educators to improve English language training. By addressing the highlighted problems, the initiative hopes to increase learners' language proficiency, resulting in greater academic performance.

KEYWORDS: English Mispronunciation, Second Language Acquisition (SLA), Influencing Factors, Language Learning, Secondary-Level Students, Native Language Interference, Instructional Methods, Language Proficiency.

1 INTRODUCTION

Language learning is not just about acquiring vocabulary and grammar; it also involves developing the ability to use the language fluently in real-world situations. Understanding how sounds are formed, how words

connect, and how conversations naturally flow is an essential aspect of the language acquisition process (Almuslimi, 2020; Ortega, 2018). Clear pronunciation is particularly crucial, as it enables learners to communicate effectively and avoid misunderstandings (Berry, 2021; Derwing & Munro, 2015). In second language acquisition, interaction and meaningful communication play critical roles, resembling first language learning processes (Ortega, 2018). However, acquiring a second language is not straightforward—it requires dedication, persistence, and motivation (Schiller & Dorner, 2021). In Malaysia, where multiple languages are spoken, English is an official second language and is used extensively in education, business, and daily communication (Anna Lynn Bakar et al., 2021). Nevertheless, Malaysian learners face significant challenges due to English's irregular spelling, complex grammar, and unpredictable pronunciation patterns, which can hinder fluency and intelligibility (Derwing & Munro, 2015).

Traditionally, pronunciation was treated as a secondary component in language education, often overshadowed by grammatical and lexical instruction. As a result, many learners struggle with pronunciation, leading to reduced fluency and increased misunderstandings (Derwing & Munro, 2020). Without explicit pronunciation training, students may find it difficult to express themselves confidently, resulting in lower participation and motivation in language learning environments (Berry, 2021; Schiller & Dorner, 2021). Although pronunciation is a key factor in communication, research on the causes of pronunciation errors and their impact remains limited. Factors such as native language interference, inadequate teaching methods, and restricted exposure to authentic English contribute to these difficulties (Derwing & Munro, 2020). Furthermore, struggles with pronunciation can negatively affect learners' confidence, participation, and overall motivation to use English, ultimately impeding their language acquisition. Investigating students' perceptions of these challenges is essential to improving pronunciation instruction and fostering better communicative competence among second language learners.

2 RESEARCH OBJECTIVES

The objectives of this research are:

1. To identify the factors that influence the pronunciation errors among second language learners.
2. To explore the students' perception of the impact of mispronunciation of English words on learners' second language acquisition

3 RESEARCH QUESTIONS

This research paper aims to answer the following questions:

1. What are the factors that influence pronunciation errors among second language learners?
2. What is the student's perception of the impact of mispronunciation of English words on a learner's second language acquisition?

4 LITERATURE REVIEW

4.1 Noam Chomsky's Linguistic Theory

Noam Chomsky's linguistic theory is often associated with transformational-generative grammar. The concept of universal grammar has profoundly impacted linguistics and language acquisition studies. Chomsky proposed that humans have an innate capacity for language, with a universal grammar that underlies all languages (Chomsky, 2009). This theory has influenced SLA by suggesting that certain aspects of language learning are pre-programmed, guiding how learners acquire language structures. Chomsky's groundbreaking ideas have sparked extensive research into the cognitive mechanisms underlying language acquisition. Scholars have investigated how learners' innate linguistic abilities interact with environmental factors to shape the language learning process.

Additionally, Chomsky's theory has prompted investigations into whether some linguistic features are more easily acquired due to inherent human capacities, contributing to ongoing debates in SLA research. Despite criticisms and revisions to Chomsky's original proposals, his foundational concepts remain influential in shaping contemporary understandings of language acquisition and informing pedagogical practices in second language teaching. By recognising the role of universal grammar and innate language abilities, educators can tailor instructional strategies to facilitate learners' acquisition of target language structures more effectively.

4.2 Fossilisation in Language

Recent research shows that fossilisation in language learners can be affected by differences in how people think and learn. Smith (2023) suggests that learners who prefer memorising information rather than understanding it deeply are more likely to fossilise. Social and cultural factors also matter; Brown and Lee (2021) found that learners from cultures where speaking perfectly is unimportant tend to make more lasting mistakes because they are less motivated to fix them. This shows the importance of creating learning environments that encourage accuracy but also support learners in seeing mistakes as a natural part of learning.

New technology is also helping to address fossilisation. Chen and Wang (2024) suggest that artificial intelligence-based tutoring systems can give personalised, timely feedback to each learner, helping to correct mistakes early. Adding these technologies to language learning programmes could be a useful way to tackle fossilisation. Overall, although fossilisation is still a big challenge in second language learning, by understanding the role of thinking styles, cultural background, and new technology, teachers can build better ways to help learners become more fluent.

4.3 Negative Transfer

Negative transfer, a common issue in second language acquisition (SLA), happens when learners accidentally use features of their first language in the second language, leading to mistakes and communication problems (Gass, 2019). It affects pronunciation, grammar, and vocabulary, making it harder for learners to develop strong language skills (Cook, 2019). Understanding how negative transfer works is important for teachers, as it helps them create better ways to prevent and fix these problems (Ellis & Barkhuizen, 2020). Teachers can help students unlearn wrong patterns and use the second language more accurately by giving focused instruction and corrective feedback based on learners' language backgrounds.

To reduce negative transfer, educators use several strategies. Teaching grammar directly by comparing the first and second languages helps learners notice possible mistakes (Lightbown & Spada, 2013). Creating immersive environments with lots of exposure to the target language also helps learners pick up correct patterns naturally (Dörnyei, 2019). Encouraging students to compare languages makes them more aware of the differences and similarities, which also helps reduce mistakes (Lyster, 2020).

5 METHODOLOGY

This research employed a survey research design, specifically a mixed-method approach, to gather data on the targeted population for this study is Sekolah Menengah Kebangsaan Saujana Indah, Pulau Pinang students. From the population of 593 students in SMKSI, 60 students participated in the quantitative study. These 60 students are the respondents of this study who answered the questionnaire, and 6 of them participated in the interview to collect the data qualitatively, specifically 3 students from Form 1 and 3 students from Form 5. Convenience sampling was used to identify the sample. The questionnaire, consisting of Likert-scale questions, was divided into three parts: Part A focuses on demographic information of the respondents, Part B focuses on knowing the factors that influence pronunciation errors between second language learners while Part C mainly explores the students' perception of the impact of mispronunciations of English words on learners' second language acquisition. Responses were collected using a Google Survey Form over 10 days. In addition to the questionnaire, interviews were conducted with open-ended questions to delve deeper into the research questions. Six questions were asked in total, with the first three addressing the first research question and the

remaining three pertaining to the second research question. Interview responses were transcribed and analysed for insights.

6 RESULTS AND DISCUSSIONS

Statistical Package for Social Science (SPSS) version 22.0 was used to analyse all the quantitative data, while thematic analysis was used to analyse qualitative data from the interview. Data analysis was performed using descriptive and frequency statistics for the data analysis performed in the present case study. In this case, the variables of interest were the Influencing Factors on English Mispronunciation Among Secondary-Level Students and Its Impact on Second Language Acquisition. Furthermore, discussions were also conducted based on the interview using thematic analysis before the researcher continued to summarise the research findings.

Demographic Information

Table 1

Demographic Information

Baseline characteristic	Frequency (N)	%
Gender		
Female	43	71.7
Male	17	28.3
Age		
Form 1	15	25
Form 2	2	3.3
Form 3	1	1.7
Form 4	29	48.3
Form 5	13	21.7
Ethnicity		
Malay	60	100
Most Used Language		
Malay	58	96.7
English	2	3.3

A total of 60 secondary-level students participated in this study. The sample comprised 43 females (71.7%) and 17 males (28.3%). In terms of academic level, the majority of respondents were from Form 4 (48.3%), followed by Form 1 (25%), Form 5 (21.7%), Form 2 (3.3%), and Form 3 (1.7%). All participants identified as Malay (100%). Regarding language usage, Malay was the most commonly used language among respondents (96.7%), while only 3.3% reported English as their primary language.

Influencing Factors on English Mispronunciation Among Secondary-Level Students and Their Perception of the Impact of Mispronunciation on Second Language Acquisition

Table 2

Influencing Factors on English Mispronunciation Among Secondary-Level Students

Statements	Frequency (N)	%
My native language significantly influences the way I pronounce words in the second language.	36	60.0

The learning environment at my school provides sufficient opportunities for me to practice pronunciation.	43	71.6
I receive helpful feedback from teachers on my pronunciation errors.	47	78.3
I frequently listen to native speakers to improve my pronunciation.	46	76.6
My English teacher corrected my mispronunciation whenever I made pronunciation errors.	24	40.0
The teaching methods used in my language classes focus adequately on pronunciation skills.	37	61.7
My peers' pronunciation influences how I pronounce words in the second language.	39	65.0
My teacher helps me when I struggle with pronouncing words.	49	81.7
I practice speaking the new language with my friends to improve my pronunciation.	47	78.3
Listening to music or watching movies in a new language helps me improve my pronunciation.	55	91.7

The findings from the questionnaire reveal several influencing factors contributing to English mispronunciation among secondary-level students. A substantial proportion of respondents (60.0%) reported that their native language significantly affects their pronunciation in English, aligning with Ortega's (2018) view that first language transfer often impacts second language acquisition. Moreover, 71.6% of students indicated that their school environment provides sufficient opportunities for pronunciation practice, reflecting the importance of learning contexts in language development (Schiller & Dorner, 2021). Besides, teacher feedback emerged as a critical factor, with 78.3% of respondents acknowledging that they receive helpful corrections on their pronunciation errors. Similarly, 81.7% reported that their teachers assist them when they struggle with pronunciation, emphasising the role of instructional support, consistent with findings by Derwing and Munro (2015). Additionally, 76.6% of students mentioned that they frequently listen to native speakers to improve their pronunciation, highlighting the significance of exposure to authentic language models in fostering accurate pronunciation (Berry, 2021). In contrast, only 40.0% of students stated that their English teachers corrected their mispronunciations whenever errors occurred, suggesting that error correction practices might not be consistently applied across classrooms. Regarding instructional strategies, 61.7% felt that the teaching methods used in their language classes adequately addressed pronunciation skills, which supports Derwing and Munro's (2020) argument for integrating focused pronunciation instruction into the curriculum. In addition, peer influence was also notable, with 65.0% of students reporting that their friends' pronunciation habits affected their own, indicating that social interaction plays a role in second language pronunciation development (Ortega, 2018). Furthermore, 78.3% of participants stated that they practice speaking the new language with their friends to improve their pronunciation, highlighting the importance of collaborative learning practices. Interestingly, listening to music or watching movies in English was identified as a particularly influential factor, with 91.7% of students agreeing that such exposure helped enhance their pronunciation skills. This finding supports Almuslimi's (2020) emphasis on the role of informal learning and multimedia exposure in second language pronunciation improvement.

To discuss further on the first research question on influencing factors on English mispronunciation among secondary-level students, the findings from the interview showed that most secondary-level students believed their native language strongly influenced the way they pronounced English words. Many students pointed out phonetic differences, such as the absence of the 'th' or /θ/ sound in their native language, which often led to mispronunciations. As discussed in the literature review, this is consistent with the concept of mother tongue influence, which refers to the impact of a learner's first language on their second language acquisition (Odlin, 2021). Mother tongue influence can either positively support pronunciation through

similarities between languages or negatively affect it, causing pronunciation errors due to differences in phonetics, grammar, or vocabulary (Gass, 2020).

Table 3
Perception of Impact of Mispronunciation on Second Language Acquisition

Statements	Frequency (N)	%
Mispronouncing English words makes me less confident when speaking English.	28	46.6
Mispronunciation affects my ability to understand lessons in my English class.	25	41.6
Mispronouncing English words makes it harder for me to communicate with classmates and teachers.	24	40.0
Mispronunciation of English words slows down my progress in learning English.	29	48.3
When I mispronounce English words, I feel less motivated to continue learning the language.	24	40.0
Mispronunciation affects my grades in English language assessments or exams.	27	45.0
Mispronouncing English words makes it difficult to interact socially with English-speaking peers.	34	56.7
Mispronouncing impacts my ability to understand spoken English during listening activities.	35	58.4
Mispronunciations hinder my ability to make friends with English-speaking peers.	20	33.3
I receive negative feedback from others about my English mispronunciation, which affects my learning.	20	33.3

The results from the questionnaire show that mispronunciation has a clear impact on students' second language acquisition. Firstly, 46.6% of students reported that mispronouncing English words made them feel less confident when speaking, supporting Derwing and Munro's (2015) findings on the link between pronunciation difficulties and communication anxiety. In addition, 41.6% indicated that mispronunciation affected their ability to understand class lessons, while 40.0% found it harder to communicate with classmates and teachers because of pronunciation issues. Moreover, 48.3% of students agreed that mispronunciation slowed down their learning progress, and 40.0% said it lowered their motivation to continue learning English. Similarly, 45.0% mentioned that their grades in English assessments were negatively impacted, further reinforcing the academic consequences of pronunciation problems (Schiller & Dorner, 2021). Besides, social interaction was also affected. Specifically, 56.7% of students reported difficulty interacting socially with English-speaking peers, and 33.3% said mispronunciation hindered their ability to make friends. Furthermore, 58.4% stated that mispronunciation made it harder to understand spoken English during listening activities, which aligns with Ortega's (2018) emphasis on pronunciation's role in listening comprehension. Finally, 33.3% of students experienced negative feedback from others, which they felt further affected their learning process. Overall, these findings suggest that mispronunciation not only impacts academic success but also affects students' confidence, motivation, and social integration in second language learning.

Besides, the further findings from the interview of the second research question on students' perception of the impact of English mispronunciation towards Second Language Acquisition concluded that most secondary-level students agreed that mispronunciation affected their classroom productivity and, over time,

influenced their English grades. Although mispronunciation did not directly lower their motivation to continue learning English, students acknowledged that it limited their ability to communicate effectively with English-speaking peers. This supports the findings of Derwing and Munro (2005), who stated that while pronunciation impacts a speaker's comprehensibility, social and cultural factors are also important in building relationships and improving communication. Therefore, teachers and schools must recognise the importance of pronunciation in students' language development. Providing students with regular opportunities to practise pronunciation in a supportive and comfortable environment is essential. For instance, teachers can offer feedback when students speak English and encourage more peer conversations in English to maximise practice. Such initiatives can help students build confidence, improve their language skills, and ultimately enable them to reach their full academic and social potential.

7 CONCLUSION

In conclusion, this study demonstrated that mother tongue interference, phonetic differences, and external factors such as learning environment, teacher feedback, peer influence, practice frequency, and teaching methods significantly contribute to pronunciation errors among secondary-level students. Although these errors do not heavily impact learners' motivation, they hinder classroom productivity, communication abilities, and academic achievement. Therefore, the practical implication of these findings is that educators and teachers must prioritise pronunciation-focused instruction, provide consistent corrective feedback, and create supportive learning environments. By doing so, students can improve their pronunciation, communicate more effectively, and realise their full academic and personal potential.

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Translanguaging For Equity: Enhancing ESL Competency and Learner Engagement in KPTM Kota Bharu OBE Classrooms

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ABSTRACT
Persistent challenges related to low English proficiency and heightened language anxiety continue to impede ESL learners' success in Malaysian higher education, particularly among rural, first-semester diploma students. Situated within the Outcome-Based Education (OBE) framework, this study investigates translanguaging as a transformative pedagogical intervention that bridges linguistic inequities and enhances learner engagement. Grounded in Translanguaging Theory, Sociocultural Theory, and the Affective Filter Hypothesis, this qualitative inquiry explores the experiences of six low-proficiency students enrolled in the HPE1043 English course at Kolej Poly-Tech MARA Kota Bharu. Data were collected through classroom observations, written reflections, and targeted assessments aligned with the course learning objectives (CLOs) and program learning objectives (PLOs). The findings reveal that translanguaging fostered a cognitively rich, affectively supportive, and socially inclusive classroom ecology. Students exhibited marked improvements in comprehension, confidence, participation, and academic performance, transforming from passive recipients to active meaning-makers. Notably, shifts in performance from SPM English results to tertiary-level assessments underscore the role of translanguaging in promoting linguistic agency and academic resilience. Rather than serving as a remedial scaffold, translanguaging emerged as an equity-driven, outcome-aligned pedagogy that empowered learners to navigate content through their full linguistic repertoires. This study advances the discourse on multilingual pedagogy by positioning translanguaging as both a pedagogical imperative and a policy-relevant strategy for fostering inclusive, learner-centred education in Malaysian ESL classrooms.

KEYWORDS: *Translanguaging, Inclusive Pedagogy, Sociocultural Theory, Outcome-Based Education (OBE), ESL Learners' Engagement*

1 INTRODUCTION

Proficiency in English is essential for success within Malaysia's higher education system, particularly as it aligns with the Outcome-Based Education (OBE) model's emphasis on cognitive development and lifelong learning (Rahman & Singh, 2022; Valdev Singh & Shaari, 2019). However, many students, especially in regions like Kelantan, struggle with low proficiency and confidence due to traditional English-only teaching methods that overlook their sociolinguistic realities (Muhamad et al., 2024). At Kolej Poly-Tech MARA Kota Bharu (KPTMKB), first-semester diploma students in the English proficiency course face significant barriers that hinder their performance and the achievement of Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs). In this context, translanguaging emerges as a transformative strategy, encouraging

students to draw on their entire linguistic resources, thereby enhancing cognitive engagement, reducing anxiety, and promoting inclusive participation (Torff & Murphy, 2021). Despite its global relevance, translanguaging is often neglected in Malaysia's ESL policies and OBE practices. Henceforth, this study aims to investigate how ESL lecturers implement translanguaging and how it influences language learning and classroom engagement, with the intention of highlighting its potential to foster more effective educational experiences in complex linguistic environments.

1.1 Problem Statement

Despite Malaysia's efforts to align with international educational standards through adopting Outcomes-Based Education (OBE), ESL classrooms still grapple with systemic obstacles that hinder language learning, especially for marginalised student groups (Zulkefly & Razali, 2019). In Kelantan, where Kelantanese Malay is prevalent in daily interactions, English remains infrequently used and often hard to access for students, leading to increased disengagement and linguistic anxiety (Kamisah Mat, 2023). This issue is particularly noticeable at Kolej Poly-Tech MARA Kota Bharu (KPTMKB), where students enrolled in the first-semester Diploma in Islamic Banking and Finance struggle with low English proficiency, notable classroom silence, and unsatisfactory assessment results in their proficiency English course (HPE1043). These challenges significantly impact the attainment of Course Learning Outcomes (CLOs), including oral and written communication, reading strategies, and listening comprehension, thereby hindering progress toward the necessary Program Learning Outcomes (PLOs) related to communication, problem-solving, and lifelong learning. The persistent use of English-only teaching methods excludes learners, heightens emotional barriers, and compromises inclusive education (James et al., 2020)While translanguaging presents a theoretically and pedagogically valid solution, its implementation within Malaysia's OBE-based ESL settings remains underexplored. Limited empirical research captures the viewpoints of both educators and students, especially in rural, underachieving contexts like KPTMKB. To address this research gap, the present study examines translanguaging as both a teaching strategy and a means to foster equitable, context-sensitive instruction that enhances student engagement, success, and institutional goals within Malaysia's diverse educational landscape.

1.2 Research Objectives

i. To examine how ESL lecturers implement translanguaging strategies to facilitate the achievement of CLOs and PLOs in line with OBE principles.
ii. To explore students' perceptions of how translanguaging enhances their comprehension, communication, and learning confidence.
iii. To assess the impact of translanguaging in reducing language anxiety and fostering classroom engagement among low-proficiency ESL students.

1.3 Research Questions

i. How do ESL lecturers implement translanguaging strategies to facilitate students' achievement of CLOs and PLOs within an OBE framework?
ii. How do students perceive the use of translanguaging in enhancing their comprehension, communication and learning confidence?
iii. How does translanguaging reduce language anxiety and foster classroom engagement among low-proficiency ESL learners?

2 LITERATURE REVIEW

This chapter critically synthesises the literature on translanguaging as an inclusive, dynamic, and pedagogically necessary approach in ESL and multilingual classrooms, particularly within Malaysian higher education. It interrogates global and local scholarship to establish the cognitive, affective, and institutional relevance of translanguaging, while addressing the gaps in its formal integration into Malaysian pedagogical frameworks. The review is structured into three key areas: translanguaging in English as a Second Language

(ESL) and multilingual contexts, affective dimensions of language learning, and translanguaging within Outcome-Based Education (OBE) models. The chapter concludes with a synthesis of gaps and presents the rationale for this study.

2.1 Translanguaging in ESL and Multilingual Classrooms: Global and Local Perspectives

In the evolving discourse on multilingual education, translanguaging has evolved from being perceived as substandard linguistic interference to being recognised as a valid and socially empowering teaching method. According to Wei & García (2022), translanguaging is the strategic use of multilingual learners' complete linguistic resources to enhance cognitive engagement and communication effectiveness. This redefinition challenges rigid monolingual beliefs, affirming that multilingualism is not a limitation but a vibrant resource that enhances academic engagement and learner independence. Substantial empirical evidence backs this theoretical shift. Vogel & García (2017) demonstrate that translanguaging improves comprehension and fosters learner agency for emerging bilinguals in the United States. Meanwhile, Creese & Blackledge (2010), reveal that, in the UK, translanguaging promotes equitable involvement and authentic self-expression among marginalised students. Together, these studies confirm that translanguaging is essential in environments where linguistic diversity and systemic inequalities coexist. Rather than undermining language standards, translanguaging improves learning by bridging knowledge gaps and fostering culturally sustaining teaching methods (Dovchin, 2021).

Nevertheless, many individuals often confuse code-switching with translanguaging. The difference between code-switching and translanguaging is evident in understanding language in multilingual settings. Code-switching describes the alternation of one language for another language, which considers each language as a self-contained system, often conceptualised in terms of grammatical alternation in interaction (Deuchar, 2020; Ergül, 2023). As with other aspects of code-switching, it strengthens the boundaries of separation within languages and, in some cases, is considered inappropriate for the classroom setting due to its detrimental effects on acquiring a second language. In contrast to code-switching, translanguaging perspectives view bilingual language use as dynamic and integrated. It enables speakers to access their entire range of linguistic repertoires, which comprise verbal, written, visual, and gestural aids, to create meaning (Canagarajah, 2011; Li, 2018). Translanguaging segues beyond code-switching, also including translation, blending, and cross-modal communication, while disputing the idea of languages as fixed entities (García & Kano, 2014; Otheguy et al., 2015). It is recognised that translanguaging in education helps advance the development of comprehension, identity, and inclusive teaching and learning strategies. Teachers and learners employ it to explain concepts and summarise in local languages or apply them in context (Hasan et al., 2020; Rajendram, 2022).

Globally celebrated, translanguaging remains conceptually underdeveloped and institutionally sidelined in Malaysia's higher education system. The postcolonial sociolinguistic context in Malaysia reinforces English as the gatekeeper to academic and professional success, relegating local languages and dialects such as *Bahasa Malaysia* and Kelantanese Malay to lesser roles in formal education (Ghazali et al., 2021). As a result, Malaysian ESL classrooms often reflect a conflict between policy-driven monolingualism and the multilingual realities encountered by learners and instructors. Although research has documented the informal and practical application of translanguaging by Malaysian educators to improve understanding and sustain classroom engagement, institutional frameworks often remain unclear or even resistant to its formal incorporation. This discrepancy is particularly evident in Kelantan, where students' linguistic resources are mainly based on local dialects (Naziman & Jaafar, 2018). In such socio-linguistically uniform contexts, translanguaging is not just helpful but fundamentally important for pedagogy. It acknowledges students' identities, democratises access to knowledge, and breaks down linguistic hierarchies. Nevertheless, despite its pedagogical necessity, translanguaging is still overlooked mainly in formal policy and instructional design in Malaysian higher education, a significant gap that this study aims to address.

2.2 Language Anxiety, Reticence, and Affective Filters in ESL Learning

Language learning is inherently emotional, influenced as much by learners' affective states as by cognitive abilities. Krashen's Affective Filter Hypothesis remains seminal in explicating how anxiety,

motivation, and self-confidence mediate language acquisition (Jegerski, 2021). Elevated affective filters hinder the reception and processing of linguistic input, resulting in limited output and communicative reluctance. Empirical evidence across ESL contexts supports this model. Research by James et al. (2020) and Mahmud et al. (2023), confirm that language anxiety correlates strongly with avoidance behaviours, silence, and low learner confidence. Cultural norms exacerbate affective barriers in Malaysia, particularly in conservative and homogenous regions such as Kelantan. Values emphasising humility, deference, and fear of public mistakes contribute to students' communicative reticence. ESL learners in these environments frequently refrain from participating, perceiving language production as a high-risk endeavour Badrasawi et al. (2020). As such, pedagogical interventions must be explicitly designed to address these emotional and psychological dimensions, enabling equitable learning opportunities. Recent research highlights translanguaging as a powerful pedagogical approach to address these emotional challenges. According to Turner & Lin (2024), Translanguaging reduces learners' linguistic anxiety by affirming familiar language resources and promoting a psychologically safe learning environment. In these supportive spaces, students are empowered to express themselves freely without fear of negative judgment, which promotes risk-taking and boosts their communicative confidence. In Kelantanese ESL classrooms, where socio-cultural and emotional pressures are especially intense, translanguaging plays a crucial role in fostering engagement(Naziman & Jaafar, 2018). It connects pedagogy to students' real linguistic experiences, transforming passive learning into dynamic, interactive participation. This study posits that translanguaging should be recognised not just as cognitive support but as an affective equaliser that can reduce psychological barriers and guarantee meaningful inclusion for learners.

2.3 Translanguaging and Outcome-Based Education (OBE)

Malaysia's higher education system is structured around the Outcome-Based Education (OBE) framework, which mandates that learning outcomes be explicitly measurable, demonstrable, and aligned with institutional goals (Paul Leong, 2022). OBE shifts instructional emphasis from content delivery to the systematic achievement of Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs) that reflect broader domains of knowledge, skills, and values (Macayan, 2017). At Kolej Poly-Tech MARA (KPTM), the HPE1043 Proficiency English course embodies this philosophy through three CLOs: CLO1 develops students' ability to apply English in spoken and written forms (aligned with PLO5: communication), CLO2 targets reading comprehension and analytical thinking (linked to PLO2: cognitive skills), and CLO3 enhances listening proficiency and reflective understanding (mapped to PLO9: lifelong learning). These outcomes are rigorously assessed through multimodal tasks, including a Language Project (30%), Speaking Task (20%), Listening Task (10%), and a Final Examination (40%), ensuring alignment between instruction, assessment, and student development.

Translanguaging, defined as the fluid and strategic use of students' full linguistic repertoires, directly reinforces OBE principles by enabling access to content, fostering higher-order thinking, and affirming learner identities (García & Wei, 2018; Canagarajah, 2011). In multilingual ESL classrooms, especially in linguistically homogeneous regions such as Kelantan, English-only policies often impede comprehension, marginalise local knowledge, and inhibit participation (Too, 2023; Dovchin, 2021). Translanguaging addresses these challenges by creating a cognitively and emotionally accessible learning space. It allows learners to negotiate meaning, express complex ideas, and engage more deeply with academic content, all of which are essential for achieving OBE-aligned outcomes such as critical thinking (PLO2), effective communication (PLO5), and independent learning (PLO9). Beyond its classroom utility, translanguaging is philosophically aligned with the learner-centred values of OBE. While OBE demands that students demonstrate transferable skills and knowledge, translanguaging facilitates those outcomes by recognising students' linguistic resources as academic capital rather than barriers. It promotes metalinguistic awareness, increases learner confidence, and nurtures autonomy, thereby contributing to the lifelong learning ethos embedded within MQF 2.0 (Hua & Wei, 2022; Cenoz & Gorter, 2020). Recent studies further confirm that translanguaging supports learners' affective needs and fosters equitable participation in assessment-driven environments (Turner & Lin, 2024; Almashour, 2024

However, despite these clear theoretical synergies, research on the integration of translanguaging within formal OBE-based ESL curricula in Malaysia remains sparse. Much of the local scholarship has focused on translanguaging in primary or informal learning settings, with little attention to its role in diploma-level instruction or institutionalised assessment structures. Additionally, there is limited empirical exploration of how ESL lecturers in rural colleges implement translanguaging to meet Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs), particularly in contexts where students enter with high affective filters and low English proficiency. This study addresses these critical gaps by investigating how translanguaging is operationalised in the HPE1043 course at KPTM Kota Bharu. It argues that translanguaging is not only pedagogically effective but crucial for the successful implementation of OBE in linguistically diverse settings. By framing translanguaging as a high-impact, inclusive strategy that aligns with institutional standards and learner realities, this study contributes to the evolving discourse on multilingual pedagogy, curriculum reform, and educational equity in Malaysian higher education.

3 RESEARCH METHODOLOGY

This research employs a qualitative approach to investigate how translanguaging serves as a powerful teaching strategy in Malaysian English as a Second Language (ESL) classrooms. It highlights the often-neglected social, cognitive, and emotional aspects of teaching and learning that quantitative methods overlook. The study specifically examines the ways ESL lecturers implement translanguaging practices and how students perceive the impact of these practices on their learning journeys. Conducted at Kolej Poly-Tech MARA Kota Bharu (KPTMKB), the research focuses on first-semester diploma students in an English proficiency course, many of whom face challenges with the language and significant levels of anxiety. Utilised in the study are two qualitative tools: open-ended questions directed at six purposely chosen students and observations made during regular ESL classes. These tools are expected to provide insights into language usage, engagement, and understanding. The research supports translanguaging as a strategic instructional method shaped by social influences and emotional environments, which are vital in the educational setting.

3.1 Theoretical Framework: Translanguaging as Pedagogical, Affective, and Institutional Praxis

This research is grounded in a comprehensive theoretical framework that positions translanguaging as essential for inclusive and transformative English as a Second Language (ESL) pedagogy. In the context of Malaysian higher education, which is influenced by linguistic uniformity and institutional accountability, translanguaging is redefined not merely as an additional option but as a critical educational necessity. This framework integrates four interconnected theories: Translanguaging Theory, Sociocultural Theory, Affective Filter Hypothesis, and the Outcome-Based Education (OBE) Model, establishing translanguaging as vital for the cognitive, social, emotional, and institutional aspects of learning.

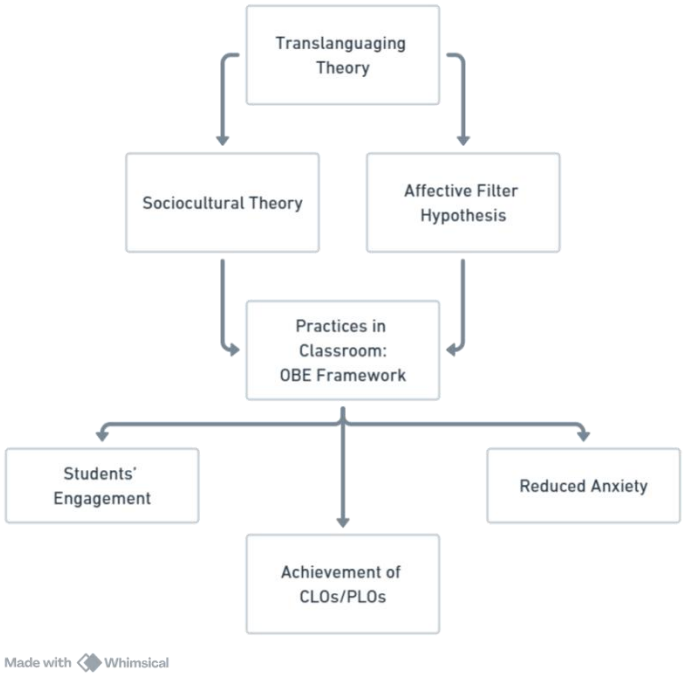


Figure 1: Integrated Theoretical Framework of Translanguaging Pedagogy within an OBE-driven ESL Context

This figure illustrates the theoretical framework that highlights the connection of four related viewpoints of the study. Together, these perspectives offer a thorough way to analyse translanguaging practices in Malaysian ESL (English as a Second Language) classrooms. Each viewpoint provides significant insights that will facilitate an understanding of how language practices are adapted in different educational settings. The following segment elaborates on each theoretical component, discussing its importance and its role in strengthening the analysis of translanguaging strategies adopted by both lecturers and students.

3.1.1 Translanguaging Theory: Pedagogical Legitimacy and Agentive Practice

Translanguaging Theory, as explained by Xin et al. (2024), conceptualise multilingual language use as dynamic, purposeful, and valuable for education. This viewpoint opposes the ideology that learners should use only a single language in classrooms by advocating for the strategic and full use of a student's linguistic repertoire to enhance cognitive engagement and communication. Unlike traditional ideology that views switching languages as unusual, translanguaging regards language users as active participants who creatively deploy different languages to make meaning, develop knowledge, and join in discussions (Back et al., 2020; Wei, 2018). In a socio-linguistically homogeneous state like Kelantan, where Bahasa Melayu and local dialects predominate in communication, translanguaging emerges as essential in ESL pedagogical implications. It not only challenges negative views of local language use but also recognises its centrality as a helpful tool for comprehension and academic engagement. In this study, translanguaging is regarded as a powerful teaching strategy that enables students to access knowledge, feel accepted, and engage confidently in English-medium instruction.

3.1.2 Sociocultural Theory: Translanguaging as Socially Mediated Learning

Sociocultural Theory of Learning, as articulated by Vygotsky (1978), underscores the inherently social nature of cognitive development. Learning is viewed as a dialogic and interactionally scaffolded process, where

knowledge construction occurs through meaningful engagement with more knowledgeable others (Ameri, 2020; Puntambekar, 2022) Translanguaging, within this perspective, operates as a crucial mediational tool in the Zone of Proximal Development (ZPD), enabling learners to bridge gaps between current competencies and target learning goals (Mirzaei et al., 2017). In Malaysian ESL classrooms, where English-only pedagogies may alienate students with limited proficiency, translanguaging offers a more inclusive alternative that re-centres collaborative learning. It facilitates peer interaction, supports co-construction of meaning, and transforms hierarchical classroom dynamics into relational and participatory spaces. Through translanguaging, learners are empowered not only to access academic content but also to contribute to shared knowledge-building processes, positioning them as active participants rather than passive recipients in the learning community (Pierson et al., 2021).

3.1.3 Affective Filter Hypothesis: Translanguaging as an Affective Enabler

Krashen's Affective Filter Hypothesis introduces a critical affective dimension to language acquisition, asserting that variables such as anxiety, motivation, and self-confidence directly mediate the success of learning (Bailey & Kadhum Fahad, 2021). In high-stakes ESL environments, particularly for low-proficiency learners who often face linguistic apprehension and fear of failure, translanguaging functions as a pivotal affective strategy. By enabling the use of familiar linguistic resources, translanguaging reduces cognitive overload and emotional strain, thereby lowering the affective filter that can inhibit language processing and production. Within this framework, translanguaging extends beyond a cognitive scaffold, as it represents an emotionally responsive pedagogy that fosters psychological safety in classrooms. It encourages risk-taking, validates learner identities, and cultivates confidence, all of which are indispensable for sustained engagement and communicative competence in language learning settings (Wang, 2020).

3.1.4 Outcome-Based Education (OBE) Model: Translanguaging as Institutionally Aligned Pedagogy

Outcome-Based Education (OBE), as proposed by Spady (1995) and institutionalised through the Malaysian Qualifications Framework (MQF), mandates that teaching practices be aligned with clearly articulated learning outcomes that demonstrate student competence. In this outcome-driven framework, translanguaging is positioned as a strategic and institutionally relevant pedagogical tool. While critics may opine that translanguaging undermines English language immersion, this study argues for its complementary role in achieving curricular goals. By broadening linguistic accessibility, translanguaging ensures that all students, regardless of linguistic background, can engage meaningfully with content, thereby promoting equitable opportunities to meet Course Learning Outcomes (CLOS) and Programme Learning Outcomes (PLOS). Translanguaging thus reinforces institutional priorities by linking inclusive, learner-centred instruction with the accountability structures of higher education (Torff & Murphy, 2021). Rather than disrupting educational standards, translanguaging is theorised to enhance them by bridging pedagogical inclusivity and measurable academic success.

3.1.5 Synthesis and Alignment with Research Questions

By integrating essential principles from Translanguaging Theory, Sociocultural Theory, the Affective Filter Hypothesis, and the Outcome-Based Education Model, we develop a robust teaching framework that increases student engagement and success. Translanguaging enhances comprehension by utilising multiple languages, aids in the formation of student identities, and promotes social interactions within educational communities. Additionally, it alleviates anxiety and boosts confidence by establishing a nurturing environment for students. Incorporating translanguaging into the official curriculum guarantees that teaching strategies are inclusive and responsive to the requirements of higher education assessments. Collectively, these ideas position translanguaging as a crucial method for fostering inclusivity, emotional health, and academic success in Malaysia.

i. **RQ1: How do ESL lecturers implement translanguaging strategies to facilitate students' achievement of CLOs and PLOs within an OBE framework?**
Grounded in Translanguaging Theory and the OBE Model, this study explores how teaching decisions are shaped by and react to curriculum demands. These frameworks collectively investigate how translanguaging is utilised not only to enhance comprehension but also to strategically connect instructional methods with formal learning objectives, ensuring that inclusive practices uphold and enhance curricular goals.

ii. **RQ2: How do students perceive the use of translanguaging in enhancing their comprehension, communication, and learning confidence?**
Based on Sociocultural Theory and the Affective Filter Hypothesis, this inquiry examines how translanguaging goes beyond cognitive accessibility to emerge as an emotionally impactful and socially integrated practice. These frameworks clarify how translanguaging enhances inclusive engagement, diminishes communicative anxiety, and boosts learner confidence by cultivating interactive and relational environments for shared knowledge creation.

iii. **RQ3: How does translanguaging reduce language anxiety and foster classroom engagement among low-proficiency ESL learners?**
Rooted mainly in the Affective Filter Hypothesis and supported by Sociocultural and Translanguaging Theories, this aspect emphasises translanguaging as an emotional mediator. It reduces anxiety and creates low-risk communication opportunities, fostering risk-taking and continuous participation, especially for learners who might otherwise be hesitant in English-only settings.

This framework reconceptualises translanguaging as a core element of ethical, inclusive, outcome-driven pedagogy in Malaysian ESL classrooms. It challenges outdated views that see translanguaging as merely remedial. Instead, it positions translanguaging as a vital strategy that promotes equitable access, encourages interaction, enhances emotional well-being, and maintains institutional relevance in multilingual education. This study highlights translanguaging as a transformative practice connecting inclusive education with curriculum accountability and sociolinguistic complexities. These aspects will be discussed further in the findings and discussions.

4. FINDINGS & DISCUSSIONS.

This section synthesises the study's findings in response to the research questions, integrating participant voices, classroom observations, and theoretical insights. The discussion centres on the thematic patterns identified during analysis and is grounded in Translanguaging Theory, Sociocultural Theory, the Affective Filter Hypothesis, and principles of Outcome-Based Education (OBE).

4.1 Translanguaging as an Instructional Strategy to Meet CLOs and PLOs

This study's findings provide compelling evidence that translanguaging is not merely supportive but pedagogically indispensable for achieving Outcome-Based Education (OBE) objectives in Malaysian English as a Second Language (ESL) classrooms. Within linguistically diverse learning environments, enforcing an English-only policy has been shown to exacerbate student anxiety and inhibit engagement, particularly for learners with limited English proficiency. In contrast, a translanguaging pedagogy that empowers both students and lecturers to fluidly employ their full linguistic repertoire, including Malay, Kelantanese Malay, and English, cultivates a dynamic and inclusive learning space that enhances comprehension, participation, and learner confidence. Grounded in Translanguaging Theory, which conceptualises linguistic competence as dynamic and interconnected, lecturers employed five deliberate strategies: instructional delivery, explanatory discourse, example provision, feedback, and peer discussions. These were integrated across four core assessments aligned with Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs). Through fluid alternation between L1 and L2, these strategies significantly improved comprehension, fulfilling CLO2 and PLO5 by

supporting the development of learners' cognitive skills. This pedagogical effect was apparent during grammar teaching. Under an English-only approach, students exhibited signs of disengagement, appearing passive, insecure, and unfocused. However, the shift to translanguaging triggered immediate behavioural and cognitive responsiveness. For instance, in explaining the concept of nouns, the lecturer stated, "... Noun is *kata nama.* Meaning to say, noun *digunakan untuk merujuk kepada pelbagai benda seperti nama manusia, objek, idea* or even animals." Following this, students became visibly more alert and participatory, actively engaging in classroom discourse. As supported by Rajendram (2023), the strategic use of students' native languages reduces cognitive load and facilitates the internalisation of complex content. In this case, it enabled mastery of CLO1 (communicating meaning effectively) and advanced PLO5 by supporting conceptual understanding.

Translanguaging also proved critical in rectifying comprehension breakdowns. During a listening task designed to assess CLO3, students struggled to interpret the assignment when instructions were delivered exclusively in English. However, after clarification through translanguaging, "*...Untuk* task *ini, awak kena mendengar dengan teliti...Barulah awak* identify the specific details..." students exhibited immediate improvement. Most were able to construct accurate responses and asked targeted questions for clarity. Their success in both the Listening Task and Language Project reinforced the value of translanguaging as a scaffold, confirming Zhu's (2023) observation that strategic language alternation enables learners to access and perform cognitively demanding tasks. To further enhance students' listening comprehension and affective engagement, the lecturer creatively incorporated music, an interest strongly shared by the students, into the instructional strategy. English songs were selected as pedagogical tools not only to train listening skills but to spark emotional and cultural relevance. Students were encouraged to listen to lyrics, interpret meaning, and respond to the songs, with the lecturer facilitating discussions in a translanguaging mode. By asking reflective questions such as "…*Awak rasa lagu ni pasal apa?*", "…Do you like the vibe of this song?", or "…*Lagu ni ada kaitan dengan emosi awak tak?*", the lecturer cultivated an environment where language learning felt personal, contemporary, and meaningful. This multimodal engagement empowered students to articulate their thoughts without fear of linguistic inadequacy and deepened their connection to the learning content.

Equally important, humour was purposefully embedded as an instructional device. The lecturer often inserted light-hearted remarks, teasingly switching between English and Malay, for example, "…*Awak ni pandai, tapi malas sikit je tu!"*, which not only humanised the classroom experience but also served to lower affective filters. Through these moments of joking translanguaging, learners felt more relaxed, which reduced performance anxiety and enabled greater expressive freedom. Praise was strategically and sincerely delivered in both languages, "…Very good effort!", "…Miss *bangga dengan awak!",* "…Nice point *tadi"*, ensuring that each student felt acknowledged, seen, and heard. This dual-channel affirmation reinforced positive behaviour and built strong interpersonal bonds between the lecturer and learners, creating a psychologically safe space that encouraged active participation and risk-taking. These outcomes demonstrate that translanguaging not only reduces linguistic barriers but also aligns directly with the cognitive, communicative, and behavioural competencies prescribed in OBE. It enabled learners to complete tasks confidently, fulfil CLO3, and make significant progress toward PLO2 (effective communication) and PLO5 (problem-solving). The findings reinforce that translanguaging is a critical instructional strategy, integral to both learner success and institutional outcome alignment, positioning it as a foundation of equitable, inclusive, and results-driven ESL pedagogy in Malaysian higher education.

Similarly, the transformative impact of translanguaging extended well beyond comprehension, penetrating the emotional and social fabric of classroom dynamics, particularly when instruction was localised through culturally resonant Kelantanese expressions. During a lesson on adjectives, the teacher's humorous example, "…Adjective ni, *kalu awok nok pehe senei gak...Awak comey*. You are cute.", triggered enthusiastic, spontaneous responses from students, *"…Comei, Missssss!"*. Learners who were typically withdrawn became visibly animated and verbally expressive, marking a pivotal shift from passive reception to empowered participation (Torff & Murphy, 2021). This moment exemplified the creation of a psychologically safe and culturally inclusive space, where students felt validated and confident. Likewise, in a speaking activity preparing for the Speaking Task, students demonstrated notable gains in L2 comprehension and cognitive processing when allowed to first engage with ideas in L1 before transitioning to English. Notably, Students 5 and 6, who were previously passive and hesitant, achieved high speaking scores (17/20 and 16/20, respectively)

after being granted the linguistic flexibility to generate ideas in Malay. This aligns directly with the core tenets of Translanguaging Theory, which empower learners to process complex content using their full linguistic repertoires, thereby advancing CLO1 (effective communication) and PLO5 (problem-solving). Furthermore, students such as Student 1 and Student 2 exhibited visible emotional uplift and renewed classroom engagement when affirmed through supportive feedback such as, "...You have natural flow in speech, *bagus. Saya suka sangat dengan awak punya idea*. Keep up the good work!". As Almashour (2024) posits, translanguaging practices empower multilingual learners to navigate and negotiate their identities within multicultural academic settings. In this case, it translated into elevated focus, confidence, and proactive classroom presence, clear indicators of a pedagogical shift from linguistic marginalisation to agentive, outcome-aligned participation.

The long-term effects of translanguaging on students' academic performance were significant. For example, among the six students in this study, Students 5 and 1 exemplified this pattern. Student 5 improved from an SPM English E to a B-, while Student 1 advanced from a C to a B-. Initially, both had low confidence and avoided English-only settings. However, integrating translanguaging into classroom discussions led to notable growth in their language skills and learning involvement. These experiences underscore the significance of translanguaging in attaining mastery of CLOS (oral and written communication, comprehension, and task completion), while supporting PLO5 (problem-solving) and PLO9 (lifelong learning) as students develop the ability to apply knowledge independently. Essentially, translanguaging connects the curriculum to student comprehension, aligning the OBE model with authentic language practices. By incorporating students' home languages, educators enhanced English learning and improved performance in English-medium assessments. This method ensures that underperforming and linguistically marginalised students are included in the OBE Model's emphasis on measurable, inclusive, and learner-centred education. Thus, translanguaging not only supported the attainment of CLOs and PLOs but also transformed the ESL classroom in Malaysia into an inclusive, linguistically democratic educational space where all students can succeed.

4.2 Translanguaging as an Affective and Social Enabler

The findings reveal that translanguaging is not merely an auxiliary technique; it constitutes a fundamental pedagogical approach that enhances cognitive accessibility, emotional well-being, and social inclusion, critical components for student success in Outcome-Based Education (OBE)-focused ESL classrooms. At KPTMKB, where English proficiency remains limited and learning outcomes are paramount, translanguaging emerges as an adaptable, ethically responsive practice aligned with both Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs). Students have consistently affirmed that translanguaging actively facilitates comprehension of English lessons and vocabulary. As Student 4 notes, "… yes, using both languages is very helpful because explanations in Malay make it easier for me to grasp the meaning and use English more clearly and quickly." This insight underscores the cognitive function of translanguaging in bridging understanding gaps. By strategically incorporating L1, lecturers clarify complex concepts, reinforce grammar, and maintain learner engagement. This practice directly advances CLOs related to comprehension and application (C2 and C3), where students are expected not only to recall but also to demonstrate meaningful understanding and use of the language. In line Cenoz & Gorter (2020), these findings affirm that translanguaging enhances both content mastery and language processing, thereby increasing students' ability to meet institutional goals.

The affective aspect of translanguaging is equally important, as the findings demonstrate its role in alleviating anxiety and fostering learner confidence, which is essential for sustained engagement and risk-taking in ESL education (Back et al., 2020). Student 5 provides a vivid illustration: "…Yesss I do feel really confident. It is because I can express myself more clearly. Plus, when I cannot recall any English words while speaking, I can substitute by using Malay. This helps me feel relaxed and progressively builds my confidence." Similarly, Student 6 notes, "…Of course I feel more confident; sometimes I know what I want to say in Malay but struggle to find the appropriate English words. For me, using both languages actually enhance my cognitive abilities." These comments highlight that translanguaging mitigates communication anxiety and supports seamless transitions between thought and articulation. According to Krashen's Affective Filter Hypothesis, supported by Wang (2020), lowering emotional obstacles improves language input and output. Thus, translanguaging serves

as a vital affective strategy, allowing students to feel safer and more empowered to participate in speaking and problem-solving tasks, which closely aligns with PLO2, emphasising effective communication.

Furthermore, students consistently highlighted the social and collaborative benefits of translanguaging in group work. Student 1 notes, "…Some students tend to understand better in Malay compared to English, so by using translanguaging, they can learn a bit about the meaning and use of English words," while Student 3 adds, "…With translanguaging, it is much easier for us to do group work and activities because we can translate the meaning of words that we don't understand." These reflections show how translanguaging promotes equitable participation in collaborative tasks. This aligns with Sociocultural Theory, which sees learning as socially mediated and knowledge built through interaction. Translanguaging, particularly through methods like the Grammar Translation Method (GTM), supports learners of varying proficiencies in contributing meaningfully (Naeem & Ghulam, 2023). It directly strengthens PLO5 (problem solving) and PLO9 (lifelong learning), as students collaborate, resolve language-related issues, and build autonomy. Overall, translanguaging supports Malaysia's Outcome-Based Education (OBE) goals by merging content mastery with inclusive, learner-centred practices. It enables students to meet learning targets while affirming their linguistic identities. Thus, it is a vital, ethically grounded approach that fosters cognitive, emotional, and social development. The findings for research question 2 confirm its value as a necessary pedagogical tool for inclusive, outcome-driven ESL instruction in higher education.

4.3 Translanguaging as a Mediator of Language Anxiety and Risk-Taking

The findings highlight the significant role of translanguaging as both an emotional and instructional facilitator, especially for low-proficiency ESL learners experiencing linguistic insecurity and performance anxiety. In learning environments where fear of public mistakes inhibits participation, translanguaging proves essential, not supplementary to pedagogy. Students reported how the use of both English and their first language helped lower anxiety and encouraged engagement. This is illustrated in Student 1's remark, "…Yes, it really helps. When the lecturer uses both languages, I feel less nervous because I can understand better. I don't feel so scared to speak or ask questions." Such testimony demonstrates how translanguaging reduces emotional barriers that typically prevent interaction in English-only settings (Zhang, 2024). Student 5 affirms this, stating, "…when I forget certain vocabulary in English, I won't go silent or feel afraid of learning English." Together, these perspectives emphasise the role of translanguaging in sustaining communication and preventing disengagement, key components of Krashen's Affective Filter Hypothesis, which links lower anxiety to improved language acquisition (Bailey & Kadhum Fahad, 2021). In socio-cultural contexts like Kelantan, where classroom silence is often associated with a fear of making mistakes and deference to authority, translanguaging offers a culturally appropriate approach to reducing affective barriers.

Beyond reducing anxiety, translanguaging increased learner enjoyment and classroom engagement (Bolkvadze, 2023). Student 5 noted, "… I enjoy it very much and I don't feel sleepy at all," indicating that translanguaging transformed learning from a passive task into a motivating experience. Student 6 elaborated, "… translanguaging lets you be yourself. I can joke, express feelings…then switch to English when I'm ready." This insight, supported by Wahyudi (2023), highlights the potential of translanguaging to affirm learner identity and promote authentic expression. Inclusive communication environments such as this support risk-taking and create dialogic spaces that foster linguistic growth at a pace responsive to learner readiness. Lecturer observations corroborated these insights: translanguaging provided a high-support, low-risk structure that enabled differentiated instruction and equitable access across proficiency levels (García & Wei, 2018). This is consistent with Vygotsky's Zone of Proximal Development (ZPD), where social mediation allows learners to progress from current capabilities toward targeted outcomes (Ohta, 2005; Pahlevansadegh, 2019) Over time, this scaffolding supported learners' progression toward communicative independence, an essential component of effective ESL instruction.

These individual and classroom transformations closely reflect the core objectives of Outcome-Based Education (OBE). As students gained confidence and engagement through translanguaging, they demonstrated marked improvement in language competencies directly aligned with the Course Learning Outcomes (CLOs) of HPE1043. These include CLO1, which focuses on the appropriate use of English in spoken and written

communication; CLO2, which emphasises the application of reading strategies for comprehension; and CLO3, which develops students' listening skills through guided techniques. These skills were not developed in isolation; instead, they contributed meaningfully to the attainment of Programme Learning Outcomes (PLOs) such as PLO5 (communication), PLO2 (cognitive and problem-solving skills), and PLO9 (lifelong learning and personal development). As observed in this study, learners who initially struggled with low proficiency began to initiate conversations, share ideas, and engage more confidently in academic discourse. Duarte (2020) supports such findings, asserting that translanguaging fosters cooperative learning environments and transforms learners from passive recipients into active meaning-makers. In the context of HPE1043, translanguaging was not merely a support strategy but a deliberate, pedagogically aligned intervention that addressed affective barriers while enhancing cognitive performance. By lowering language anxiety, affirming students' linguistic identities, and encouraging risk-taking, translanguaging enabled deeper engagement and sustainable language development in ways that monolingual, rigid instructional approaches often fail to achieve. These findings reinforce that translanguaging is not only compatible with OBE but also instrumental in achieving its learning goals, making it a vital, equity-driven strategy for inclusive and outcomes-based ESL instruction in Malaysian higher education.

4.4 Integrative Discussion: Translanguaging as a Pedagogical Catalyst for Transformative Learning Outcomes

The findings in this section highlight an important and well-supported insight: translanguaging is not just a helpful teaching method but a transformative educational strategy that can significantly alter academic paths (Canagarajah, 2011; Too, 2023). By analysing students' progress from their national-level SPM English results to their final grades in the tertiary-level English course HPE1043, the data provides undeniable evidence of substantial academic improvement driven by translanguaging pedagogy. The results can be seen below:

Student	SPM English Grade	HPE1043 Grade
1	B	A
2	D	B
3	E	B-
4	C	B-
5	B+	B+
6	B+	A

Table 1: Students' English results from SPM and HPE1043

The upward trend in academic performance, particularly the rise from E and D grades in SPM to B and B- in HPE1043, signifies a pedagogical breakthrough. These changes are substantial, indicating a significant transformation in student confidence, understanding, and participation in the classroom, especially for those previously classified as low-achieving. Translanguaging legitimises students' linguistic abilities and reduces cognitive anxiety, fostering a psychologically safe environment that encourages participation, improves clarity, and speeds up the mastery of course material (Takaki, 2023; Zhang, 2024).

Even in instances where grades remained numerically stable, the impact of translanguaging was undeniably significant. For example, Student 5 maintained a consistent B+ from her SPM English to the final assessment in HPE1043. However, this stability represents sustained excellence rather than stagnation. She attained the highest score in the final examination (31.6/40), excelled in individual coursework, and explicitly credited her improved comprehension and emotional resilience to translanguaging practices. The only area of decline was observed in her group project (16/30), suggesting that interpersonal rather than linguistic factors were at play. From an OBE perspective, her performance exemplifies high achievement in CLO1 (applying English appropriately in spoken and written communication) and CLO3 (using effective listening strategies),

which are constructively aligned with PLO5 (effective communication) and PLO9 (lifelong learning and personal development). This case challenges the reductive notion that upward grade shifts solely define language learning success. Instead, it illustrates how translanguaging supports both academic recovery and the maintenance of high performance. It fosters metalinguistic awareness, psychological safety, and learner autonomy, outcomes critical to Outcome-Based Education. Student 5's case demonstrates how translanguaging strengthens the learner's ability to perform consistently across assessments while sustaining motivation and emotional well-being. It empowers marginalised learners to overcome linguistic barriers and allows proficient students to deepen their engagement. Far from being a remedial tool, translanguaging emerges as a high-impact, equity-driven pedagogy that supports the holistic development of learners in multilingual English as a Second Language (ESL) contexts. In doing so, it reinforces the urgency of positioning translanguaging not as an auxiliary method, but as a core instructional strategy essential to the success of OBE-aligned English language education in Malaysia.

5. CONCLUSION

This study affirms that translanguaging is not a peripheral support strategy, but a pedagogically essential and institutionally aligned approach for advancing ESL competency and learner engagement in Malaysian Outcome-Based Education (OBE) classrooms. Through qualitative insights from classroom practices and student reflections in the HPE1043 Proficiency English course at KPTM Kota Bharu, translanguaging was shown to directly enhance learners' ability to meet CLO1 (applying English in spoken and written communication), CLO2 (applying effective reading strategies), and CLO3 (employing listening techniques for comprehension). These outcomes were aligned with key Program Learning Outcomes (PLOs): PLO2 (cognitive and problem-solving skills), PLO5 (effective communication), and PLO9 (lifelong learning and personal development), demonstrating that translanguaging not only supports language acquisition but also cultivates transferable academic competencies demanded by the MQF. Critically, this research challenges the deficit-oriented assumptions underlying English-only policies in Malaysian English as a Second Language (ESL) instruction. Instead, it positions translanguaging as a transformative equity-driven pedagogy that empowers low-proficiency students, sustains high achievers, and fosters inclusive, culturally responsive classroom ecologies. It lowers affective barriers, nurtures psychological safety, and promotes sustained learner autonomy and participation, hallmarks of true OBE success. In light of Malaysia's multilingual reality, the evidence presented here strongly supports institutionalising translanguaging within national ESL policy and practice. Doing so will not only democratise access to English education but also ensure that academic excellence is achieved without erasing linguistic identity. Translanguaging must be embraced not as an optional tool but as a core pedagogical principle for building just, inclusive, and outcome-driven education in Malaysia's higher learning institutions.

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Language Teacher Cognition and Classroom Interaction: Enhancing Students' Speaking Skills at Agama Rakyat Schools in Perak

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ABSTRACT

This study explores the interplay between language teacher cognition (LTC) and classroom interaction practices in facilitating students' speaking skills at Agama Rakyat Schools (SAR) in Perak, Malaysia. Anchored in Borg's (2003) LTC framework and Sinclair and Coulthard's (1975) Initiation-Response-Feedback (IRF) model, this mixed-method research examines how teachers' beliefs, knowledge, and practices align with their actual classroom behaviours. Data were collected through twelve classroom observations, semi-structured interviews with teachers and students, and post-observation reflections. Findings indicate that although teachers possess theoretical awareness of the IRF method's effectiveness, their practical execution is often hindered by contextual factors such as students' low English proficiency, limited resources, and institutional constraints. The study further reveals mismatches between teachers' stated beliefs and classroom practices, suggesting that external challenges significantly mediate pedagogical implementation. It concludes that professional development, institutional support, and the inclusion of student perspectives are vital to optimizing classroom interaction and improving English speaking outcomes. This research contributes to the growing discourse on teacher cognition by offering a more holistic view of how LTC operates within under-resourced educational settings.

KEYWORDS: Language Teacher Cognition (LTC); Initiation-Response-Feedback (IRF); speaking skills; English language teaching; SAR schools; teacher beliefs; classroom interaction; Malaysia; mixed-method research

1 INTRODUCTION

1.1 Background of the Study

English is widely recognized as a global lingua franca, essential for communication across sectors like trade, education, and technology. In Malaysia, it is the most important second language and is taught from primary to tertiary levels as part of the national strategy to enhance global competitiveness (Ministry of Education Malaysia, 2012). To strengthen English education, several reforms have been introduced. These include the KBSM syllabus in 1982, which adopted Communicative Language Teaching (CLT) (Abu Bakar et al., 2021; Aina Hafizah & Parilah, 2019), followed by KSSM and the PPSMI initiative in 2002. The most comprehensive reform is the CEFR-aligned curriculum under the English Language Education Roadmap 2015–2025 (Abu Bakar et al., 2021). Programs like the Highly Immersive Programme (HIP) further support English use in both academic and informal settings.

These policies apply to all school types, including religious schools, ensuring English remains central in preparing Malaysian students for global engagement (Ministry of Education Malaysia, 2012).

1.2 History of Malaysian Islamic Schools

Islamic education in Malaysia began with traditional Quranic lessons and evolved through Pondok and Madrasah systems (Ahmad Fauzi, 2017). British colonialism led to the integration of academic subjects into religious schools. Post-independence, the government supported Islamic education through institutions like SMKA and SABK. Privately funded schools (SAR) continue to operate independently but must adhere to the national curriculum. Based on a study carried out by the Advisory Board for the Coordination of Islamic Education or Lembaga Penyelaras dan Pendidikan Agama Islam (LEPAI) as cited in Azmil Tayeb (2018), in general, there are four types of IIS in Malaysia:

i. Sekolah Menengah Kebangsaan Agama (SMKA) which are fully managed by the Ministry of Education;
ii. Sekolah Agama Negeri (SAN), managed by the respective State Departments of Religious Affairs;
iii. Sekolah Agama Bantuan Kerajaan (SABK);
iv. Private Sekolah Agama Rakyat or Agama Rakyat Schools (SAR) that are operated and managed by non-governmental Islamic organizations such as Angkatan Belia Islam Malaysia (ABIM) or the Muslim Youth Movement of Malaysia, Jemaah Islam Malaysia (JIM) and even private individuals.

This study focuses on SAR schools, which are managed by NGOs or individuals and must register with the Ministry of Education to run standardized exams.

1.3 Problem Statement

English is increasingly vital in today's globalized world, offering students greater confidence, academic success, and access to educational and career opportunities. However, Sekolah Agama Rakyat (SAR) schools continue to face challenges in English language education, particularly in national examination performance (Asmaliza, 2018; MOE, 2012; Nur Farhana et al., 2022).

Scholars argue that students in Islamic-based education often deprioritize English learning. For instance, Solehah Yaacob (2022) notes their limited interest in mastering English, while Rosli Othman (2018) highlights the generally low proficiency levels among SAR and SABK students. Maszlee Malik (2018) emphasizes that these schools must improve English instruction to remain relevant in a competitive global landscape.

If these issues are not addressed, students may struggle in higher education, where English is often the medium of instruction. Therefore, immediate interventions are needed to enhance English proficiency among SAR students.

1.4 Theoretical Underpinnings

1.4.1 Language Teacher Cognition (LTC)

Borg's LTC framework explores how teachers' beliefs, knowledge, and past experiences influence their classroom practices. Four key constructs - schooling experience, professional training, classroom practice, and school context, interact to shape teacher cognition. Tensions often arise between beliefs and practices due to external constraints, such as curriculum demands or institutional policies.

1.4.2 Initiation–Response–Feedback (IRF)

The IRF model by Sinclair and Coulthard (1975) describes a common teacher-student interaction pattern: initiation, student response, and teacher feedback. While widely used, the model can limit student talk if not extended. Researchers advocate for modified IRF sequences that replace simple feedback with follow-up questions, fostering richer, more meaningful classroom discourse that promotes speaking skills.

1.5 Research Objectives

This study aims to investigate teachers' cognition and classroom practices regarding the use of IRF to enhance students' speaking skills in SAR schools.

RO 1: Examine teachers' beliefs about classroom interaction in speaking lessons.
RO 2: Observe how teachers facilitate IRF to promote student speaking.
RO 3: Investigate how students contribute to IRF moves.
RO 4: Explore reasons behind any congruence or mismatch between beliefs and classroom practices.

1.6 Research Questions

Four Research Questions which guided the researcher all throughout the study:

RQ1 - What are the teachers' cognition about the role of IRF in developing speaking skills?
RQ2 - How do teachers facilitate IRF in classroom interactions?
RQ3 - How do students benefit from IRF in speaking activities?
RQ4 - What are the teachers' explanations for congruence or incongruence between their beliefs and practices?

This study uses Borg's LTC and Sinclair & Coulthard's IRF frameworks to explore teachers' stated beliefs, observed practices, and student experiences in SAR schools.

1.7 Significance of the Study

This study holds significance in three key areas. Educationally, it emphasizes the rising importance of Sekolah Agama Rakyat (SAR) as parents increasingly seek Islamic-based education that also supports academic excellence, making English language instruction in these schools a vital area of focus. Pedagogically, the study offers insights into teacher-student interactions, particularly through the IRF method, and how it can enhance speaking skills in English classrooms. Theoretically, it contributes to Borg's Language Teacher Cognition (LTC) framework by examining both teacher and student perspectives, shedding light on the alignment or mismatch between teacher beliefs and classroom realities, and underscoring the value of student experiences in evaluating teaching effectiveness.

2 LITERATURE REVIEW

Previous research in the field of Language Teacher Cognition (LTC) has established that teachers' beliefs, knowledge, and experiences profoundly shape their classroom practices (Borg, 2003, 2021). These cognitive constructs are often influenced by prior learning experiences, professional training, and contextual factors. Studies such as Jaeger (2019) have shown that while teachers may hold progressive beliefs about communicative pedagogy, their classroom behaviour may not always align due to institutional constraints, time pressures, and student characteristics.

In the Malaysian context, English language instruction has undergone substantial reform, particularly through the CEFR-aligned curriculum (Ministry of Education Malaysia, 2012). Despite these reforms, challenges persist in religious schools, such as SAR institutions, where resource limitations and the dominance of religious subjects can impede English language learning (Rahman et al., 2020). These schools often struggle to recruit qualified English teachers and lack access to interactive learning tools that foster spoken language skills.

Research on the Initiation-Response-Feedback (IRF) model has highlighted both its limitations and potential. While some scholars critique IRF for promoting teacher-dominated discourse (Wells, 1993), others argue that IRF, when applied flexibly, can support dialogic teaching and enhance learner engagement (Zaswita, 2022). Teachers who extend the feedback move or delay evaluation have been found to encourage more meaningful student responses, fostering a richer classroom discourse (Nassaji & Wells, 2000).

However, most studies on IRF and LTC have been conducted in mainstream or well-resourced settings. There remains a gap in the literature regarding how these frameworks operate in under-resourced or faith-based schools like SAR institutions. This study addresses that gap by exploring how English teachers in SAR schools understand and implement IRF within the constraints of their unique teaching environments. It also contributes to the literature by integrating student perspectives into the analysis of teacher cognition and classroom interaction.

3 METHODOLOGY

3.1 Data Collection Procedures

The data collection for this study was conducted in several structured phases, combining both quantitative and qualitative approaches to ensure depth and breadth in addressing the research questions.

i The study began with the distribution of demographic and PCK questionnaires to 21 English language teachers from SAR schools in Perak. This initial phase offered a broad understanding of the teachers' backgrounds, professional development levels, and their familiarity with the IRF method.

ii. From this group, six teachers were purposively selected for the qualitative phase based on their willingness to be observed and their representation of diverse SAR school settings.

iii. Before classroom observations, the six teachers participated in semi-structured pre-observation interviews to capture their beliefs and expectations regarding the use of IRF-Moves in developing students' speaking skills.

iv. Each teacher was then observed during a regular English lesson. Observations were guided by Galegane's (2015) Quality of Classroom Descriptors, focusing on how teachers implemented IRF sequences and whether follow-up moves promoted student elaboration.
v. Following the observations, stimulated recall interviews were conducted to delve deeper into participants' reflections. These involved both teachers and selected students from the observed lessons.
vi. For teachers, the interviews involved reviewing video excerpts from their lessons to reflect on their instructional decisions, particularly their use of IRF strategies and how these aligned with their stated pedagogical beliefs.
vii. Students, on the other hand, were asked to reflect on their classroom experiences, focusing on how IRF interactions influenced their engagement, comprehension, and speaking confidence.
viii. Finally, post-observation interviews were held with teachers to identify the alignment or misalignment between their stated beliefs and observed practices. These interviews revealed contextual factors such as student proficiency, cultural expectations, and access to training that influenced classroom realities.

3.2 Data Analysis

The analysis of quantitative data was carried out using frequency and percentage to identify general patterns in teacher profiles, training frequency, and self-perceived instructional competence. For qualitative data, thematic analysis was employed. Interview transcripts and observation notes were coded inductively to identify recurring themes related to teacher cognition, classroom interaction patterns, student engagement, and contextual constraints. This combination of data sources and analytical techniques allowed for a comprehensive understanding of how LTC manifests in the teaching of speaking within the unique setting of SAR schools.

4 FINDINGS AND DISCUSSION

4.1 Quantitative

4.1.1 Questionnaire Part A: Demographic Analysis

The demographic analysis of the participants in this study provides valuable insights into the professional backgrounds and teaching contexts of English language teachers at Sekolah Agama Rakyat (SAR) schools in Perak. A total of 21 English teachers participated in the quantitative phase of this study. These teachers represented a range of SAR schools, with varying institutional capacities and student populations. In order to streamline the analysis and focus on the most relevant aspects influencing language teaching practices, the researcher chose to interpret only selected elements from the demographic data. These include academic qualification, self-perceived language proficiency, reasons for teaching English, and the minimum hiring requirements set by SAR schools for English language teachers.

Table 4.1 summarised the demographic analysis.

Table 4.1 – Demographic Analysis

Academic Qualifications	**Self-perceived Language proficiency**	**Reasons for Choosing Teaching**	**Minimum Hiring Requirements by Schools**

23.8% - Diploma in other fields 14.3% - Bachelor's in language teaching 47.6% - Bachelor's in other fields 14.3% - Master degrees in non- language areas.	Low to moderate	2 teachers had ESL qualifications 10 cited interests in teaching 7 entered due to unemployment.	43% of schools require at least a certificate in English teaching 24% a bachelor's in English 5% a diploma in any field 5% Good at English 5% can teach English 5% Experience

The surveyed teachers showed diverse academic backgrounds. Only 14.3% had a bachelor's in language teaching, while 47.6% held unrelated bachelor's degrees, 23.8% had diplomas in non-language fields, and 14.3% held non-language master's degrees. Most teachers rated their language proficiency as low to moderate, and only two had formal ESL qualifications. In terms of motivation, 10 teachers cited interest in teaching, while 7 joined due to unemployment.

School hiring standards also varied: 43% of schools required a certificate in English teaching, 24% preferred a bachelor's in English, and smaller percentages accepted a diploma (5%), English proficiency (5%), ability to teach (5%), or experience (5%).

These findings reveal a mismatch between teachers' qualifications and the demands of English language teaching. The limited number with formal training and moderate proficiency levels raise concerns about instructional quality. Meanwhile, the relatively lenient hiring practices highlight the need for clearer certification pathways and stronger professional development to better prepare teachers for effective English instruction.

4.1.2 Questionnaire Part B - Teachers' Pedagogical Content Knowledge (PCK) in English Language Teaching

Part B of the questionnaire was designed to assess the level of Pedagogical Content Knowledge (PCK) among English language teachers in Sekolah Agama Rakyat (SAR) secondary schools. In line with Shulman's (1986) definition, PCK encompasses a teacher's understanding of how to effectively deliver subject content using appropriate instructional strategies that consider both the subject matter and the learning needs of students. Within the context of this study, PCK refers specifically to the teachers' ability to teach English using effective techniques grounded in linguistic knowledge, such as grammar, vocabulary, syntax, and pronunciation, while also considering learner diversity and classroom dynamics.

A central focus of this section was to determine the extent of teachers' participation in professional development courses over the past two years, particularly those aimed at improving their pedagogical strategies for teaching English. This indicator served as a proxy for measuring the currency and relevance of their teaching knowledge and practices. Table 4.2 summarise the data on the frequency of attendance in language teaching-related courses over the past 2 years.

Table 4.2 The frequency of attendance in language teaching-related courses over the past 2 years

	ITEMS	DEGREE OF FREQUENCY WITHIN 2 YEARS							
		0	1-2	2-3	3-4	4-5	5-6	MEAN	LEVEL
1	ESL Theory	16	4	0	1	0	0	0.2	Very Negative
2	ESL Curriculum/Syllabus design	13	6	0	2	0	0	0.4	Very Negative
3	Applied Linguistics	18	2	0	0	1	0	0.1	Very Negative
4	Phonetics	17	3	0	0	1	0	0.2	Very Negative
5	Sociolinguistics	18	2	0	1	0	0	0.1	Very Negative
6	Psycholinguistics	18	2	1	0	0	0	0.1	Very Negative
7	ESL Second language acquisition learning	14	6	0	1	0	0	0.3	Very Negative
8	Material development	14	7	0	0	0	0	0.3	Very Negative
9	Approaches and teaching methods	12	9	0	0	0	0	0.4	Very Negative
10	Teaching reading	11	10	0	0	0	0	0.5	Very Negative
11	Teaching writing	12	8	0	1	0	0	0.4	Very Negative
12	Teaching listening	11	9	0	1	0	0	0.5	Very Negative
13	Teaching speaking	11	9	0	1	0	0	0.5	Very Negative
14	Teaching Grammar	14	7	0	0	0	0	0.3	Very Negative
15	Teaching Literature	14	7	0	0	0	0	0.3	Very Negative
16	Testing and Assessment in ESL	13	8	0	0	0	0	0.4	Very Negative
17	Teaching Literature	21	0	0	0	0	0	0.0	Very Negative
18	English Computer-aided Instruction	15	6	0	0	0	0	0.3	Very Negative
19	Lesson plan	8	12	1	0	0	0	0.6	Very Negative
20	Practicum on English Teaching	20	1	0	0	0	0	0.0	Very Negative
	GRAND MEAN							6.2	
	AVERAGE MEAN							0.3	VERY NEGATIVE

Using a scale adapted from Muhammad Amin et al. (2001), the study classified teacher training attendance from “Very Negative” to “Excellent.” Alarmingly, all 21 teachers (100%) reported little to no participation in professional development over the past two years, with an average attendance score of just 0.3—placing them in the “Very Negative” category.

This raises serious concerns about the teachers’ preparedness, especially in teaching speaking,a skill that requires updated strategies like Communicative Language Teaching (CLT), CEFR-aligned instruction, and IRF-based interaction. The lack of ongoing training likely reflects broader systemic issues such as limited access, institutional neglect, and lack of incentives for professional growth.

Without addressing this gap, teachers may stagnate, and students' communicative competence may suffer. Therefore, SAR schools must urgently prioritize contextually relevant and practical continuous professional development to improve teaching quality and student speaking outcomes.

4.1.3 Questionnaire Part C – Knowledge About IRF

Part C of the questionnaire explored teachers’ cognition regarding the Initiation-Response-Feedback (IRF) model within Simon Borg’s Language Teacher Cognition (LTC) framework. It examined their beliefs, knowledge, and practices in using IRF to enhance students’ speaking skills.

Findings revealed that 35% of teachers were influenced by their own schooling experiences, reinforcing Borg's view that personal history shapes pedagogical beliefs—especially when formal training is limited. While 86% claimed to understand how IRF works, actual classroom implementation varied. Most teachers relied heavily on teacher-led questioning, indicating a teacher-centred approach that may limit meaningful student talk.

Although 67% felt their training prepared them to use IRF, this confidence contrasts with earlier findings of limited professional development. This suggests that teachers may be equating general teaching experience with readiness for specific strategies like IRF.

All teachers agreed that internal and external classroom factors significantly impact their teaching. In SAR schools, challenges such as time constraints, emphasis on religious subjects, and varied student proficiency levels complicate the effective use of IRF. Overall, while teachers show theoretical awareness of the IRF model, contextual limitations and traditional questioning patterns hinder its full potential—highlighting the need for more focused, practical training.

4.2.1 Pre-Observation Semi-Structured Interview: Understanding Teachers' Cognition about the IRF-Moves in Facilitating Students' Speaking Skills

The pre-observation semi-structured interviews provided valuable insights into the underlying beliefs, knowledge, and thinking processes of English language teachers at SAR schools regarding the use of Initiation-Response-Feedback (IRF) Moves in classroom interaction. This phase was particularly crucial in answering Research Question 1 - What are the teachers' cognition about the role of IRF-Moves in teacher-student classroom interactions in facilitating students' speaking skills?

The interviews explored their understanding of key concepts related to the CEFR**,** Communicative Language Teaching (CLT)**,** and the Initiation–Response–Feedback (IRF) framework. The responses revealed recurring themes that reflect how teachers perceive and apply these frameworks in their classroom practices as shown in Table 4.3.

Table 4.3 The themes emerged from the Pre-Observation Interview

	THEMES FROM PRE-O-IV
Teachers' knowledge on CEFR	Helps in teaching speaking by outlining specific proficiency levels, from A1 (beginner) to C2 (proficient).
Teachers' knowledge on CLT	A teacher must be a role model of a competent English language user
	Teachers acts as facilitators who guide students in the speaking activities
	Encourages interactional activities such as role-play, pair work, presentation
Teachers' knowledge on IRF	I always utilize open-ended questions
	I always utilize probes to create longer strands
	I always encourage other students to ask questions too
	Students usually provide individual acknowledgement (yes/no)
	Students usually provide individual reply using longer sentences
	Students usually provide individual sign language
	Peers are encouraged to provide additional comments
	I usually accept students' correct answers
	I would praise students when they answer correctly
	I would provide follow-ups to create longer strands of discussions
	I focus on fluency, however provide subtle grammar corrective feedback

Pre-observation interviews revealed that SAR English teachers hold a foundational understanding of key frameworks guiding speaking instruction, namely CEFR, Communicative Language Teaching (CLT), and the Initiation–Response–Feedback (IRF) model.

Teachers generally demonstrated a practical grasp of the CEFR, using its proficiency levels (A1–C2) to guide their lesson planning. One teacher explained how knowing a student's level helped her adjust speaking tasks to match their ability, ensuring lessons were appropriately scaffolded.

Their knowledge of CLT was also evident. Teachers viewed themselves as facilitators and role models of effective English use. Interactive tasks such as role-plays and pair work were commonly mentioned as tools to encourage authentic communication and active student participation.

In terms of IRF, teachers described using open-ended questions and probes to prompt longer responses. They also encouraged peer interaction and provided positive feedback, often praising correct answers and using follow-ups to sustain discussions. While fluency was the focus, minor grammar corrections were offered subtly to support accuracy.

Overall, the data indicate that these teachers attempt to align their classroom practices with recognized pedagogical frameworks, particularly in fostering interaction and supporting students' speaking development through structured and communicative approaches.

4.2.2 Stimulated Recall Interview with Students: Exploring Student Perspectives on the IRF Method in Speaking Lessons

To address Research Question 3 - How do the students benefit from the IRF-Moves in the teacher-student classroom interactions to help improve their speaking skills?, stimulated recall interviews were conducted with 12 selected students from various SAR schools who had participated in speaking lessons where the Initiation-Response-Feedback (IRF) method was observed. These interviews provided a critical insight into the students' lived experiences and their emotional, cognitive, and linguistic responses to the pedagogical strategies employed by their teachers.

From their responses, several key themes emerged that highlight the impact of the IRF method on their speaking development and overall classroom experience such as (i) Reduction of Language Anxiety (ii) Enjoyable and Engaging Lessons (iii) Supportive Classroom Environment (iv) Boost in Speaking Confidence (v) Improved Speaking Skills (6) Spontaneous Speaking Moments (vi) Motivational Value of IRF and (vii) Peer Support during IRF Exchanges

4.2.3 Analysis of Classroom Observations Based on the Systematic Classroom Observation Scale

To answer Research Question 2 - How do the teachers facilitate the IRF-Moves in the teacher-student classroom interactions to help improve their students' speaking skills? 12 classroom observations were conducted using a systematic classroom observation scale adopted by Kalpana (2015). This template was constructed based on themes extracted from the pre-observation interviews as shown in Table 4.3. During the actual classroom observations, the researcher referred to this template to examine whether the teachers' stated beliefs and intentions were observable or unobservable in the teachers' actual classrooms. This approach allowed for a direct comparison between what teachers said they would do and what actually occurred in their lessons. Table 4.4 summarises the findings at this stage.

Table 4.4 Comparison of Pre-Observation Interviews and Classroom Observations

	THEMES FROM PRE-O-IV	OBSERVABLE	UNOBSERVABLE
Teachers' knowledge on CEFR	Helps in teaching speaking by outlining specific proficiency levels, from A1 (beginner) to C2 (proficient).	12/12	-
	A teacher must be a role model of a competent English language user	2/12	10/12

Teachers' knowledge on CLT	Teachers acts as facilitators who guide students in the speaking activities	12/12	-
	Encourages interactional activities such as role-play, pair work, presentation	9/12	3/12
Teachers' knowledge on IRF	I always utilize open-ended questions	9/12	3/12
	I always utilize probes to create longer strands	12/12	-
	I always encourage other students to ask questions too	12/12	-
	Students usually provide individual acknowledgement (yes/no)	12/12	-
	Students usually provide individual reply using longer sentences	12/12	-
	Students usually provide individual sign language	12/12	-
	Peers are encouraged to provide additional comments	12/12	-
	I usually accept students' correct answers	12/12	-
	I would praise students when they answer correctly	12/12	-
	I would provide follow-ups to create longer strands of discussions	9/12	3/12
	I focus on fluency, however provide subtle grammar corrective feedback	-	12/12

4.2.4 Congruence and Incongruence Between Teachers' Beliefs and Practices: Evidence from 12 Classroom Observations

The classroom observation data revealed that the majority of themes discussed during the pre-observation interviews were successfully translated into actual classroom practices. All 12 classes demonstrated the use of CEFR-aligned instruction, where teachers structured speaking tasks according to students' proficiency levels. Similarly, the facilitative role of teachers in guiding and supporting students during speaking activities was consistently observed in all classrooms. IRF-related strategies such as using probes to generate extended responses, encouraging peer questioning, accepting correct answers, and praising student contributions were also impressively evident in all classes. Furthermore, students' active participation, whether through short acknowledgements, longer responses, or non-verbal contributions like sign language was highly observable across the board. The use of interactional activities (e.g., pair work, role-plays) and open-ended questioning was present in the majority of classes (9/12), and follow-up moves to extend discussions were likewise observed in most classrooms.

Despite the generally positive findings, a few themes remained unobservable. Notably, only 2 out of 12 classes showed evidence that teachers positioned themselves as role models of competent English language use, suggesting a gap between belief and actual language demonstration. Three classes did not show evidence of open-ended questions or follow-up prompts, which may limit students' opportunities to elaborate during speaking tasks. Most alarmingly, none of the observed classes showed the use of subtle grammatical corrective feedback during interaction, even though teachers claimed to apply this approach in interviews. These discrepancies point to certain practices that are either not fully internalized or are difficult to implement in real classroom conditions.

Overall, the findings are encouraging. Most of the targeted themes, particularly those aligned with CEFR and IRF strategies were clearly observable, reflecting a strong understanding and practical application of interactional techniques by SAR teachers. Only a small number of themes were unobservable, yet they are important and merit further attention. The limited demonstration of teacher language modelling and the absence of grammar-focused feedback raise questions about possible constraints, such as low teacher confidence, limited training, or time pressures during lessons. These unobservable elements should be further investigated to identify underlying causes and inform future training or support programs. Nonetheless, the high level of observable practices suggests that SAR teachers are largely successful in facilitating IRF moves to promote student speaking skills.

4.2.5 Quality of Classroom Scores

The classroom scores were analysed using Galegane's (2015) Quality of Classroom Descriptors. According to this rubric, lessons rated as "Better" featured more student talk than teacher talk, with extended student-teacher exchanges and spontaneous student responses. "Good" lessons showed moderate levels of student engagement, while "Fair" lessons were predominantly teacher-led, offering limited opportunities for students to speak. Table 4.5 provides the summary of the teachers' teaching quality based on Galegane's Quality of Classroom Descriptors (2015).

Table 4.5 Teachers' Teaching Quality Scores

	TEACHER	SPEAKING CLASS	SCORE
1	Teacher A	1st Class	Average
		2nd Class	Good
2	Teacher B	1st Class	Better
		2nd Class	Better
3	Teacher C	1st Class	Good
		2nd Class	Good
4	Teacher D	1st Class	Good
		2nd Class	Good
5	Teacher E	1st Class	Average
		2nd Class	Good
6	Teacher F	1st Class	Average
		2nd Class	Average

The researcher employed Galegane's Quality of Classroom Descriptors (2015) as the rubric to evaluate the quality of classroom interaction across 12 observed English lessons in SAR schools. Each teacher's instructional practices were evaluated across multiple indicators, including lesson structure, teacher talk, student engagement, questioning techniques, and the extent to which classroom interaction supported speaking development. Based on this evaluation, (1) 3 lessons were rated as "Better", (2) 5 lessons were rated as "Good", and (3) 4 lessons were rated as "Fair."

Overall, classroom performance was deemed generally good, indicating teachers' foundational understanding of IRF-Moves, though further support is needed to foster more interactive, student-centred communication.

4.2.6 Post-Observation Interview: Coherence and Incoherence between Beliefs and Practices

The post-observation semi-structured interviews provided valuable insight into the degree of alignment between what teachers believed about the use of the IRF (Initiation-Response-Feedback) method in speaking instruction and how they actually practiced it in the classroom. Two broad categories of findings emerged: reasons for coherence and reasons for incoherence.

4.2.7 Reasons for Coherence (Alignment between Beliefs and Practices)

Several factors contributed to the coherence between teachers' beliefs and classroom practices. Although formal professional development was limited, those who attended even a few courses on PCK and CEFR reported lasting benefits, gaining clearer understanding of student-centred instruction and strategies for developing speaking skills. Some teachers also actively sought growth through informal means—such as WhatsApp and Telegram groups—where they shared ideas and solved problems collaboratively, especially in resource-limited SAR schools. Peer collaboration within schools further supported this growth, with teachers learning from more experienced colleagues through in-house training and casual mentorship. Overall, these findings suggest that even without extensive formal training, dedicated teachers could internalize and apply effective pedagogical strategies through informal learning and peer support.

4.2.8 Reasons for Incoherence (Mismatch between Beliefs and Practices)

Many teachers demonstrated a clear disconnect between their beliefs about the value of the IRF method and their actual classroom practices. A key factor was their limited English proficiency, which weakened their confidence and led to reliance on rigid lesson plans, limiting the spontaneity needed for effective IRF use. Another major issue was their misunderstanding of Communicative Language Teaching (CLT); some equated it with unstructured conversation, overlooking how IRF can scaffold student speech when applied correctly.

Additionally, most teachers lacked formal TESL training, with academic backgrounds in unrelated fields. This left them without the theoretical knowledge or pedagogical strategies needed for student-centered speaking instruction. The inclusion of Tahfiz students, who had minimal English exposure, further widened proficiency gaps and made uniform speaking activities difficult to implement.

Sociocultural expectations also influenced teaching choices. Some teachers reported that parents prioritized religious studies over English, reducing support for oral language instruction. As a result, many teachers felt pressured to downplay speaking activities in class.

Overall, while a few teachers bridged the theory-practice gap through informal learning and peer support, most struggled due to combined challenges related to language ability, training, classroom context, and cultural expectations. These factors collectively hindered the consistent and effective use of IRF in SAR classrooms.

5 CONCLUSION

Although SAR teachers understand the value of the IRF method in teaching speaking, its implementation is limited by factors such as lack of professional development and socio-cultural constraints like parental preference for religious education. To improve outcomes, SAR schools should prioritize targeted CPD focused on IRF strategies and CEFR-aligned practices. Empowering teachers through reflective practice and involvement in decision-making is also essential. Support for mixed-proficiency classrooms, especially with Tahfiz students, should include differentiated instruction and peer learning. At the same time, culturally relevant teaching that blends Islamic values with English learning can make lessons more meaningful. Finally, collaboration with families and communities is crucial to shift perceptions and build support for English education. Together, these steps can enhance speaking instruction and align religious and academic goals.

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Language Teacher Cognition on The Role of Essay Outlines in Writing Instruction: A Qualitative Study

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ABSTRACT

This qualitative case study explores the relationship between language teacher cognition and classroom practices in the teaching of essay outlines within ESL writing classrooms. Drawing on Borg's (2003) Language Teacher Cognition (LTC) framework, the study examines how two experienced tertiary-level ESL teachers, Mr. F and Ms. J, conceptualize and implement essay outlining as part of their writing instruction. Data were collected through pre-observation interviews, systematic classroom observations, and post-observation interviews. Thematic analysis and frequency counts were used to identify recurring beliefs and their degree of enactment in the classroom. Findings revealed strong coherence between teachers' beliefs and their practices in areas such as structured instruction, use of scaffolding, peer collaboration, and emphasis on thesis development. However, partial incoherence was noted in the use of English as the target language and the perceived time-saving benefits of outlining, which were hindered by student-related challenges such as limited background knowledge and low language confidence. The study concludes that while teacher cognition significantly informs pedagogical practice, its implementation is often mediated by contextual and learner-based factors. The findings underscore the need for responsive teacher education that supports adaptive strategies to bridge the gap between instructional beliefs and classroom realities.

KEYWORDS Language Teacher Cognition**,** Essay Outlines**,** Writing Instruction**,** ESL Classroom, Beliefs and Practices**,** Pedagogical Scaffoldin

1 INTRODUCTION

1.1 Background

Teaching essay writing in ESL classrooms goes far beyond merely instructing students to place sentences into paragraphs. It is an intellectually demanding process that requires learners to engage in structured thinking, a mental activity that involves generating ideas, organizing them into a coherent sequence, and establishing clear connections between those ideas. Writing an effective essay demands not only linguistic proficiency but also cognitive clarity in presenting arguments and supporting evidence. Within this complex

process, one component that plays a pivotal yet often overlooked role is the essay outline. An essay outline functions as a scaffold or blueprint, enabling students to map out their ideas before engaging in the actual act of writing. It encourages students to pre-plan the structure of their essay, determine where each point fits, and identify how their thesis statement will be supported throughout. According to Hyland (2003), outlining is especially crucial in ESL contexts because it reduces the cognitive load during writing, allowing learners to focus more on language accuracy, coherence, and content development. Despite its potential to foster better writing habits and performance, the practice of teaching outlining explicitly remains inconsistent or even absent in many ESL writing classrooms.

1.2 Difficulty Faced by Students if They Are Not Taught Essay Outline

Without a proper outline, students often produce disorganized and fragmented essays characterized by weak thesis statements, incoherent paragraph structures, and supporting points that lack relevance or logical sequencing. This lack of structure significantly hinders the readability and overall persuasiveness of their writing. Research has shown that when students are not taught to plan and outline their essays systematically, their writing tends to suffer from poor cohesion and coherence, as they struggle to maintain a clear flow of ideas and argumentation. A recent study by Alharbi (2023) found that students who engaged in pre-writing outlining tasks demonstrated significantly higher organization and idea development in their essays compared to those who did not. This reinforces the pedagogical importance of integrating structured outlining into writing instruction, especially in ESL contexts.

1.3 Importance of Teaching Essay Outline

Teaching students how to construct essay outlines is a crucial step in academic writing development, particularly for second language learners. An essay outline serves as both a visual scaffold and a cognitive framework that allows students to plan and organize their ideas systematically before engaging in the actual writing process. This pre-writing strategy helps students identify key components such as thesis statements, topic sentences, supporting arguments, and transitions, ultimately improving overall text cohesion and coherence (Hyland, 2019).

Moreover, outlining enhances students' metacognitive awareness, enabling them to monitor the flow of their arguments and maintain focus on the essay's objectives. Recent studies emphasize that when students use outlines, they tend to write with greater clarity, purpose, and syntactic complexity (Zhang & Zhang, 2023). It also facilitates genre-based writing, allowing learners to internalize academic conventions, especially in argumentative and expository texts (Teng, 2021).

Importantly, from a pedagogical standpoint, teaching outlines supports process-oriented writing instruction, which encourages drafting, revising, and reflecting—key components in developing advanced literacy. Teachers who emphasize outlining are better positioned to guide students through recursive stages of writing, nurturing independence and transferable writing skills that extend beyond ESL classrooms.

1.4 Problem Statement

Despite the widely acknowledged advantages of teaching essay outlining, its implementation in ESL classrooms remains inconsistent and fragmented. Some teachers prioritize content delivery and grammatical accuracy over the development of organizational skills such as outlining. Others may view outlining as time-consuming or redundant, especially under tight syllabus constraints or exam-oriented curricula (Lee & Mak, 2022).

The lack of standardized practices for teaching outlines further contributes to pedagogical inconsistency, with variations in when, how, and to what extent outlining is taught. Moreover, teacher beliefs about its importance are not always reflected in classroom practice, a phenomenon often linked to cognitive dissonance between what teachers know or believe and what they actually do (Borg, 2015). External factors such as class size, student proficiency levels, and administrative pressures often result in incoherence between intended and enacted instruction.

This study seeks to explore such gaps by examining the relationship between teacher cognition and actual classroom practices in the context of teaching essay outlines. Understanding this relationship is essential for informing future teacher training, curriculum design, and writing pedagogy.

1.5 Concept of Teacher Cognition

Teacher cognition encompasses the beliefs, knowledge, attitudes, and thought processes that teachers draw upon in their instructional decisions and classroom practices. It is widely recognized as a significant factor in shaping how teachers plan lessons, respond to student needs, and adopt or resist pedagogical innovations (Borg, 2003). However, research has consistently shown that there is often a gap between what teachers believe and what they actually do in practice. This gap can manifest as either coherence, where beliefs are reflected in practice, or incoherence, where practices diverge from beliefs due to a range of mediating factors such as institutional constraints, time limitations, curriculum requirements, or student characteristics (Li & Yan, 2022). Understanding the dynamic and context-sensitive nature of teacher cognition is crucial for interpreting classroom behaviours and for informing professional development initiatives that aim to bring practice into closer alignment with informed pedagogical beliefs. “Teachers' cognition is not a fixed entity but a dynamic system influenced by multiple contextual, experiential, and institutional factors, which may support or hinder the translation of beliefs into practice.” (Li & Yan, 2022, p. 2)

1.6 Research Objectives and Research Question

This study investigates language teacher cognition in the context of teaching essay outlining by exploring three interconnected dimensions: (1) stated beliefs, or what teachers explicitly express regarding the purpose and value of essay outlines; (2) classroom practices, referring to how these beliefs manifest or fail to in real-time instruction; and (3) contextual factors that influence whether teachers act coherently (belief and practice align) or incoherently (beliefs not enacted). Teacher cognition research consistently emphasizes this triadic relationship between beliefs, practice and coherence as well as the surrounding teaching environment (Borg, 2003). Using a mixed-method approach, this study aims to uncover not only what teachers believe and do, but also why coherence may be disrupted, whether by time constraints, institutional demands, or student diversity, thus contributing to a deeper understanding of teacher decision-making in writing pedagogy.

Three research questions that will guide the researcher along the way are:

RQ1 - What are the teachers' beliefs about the importance of teaching essay outline?
RQ2 - To what extent are their beliefs about the importance of teaching essay outline observable in their classrooms?
RQ3 - What contextual factors explain any coherence or incoherence?

1.7 Significance

Findings from this study will deepen our understanding of how language teachers’ beliefs about instructional strategies such as the use of essay outlines are manifested (or not) into classroom practice. This alignment or misalignment, often shaped by contextual factors like time constraints, curriculum demands, or student diversity, can significantly affect the quality of writing instruction in ESL settings. Recognizing such dynamics is essential for developing responsive teacher education programs, refining writing curricula, and improving classroom interventions. Recent research underscores that teacher cognition directly informs pedagogical decisions, but external factors often mediate their enactment in practice (Skott & Karlsson, 2023). By identifying where coherence and incoherence occur, this study provides practical insights for curriculum planners, policymakers, and teacher educators to better support writing instruction in linguistically diverse classrooms.

2 LITERATURE REVIEW

2.1 Concept of Language Teacher Cognition

Language Teacher Cognition (LTC) explores the mental lives of teachers, their beliefs, knowledge, and decision-making processes, and how these are formed and reformed through experience, training, and practice (Borg, 2006). Borg's (2003, 2006) framework of Language Teacher Cognition (LTC) offers a comprehensive model to understand how teachers' beliefs and knowledge systems influence their instructional choices. The framework identifies four major constructs that interact to shape teacher thinking and classroom behaviour: teachers' prior language learning experiences, teacher education and professional development, contextual factors, and classroom practices.

Firstly, teachers' own experiences as language learners play a foundational role in forming their beliefs about language instruction. For instance, a teacher who was taught writing through rigid templates may carry forward this belief into their own instructional practice, often without critical examination (Borg, 2003). Recent studies continue to support this view, showing that teachers often replicate strategies they found effective or emotionally resonant during their schooling (Li & Walsh, 2021; Tao & Gao, 2023).

Secondly, teacher education and professional development significantly shape pedagogical beliefs and instructional strategies. Through pre-service coursework and in-service training, teachers are exposed to theories of learning, instructional models, and curriculum mandates that influence how they conceptualize and teach writing. However, recent research by Zheng and Wang (2024) suggests that such training must be continuously updated and context-sensitive; otherwise, it risks becoming disconnected from classroom realities.

Thirdly, contextual factors including school policies, institutional culture, class size, and student proficiency, strongly mediate the implementation of teachers' beliefs. Even when a teacher value teaching essay outlines, these beliefs may be side-lined in favour of completing exam-focused syllabi or managing heterogeneous classrooms (Nguyen & Wyatt, 2020). These structural constraints often lead to what Borg (2015) refers to as a "mismatch" between belief and practice.

Finally, classroom practices serve as the arena where beliefs are either enacted or compromised. Observing classroom behaviour reveals the extent to which teacher cognition is implemented in practice. However, as highlighted by recent literature, teachers may adjust or abandon their original plans in response to student feedback, time pressure, or administrative demands (Kubanyiova & Feryok, 2015; Lee, 2023).

Using Borg's LTC framework in a study on teaching essay outlines is particularly significant. Outlining is not merely a technical step in writing. It is a cognitively demanding strategy that reflects deeper pedagogical choices. By analysing teacher cognition through the four constructs, researchers can explore not only whether teachers value outlines but also how those values are shaped, challenged, or constrained. The framework enables a nuanced understanding of the coherence, or lack thereof between what teachers know, believe, and do in teaching writing.

2.2 Pedagogical Content Knowledge (PCK)

While Borg's (2003) Language Teacher Cognition (LTC) framework provides a lens into the beliefs, knowledge, and contextual influences that shape teaching practices, Shulman's (1986, 1987) theory of Pedagogical Content Knowledge (PCK) offers a complementary perspective by focusing on the knowledge base for teaching. PCK bridges the gap between content knowledge (what teachers know about the subject matter) and pedagogical knowledge (how to teach it effectively), positioning it as the specialized knowledge that enables teachers to transform subject matter into comprehensible learning experiences for students.

Shulman (1986) proposed that effective teaching requires not only mastery of subject content but also an understanding of how to present that content in ways that accommodate diverse learners' needs. In the context of essay outlining, this involves knowing how to scaffold complex concepts such as thesis statements, paragraph unity, and transitions, and how to tailor these concepts through instructional strategies like modelling, guided practice, and feedback.

For this study, PCK is especially relevant in explaining how and why teachers like Mr. F and Ms. J choose particular methods—such as collaborative Google Docs, visual aids, and mini-lessons—to teach outlining. These instructional choices reflect not only their beliefs (as emphasized in LTC) but also their deep

pedagogical knowledge of how students learn writing. For example, Ms. J's emphasis on step-by-step modelling and cognitive scaffolding shows her PCK in anticipating student difficulties and using tools like sentence starters and fill-in-the-blank outlines to support comprehension.

Moreover, PCK can shed light on the coherence between beliefs and practices: where beliefs about the value of outlining align with observable classroom strategies, it may be due to the teachers' strong pedagogical reasoning and understanding of how to adapt content for effective learning. Conversely, when incoherence emerges (such as students reverting to L1 or struggling to generate ideas), it suggests areas where pedagogical strategies may require further adaptation to suit student readiness and contextual constraints—an interplay between PCK and situational factors.

Integrating PCK with LTC thus enhances the theoretical grounding of this study by offering a richer explanation of why teachers act the way they do—not just because of what they believe, but also because of how they conceptualize the teaching of writing itself. This integrated perspective allows for a more nuanced understanding of instructional behaviour, especially in the complex context of ESL academic writing classrooms.

3 METHODOLOGY

3.1 Research Design

This qualitative study employed a mixed-method case study involving interviews and classroom observations to triangulate data.

3.2 Participants

Two experienced ESL teachers from a tertiary institution, Mr. F and Ms. J, were selected based on their extensive involvement in teaching academic writing and their demonstrated commitment to improving students' essay writing skills. Both educators have been actively involved in designing writing modules, conducting workshops on essay planning, and mentoring students through intensive writing tasks. Their selection was also influenced by their contrasting pedagogical styles and varying levels of experience with incorporating outlining techniques in the classroom, which provided a rich ground for exploring the complexity of language teacher cognition in practice.

3.3 Data Collection Method

3.3.1 Pre-Observation Interviews

Each teacher participated in one semi-structured pre-observation interview that lasted approximately 45 minutes. These interviews were conducted individually in a quiet office setting and guided by a set of open-ended questions focused on teachers' personal beliefs about the significance of teaching essay outlines. The interviews aimed to capture their perceptions of students' needs, pedagogical preferences, and experiences in implementing outlines in writing lessons. Both Mr. F and Ms. J elaborated on their instructional methods and shared their thoughts on how outlining supports student learning, particularly in relation to structuring ideas and improving coherence. Rich narrative responses were obtained as the semi-structured format allowed for in-depth elaboration. Follow-up prompts helped clarify responses related to their preferred strategies, the frequency of teaching outlines, and how they assessed the effectiveness of outline instruction in helping students write better essays. Audio recordings were transcribed and later analysed to extract recurring themes representing each teacher's cognition on essay outlining.

3.3.2 Classroom Observations

To gather contextual data on how teacher beliefs translated into classroom practices, each participant was observed twice over the course of two 2-hour essay writing classes. The classroom observations were non-intrusive and recorded using field notes and audio devices, allowing the researcher to focus on teacher-student interaction, instructional delivery, and use of outlining strategies. This method enabled the researcher to identify whether beliefs stated in the pre-observation interviews were evident (observable), partially present (unobservable), or entirely missing (unexecuted) in real classroom settings. By attending two separate lessons

per teacher, the study aimed to capture a fuller picture of instructional consistency, pedagogical decisions, and real-time constraints. Special attention was given to how outlines were introduced, modelled, and scaffolded within the lesson, along with how much student engagement occurred during outlining stages.

3.3.3 Post-Observation Interviews

Post-observation interviews were conducted with both teachers within 48 hours of the second classroom observation. These reflective interviews aimed to explore reasons behind the alignment or misalignment between their earlier stated beliefs and their actual classroom behaviour. The discussions focused on what informed their teaching choices, challenges they faced during lesson implementation, and contextual factors such as student proficiency, time constraints, and institutional policies that may have influenced the coherence or incoherence between cognition and practice. These interviews lasted between 30–45 minutes and were transcribed for analysis. Teachers were also shown selected observational notes and invited to comment or clarify instructional decisions, allowing for collaborative validation and deeper understanding of observed practices.

3.4 Research Instruments

Three main research instruments were employed to ensure comprehensive and valid data collection in this study. The first instrument was the pre-observation interview protocol, adapted from Kalpana (2014), which consisted of open-ended questions aimed at eliciting teachers' beliefs, prior experiences, and intended instructional practices regarding essay outlining. The questions focused on the rationale behind teaching outlines, perceived benefits for students, and strategies used to facilitate outlining in the ESL writing classroom. The second instrument was the systematic classroom observation scale, also adopted and modified based on Kalpana's (2014) observation rubric, which was used to record observable behaviours and instructional techniques associated with essay outlining. This instrument enabled structured documentation of whether and how teacher beliefs were manifested during lessons, specifically through strategies such as scaffolding, modelling, student engagement, and the integration of language targets. The third instrument was the post-observation interview protocol which consists of questions allowing for an in-depth understanding of the reasons behind any observed coherence or incoherence between the teachers' stated beliefs and classroom actions. The triangulation of these instruments not only strengthened the reliability of the findings but also provided nuanced insights into the dynamic interplay between belief and practice in the teaching of essay outlines.

3.5 Data Analysis

Thematic analysis and frequency counts were applied to ensure a comprehensive understanding of patterns and consistencies within the data. Braun and Clarke's (2006) six-phase thematic analysis framework was adopted, beginning with data familiarization and initial coding, followed by theme generation, reviewing, defining, and naming. This method has been widely used in educational research for its flexibility and depth in qualitative analysis (Nowell et al., 2017)

Each data set comprising the pre-observation interview, classroom observations, and post-observation interviews was coded and analysed individually for each teacher to preserve the contextual integrity of their beliefs and teaching behaviour. Subsequently, frequency counts were conducted to quantify the presence or absence of recurring codes and to evaluate the extent to which stated beliefs translated into observable classroom practice.

To capture the richness and variation of instructional behaviour across time, data from both observed classes for each teacher were combined during the thematic analysis phase**.** This allowed for the identification of recurring instructional patterns, and the emergence of broader pedagogical trends. Combining the two classroom sessions ensured that any isolated practices or one-off behaviours were distinguished from consistent teaching habits, thus enabling the researcher to extract main themes that represented the core beliefs and practices of each teacher.

This dual approach of thematic and quantitative coding helped generate an enriched, triangulated view of teacher cognition. The cross-case analysis between Mr. F and Ms. J enabled further insight into the variability

of instructional practices and highlighted contextual factors such as institutional constraints, classroom management issues, and student responsiveness that contributed to coherence or incoherence between beliefs and practices.

4 FINDINGS

4.1 Mr F

4.1.1 Pre-Observation Interview

The pre-observation interview with Mr. F offered meaningful insights into his beliefs regarding the significance of teaching essay outlines. He firmly believed that outlining is essential in guiding students to plan, structure, and articulate their ideas effectively. His responses reflected a thoughtful integration of structural, language-related, and instructional aspects, demonstrating a well-rounded perspective on how outlining contributes to successful writing instruction. The themes identified from his responses are as follows:

- Outlines provide structure and clarity
- Outlines save time during writing
- Prevents common student mistakes
- Thesis statement as the "brain" of the essay
- Grammar and vocabulary must be emphasized in outlining
- Visual aids support essay planning
- Teachers should facilitate, not dominate
- Explicit instruction is crucial
- Use of real examples and peer interaction are crucial

4.1.2 Systematic Classroom Observation Scale

This section presents the findings from the systematic classroom observation carried out for Mr. F. The themes were first derived from the pre-observation interview to capture his beliefs regarding the significance of teaching essay outlines. These themes served as reference points to assess whether her beliefs were evident, partially evident, or not evident at all during actual teaching sessions. Table 4.2 illustrates the extent to which Mr. F's expressed beliefs aligned with her instructional practices during the observations.

Table 4.1
Alignment Between Beliefs and Observed Classroom Practices in Mr. F's Classrooms

	Themes from Pre-Observation Interview	Observable	Partially Observable	Unobservable
1	Outlines provide structure and clarity	✓		
2	Outlines save time during writing		✓	
3	Prevents common student mistakes	✓		
4	Thesis statement as the "brain" of the essay	✓		
5	Maximal use of the target language to ensure the correct use of grammar and vocabulary in outlining		✓	
6	Visual aids support essay planning	✓		
7	Teachers should facilitate, not dominate	✓		
8	Explicit instruction is crucial	✓		
9	Use of real examples and peer interaction are crucial	✓		

Table 4.1 demonstrates a predominantly high level of coherence between Mr. F's stated beliefs and his classroom practices, with seven out of nine themes being fully observable. These include his emphasis on structured outlining, visual support, the centrality of the thesis statement, and the importance of explicit instruction and peer interaction, all of which were evident through guided modelling, board work, and student

collaboration. Mr. F also maintained a facilitative teaching role, allowing space for student input while providing necessary scaffolding. However, two themes were only partially observable. While Mr. F believed that outlining should save time during writing, the classroom data showed that students still struggled with idea generation, indicating that the time-saving benefit was not fully realized. Additionally, although he promoted the maximal use of the target language, students occasionally reverted to their mother tongue, especially during group discussions.

4.1.3 Post-Observation Interview

Although Mr. F held the belief that outlining would help students write more efficiently, classroom observations revealed that many students continued to face difficulties generating ideas. This implies that the expected time-saving advantage was not fully achieved, possibly because of their limited background knowledge and insufficient practice in using outlines. Furthermore, despite his emphasis on using the target language consistently, some students reverted to their native language during group discussions. This indicates that while Mr. F's pedagogical intentions reflected sound instructional principles, factors such as students' language proficiency and self-confidence affected how fully these beliefs could be implemented in practice.

4.2 Ms. J

4.2.1 Pre-Observation Interview

The pre-observation interview with Ms. J provided valuable insights into her beliefs about the importance of teaching essay outlines. Ms. J expressed a strong conviction that essay outlining plays a vital role in helping students plan, organize, and express their ideas clearly. Her responses revealed a balance between structural, linguistic, and pedagogical considerations, indicating a comprehensive understanding of how outlining supports effective writing instruction. The following themes were extracted from her responses:

- Outlines provide structure and clarity
- Outlines save time during writing
- Prevents common student mistakes
- Thesis statement as the "brain" of the essay
- Maximal use of the target language to ensure the correct use of grammar and vocabulary in outlining
- Visual aids support essay planning
- Teachers should facilitate, not dominate
- Explicit instruction is crucial
- Use of real examples and peer interaction are crucial

4.2.2 Systematic Classroom Observation Scale

This section summarizes the results from the systematic classroom observation conducted for Ms J. The themes were initially extracted from the pre-observation interview to reflect her beliefs about the importance of teaching essay outlines. These themes were then used as indicators to evaluate whether such beliefs were observable, partially observable, or unobservable in actual classroom practice. Table 4.2 outlines the alignment between Ms J's stated beliefs and his teaching actions during the observed lessons.

Table 4.2
Alignment Between Beliefs and Observed Classroom Practices in Ms J's Classrooms

	Themes from Pre-Observation Interview	Observable	Partially Observable	Unobservable
1	Outlines save time during writing		✓	
2	Outlines help students organize ideas	✓		
3	Step-by-step teaching is necessary	✓		
4	Thesis statement is central	✓		

5	Outlining relieves mental blocks	✓	
6	Students struggle linking thesis to topic sentences	✓	
7	Vocabulary and grammar must be planned		✓
8	Google Docs for collaborative outlining	✓	
9	Real examples and revisiting past content help understanding	✓	

Table 4.2 illustrates the extent to which Ms. J's beliefs about teaching essay outlines were reflected in her actual classroom practices. Out of nine identified themes, seven were fully observable, indicating a high level of coherence between her stated beliefs and teaching behaviours. These include her emphasis on structured teaching, the importance of the thesis statement, use of real examples, digital collaboration via Google Docs, and supporting students through cognitive scaffolding. Two themes were partially observable: (1) the belief that outlining saves time—since students still struggled to generate ideas efficiently and (2) the belief in planning vocabulary and grammar to maximize use of the target language—partially implemented as some students reverted to their mother tongue during discussions. Overall, the data suggests that Ms. J demonstrated strong alignment between her cognition and classroom practices, with minor gaps largely influenced by student-related factors.

4.2.3 Post-Observation Interview

Similar to Mr. F's class, Ms. J believes that outlining would help students save time during the writing process. However, this belief was partially observable was only partially realised in both of her classrooms, as many students continued to struggle when generating ideas. This difficulty can be attributed to their limited background knowledge and insufficient exposure to the topic, which hindered their ability to construct content-rich outlines. Additionally, as how Mr. F agrees about the necessity of employing maximal use of the target language, both of her lessons witnessed this practice was not fully observable. Despite efforts to model English usage, many students frequently reverted to their mother tongue, especially during peer discussions. This suggests that low confidence, limited vocabulary repertoire, and possibly a lack of sustained practice in using English for academic purposes remain key barriers. These partially observable outcomes highlight a shared challenge across both classrooms, indicating that while teacher beliefs were pedagogically sound, student-related factors often impeded full implementation.

4.3 Reasons for coherence and incoherence

This section explores the factors that contributed to the coherence and incoherence between the teachers' stated beliefs and their actual classroom practices. Drawing from post-observation interview data, the analysis focuses on identifying what facilitated the successful enactment of beliefs, as well as what hindered their full implementation. Notably, both Mr. F and Ms. J demonstrated several areas of coherence, particularly in their use of structured strategies for teaching essay outlining. However, a recurring pattern of partial observability was found across both classrooms, especially concerning the expected time-saving effects of outlining and the consistent use of the target language during collaborative activities. These shared elements of incoherence suggest that certain student-related factors, such as limited background knowledge and low confidence in English may play a significant role in shaping or constraining how teacher beliefs are enacted. The following subsections present a detailed explanation of these patterns, organized according to observable and partially observable themes, with support from post-observation interview insights.

The coherence between the teachers' beliefs and their classroom practices was generally strong for both Mr. F and Ms. J, with the majority of their professed beliefs fully observable in classroom instruction. This consistency can be attributed to several key factors. Firstly, both teachers demonstrated solid pedagogical content knowledge (PCK) and a strong understanding of essay outlining as a strategy for enhancing students' academic writing. Their practices—such as explicit instruction, the use of visual aids (Mr. F), and collaborative tools like Google Docs (Ms. J)—reflected deliberate attempts to scaffold student learning in line with their beliefs. They also demonstrated a facilitative teaching style, placing emphasis on guided instruction, peer

interaction, and real examples to help students internalize essay components like the thesis statement and topic sentences.

However, incoherence emerged in two recurring areas for both teachers: (1) the belief that outlines save time during writing, and (2) the belief in using the target language (English) maximally during the outlining process. In both Mr. F's and Ms. J's classrooms, these beliefs were only partially observable. While both teachers structured lessons to promote efficiency in writing through outlining, many students continued to struggle during the idea-generation phase. Post-observation interviews revealed that students' limited background knowledge, weak reading habits, and lack of practice in brainstorming constrained their ability to construct content efficiently. This mismatch suggests that while the outlining framework was well-taught, students lacked the content literacy and readiness to use it effectively.

Similarly, both teachers emphasized using English throughout the outlining tasks, but students frequently reverted to mother tongue use during discussions. This was especially noticeable in lower-proficiency groups. The main reasons for this partial implementation include low self-confidence, limited vocabulary, and insufficient exposure to academic discourse in English. These factors hindered students' ability to fully engage in English-medium writing activities, despite the teachers' modelling and encouragement.

In summary, the coherence observed stemmed from both teachers' clarity of purpose and skilful lesson design. Meanwhile, the incoherence was largely influenced by student-related variables rather than inconsistencies in teacher cognition. These findings emphasize the importance of pairing well-structured writing instruction with continuous support in content development and language confidence to fully realize the benefits of essay outlining strategies in ESL contexts.

5 CONCLUSION

This study investigates the relationship between language teacher cognition and classroom practices in the teaching of essay outlining. Drawing on data from pre-observation interviews, classroom observations, and post-observation interviews of two ESL teachers, the study revealed a generally strong coherence between what teachers believed and what they practiced, particularly in areas related to structure, scaffolding, and explicit instruction. Both Mr. F and Ms. J demonstrated consistent pedagogical strategies that reflected their stated beliefs, such as using outlines to guide student thinking, employing visual or digital tools, and facilitating peer collaboration. These practices were not only observable but also supported by clear pedagogical content knowledge and a shared belief in the importance of step-by-step instruction. However, some areas of incoherence emerged, especially regarding the anticipated benefits of outlining in saving time and the full implementation of English as the target language. Despite their modelling and encouragement, students in both classrooms struggled with idea generation and frequently switched to their mother tongue, limiting the realization of these beliefs in practice. Post-observation interviews suggested that these gaps were not due to flaws in teacher cognition but rather to student-related factors such as limited background knowledge, low confidence in language use, and insufficient practice with academic English.

The findings emphasize that teacher cognition cannot be fully understood in isolation from the classroom context. Even when teachers possess strong pedagogical beliefs, the enactment of these beliefs can be constrained or shaped by student readiness, institutional culture, and classroom realities. Ultimately, this study underscores the importance of integrating teacher belief systems with contextual responsiveness, suggesting that professional development and curriculum design must support not only technical training but also adaptive strategies that address student variability and learning needs. Strengthening these alignments will enable teachers to bridge the gap between intention and implementation, thereby enhancing the overall quality of writing instruction in ESL contexts.

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Meneroka Cabaran Guru Internship Bimbingan Dan Kaunseling Dalam Pelaksanaan Kaunseling Kerjaya Di Sekolah

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ABSTRAK

Pendidikan kerjaya merupakan asas kepada peranan guru bimbingan dan kaunseling disekolah. Perkhidmatan ini salah satu penentu asas kepada kejayaan pelajar internship Bimbingan dan Kaunseling. Peneguhan kemahiran dalam inforcement from the aspect of knowledge, practice of skills, and theory must be undertaken in empowering internship students at the university. Qualitative method was applied in exploring this issue. Realiti hari ini menyaksikan peranan Guru B&K internship dalam menghadapi cabaran masalah halatuju kerjaya pelajar. Ada pelbagai kaedah yang digunakan untuk menangani tugas pelaksanaan kaunseling kerjaya. Penyelidikan ini melibatkan empat responden kajian yang berdasarkan profesion mereka sebagai guru pelatih Bimbingan dan Kaunseling Universiti Utara Malaysia, yang melalui Internship Fasa satu di beberapa buah sekolah di daerah Kubang Pasu. Data kajian yang diambil melalui temubual separa berstruktur, pemerhatian dan analisis dokumen telah dianalisis dengan menggunakan analisis kandungan. Pencarian kajian menampakkan beberapa masalah utama yang telah dihadapi oleh subjek kajian dalam menjalankan kaunseling kerjaya, iaitu antaranya adalah penglibatan pelajar yang pasif, peringkat pengetahuan pelajar yang rendah, serta berkesan pengukuran minat kerjaya yang terhad. Kajian ini menjanjikan supaya penyelidikan lanjut diteruskan bagi meneroka cabaran pelaksanaan program kerjaya dengan lebih dalam, termasuklah melibatkan peserta kajian dari pelbagai latar belakang etnik, meningkatkan jumlah subjek kajian, serta menganalisis etika dan sikap guru pelatih Bimbingan dan Kaunseling dalam pelaksanaan kaunseling kerjaya. Impact of this research is useful to different stakeholders such as teachers internship counselors, lecturers supervisors practicum, lecturers Bimbingan and Kaunseling courses, students, and school management.

KEYWORDS: Cabaran, guru bimbingan dan kaunseling internship, kaunseling kerjaya, pendidikan

1 PENGENALAN

Kaunseling kerjaya adalah satu proses dalam membantu individu berdepan keptusan membuat pemilihan kerjaya (Brown & Brook, 1985). Berdasarkan garis panduan Kementerian Pendidikan Malaysia (2015), perkhidmatan Bimbingan dan Kaunseling (B&K) di sekolah merangkumi empat fokus utama, iaitu pembangunan sahsiah murid, peningkatan disiplin kendiri, pendidikan kerjaya, serta aspek psikososial dan kesejahteraan mental murid. Dalam konteks ini, pendidikan kerjaya merupakan salah satu komponen penting yang perlu disampaikan melalui perkhidmatan kaunseling kerjaya kepada murid di peringkat sekolah. Rentetan itu, pelajar kursus Bimbingan dan Kaunseling di Institusi Pengajian Tinggi Awam (IPTA) disempitkan oleh penambah latihan lapangan melalui program Internship Fasa satu dan dua selama 12 minggu di universiti dan sekolah sebagai syarat kelayakan untuk bergraduasi. Walaupun kita sedar, duniawi juga menemukan era keperluan perkhidmatan ini dalam bidang kerjaya. During the internship and practicum, Bimbingan and Kaunseling teacher-trainers conduct several types of B&K services such as career counseling sessions under the supervision and direction of lecturers in charge and the designated school guidance teachers (Mohd Mansor Abdullah, 2017). Pelaksanaan kaunseling kerjaya dalam sekolah dapat dilakukan menggunakan pelbagai teknik yang disesuaikan menurut keperluan murid serta kemampuan yang dimiliki oleh Guru Bimbingan dan Kaunseling (GBK). Kreativiti dan kebolehsuaian kaunselor pelatih bermain peranan terpenting dalampastikan pelaksanaan kaunseling kerjaya itu berkesan, selaras dengan keperluan era murid serta melalui kaedah penyampaian yang dinamik dan relevan (Sapora Sipon, 2023).

2 PENYATAAN MASALAH

Implementasi perkhidmatan Bimbingan dan Kaunseling (B&K) oleh guru pelatih telah terdedah kepada pelbagai kekangan, khususnya dalam elemen kaunseling kerjaya. Salah satu utama di antaranya adalah kekurangan latihan praktikal yang cukup sebelum guru pelatih melalui latihan lapangan di sekolah, yang selanjutnya mempengaruhi peningkatan kualiti profesionalisme mereka sebagai calon guru kaunseling. Penyelidikan terbaru oleh Rahim et al. (2021) menunjukkan bahwa kekuatan kurikulum latihan perguruan memberi kesan langsung terhadap pembentukan kompetensi guru pelatih yang cemerlang. Kurikulum less yang pendedahan praktikal in a whole can lead to weaknesses in applying intervensi kaunseling at school effectively. Selain itu, terdapat di kalangan guru pelatih B&K yang masih berasa ragu dan keliru dalam memilih dan mengaplikasikan teori kaunseling yang bersesuaian dengan masalah yang dihadapi klien. Menurut Kajian oleh Azlan dan Kamaruddin (2020), kepercayaan dalam memilih pendekatan teori adalah antara elemen penting yang mempengaruhi keberkesanan sesi kaunseling. Ketidakyakinan ini berpunca daripada pengalaman terhad dalam mengendalikan sesi sebenar serta kefahaman yang kurang mendalam terhadap aplikasi teori dalam konteks murid sekolah.

Tambahan pula, pelaksanaan kaunseling kerjaya khususnya di sekolah-sekolah kawasan luar bandar atau pedalaman masih kurang menyeluruh. Hal ini disokong oleh dapatan Shima dan Abu Yazid (2019), yang menunjukkan bahawa pelajar sekolah menengah luar bandar mempunyai keperluan yang lebih tinggi terhadap perkhidmatan kaunseling dalam aspek kerjaya dan akademik berbanding keperluan sosial dan peribadi. Kekurangan akses kepada sumber, pendedahan kerjaya, dan sokongan sistematik menyebabkan pelajar luar bandar terpinggir daripada manfaat penuh perkhidmatan kaunseling kerjaya.

Pengalaman pelajar guru bimbingan dan kaunseling semasa menjalani Internship turut mencerminkan cabaran ini, terutamanya dalam aspek pelaksanaan inventori kerjaya kepada murid di sekolah. Kemahiran yang kurang dalam mentadbir dan menafsir inventori minat kerjaya menyebabkan proses penilaian tidak mencapai objektif sepenuhnya, sekaligus menjejaskan keberkesanan intervensi lantas menyebababkan murid bosan sepanjang sesi berlangsung. Kajian ini menumpukan kepada empat seorang guru pelatih B&K yang berada dalam Internship Fasa 1 yang dipilih dengan tujuan. Ruang penyelidikan ini terhad kepada sempat buah sekolah saja di daerah Kubang Pasu, menjadi factor lokasi dan bilangan peserta sebagai had kajian yang perlu diambil kira. Secara keseluruhan, kaunseling kerjaya berfungsi penting dalam membantu murid memahami jalur kerjaya

yang tepat berdasarkan minat, bakat, dan potensi mereka. Namun demikian, pelaksanaan di peringkat sekolah sering terganggu oleh cabaran- cabaran tertentu.

Jika masalah-masalah ini tidak diberi cabaran dengan serius, guru pelatih mungkin tidak dapat menjalankan peranan mereka sebagai fasilitator kerjaya yang berkesan, sedangkan murid pula tidak dapat menangkap peluang untuk membina asas kerjaya yang kukuh. Oleh itu, usaha bersepadu perlu dilaksanakan merangkumi penambahbaikan kurikulum latihan guru, bimbingan intensif semasa praktikum, pemilihan alat penilaian yang lebih efisien serta sokongan berterusan daripada pihak sekolah dan institusi pengajian tinggi. Langkah-langkah ini diharap dapat memperkukuh kecekapan guru pelatih dan meningkatkan impak kaunseling kerjaya kepada pembangunan masa depan murid.

2.1 Objektif Kajian

1. Mengenal pasti cabaran yang dihadapi oleh guru internship bimbingan dan kaunseling dalam pelaksanaan kaunseling kerjaya di sekolah.

2.2 Soalan Kajian

1. Apakah cabaran yang telah dihadapi oleh guru Internship bimbingan dan kaunseling dalam menjalankan kaunseling kerjaya di sekolah?

3 METODOLOGI KAJIAN

This study employed kualitatif design with study approach of kajian kes in approaching the challenges of implementation of career counseling by UUM guru pelatih Bimbingan dan Kaunseling undergoing the Internship Fasa 1 program. Justification for using this design choice is based on the need for the study in collecting data intensively through interview, observation, and document analysis, which was then analyzed employing tematik analysis method. Persampelan kajian ini melibatkan empat peserta kajian yang melibatkan guru pelatih perempuan dari Program Ijazah Sarjana Muda Pendidikan (Bimbingan dan Kaunseling), yang pernah mengalami latihan internship di sekolah daerah Kubang Pasu. Sampel dirampas secara rawak dan berpemborongan berdasarkan persetujuan dan kebukaan peserta untuk memberikan kerjasama dalam kajian ini. Instruments utama digunakan ialah temubual separa berstruktur yang dibina dan mempunyai kesahan. Transkrip temubual kemudian dibezakan oleh peserta kajian untuk tujuan pengesahan, seperti yang dibahagiankan oleh Bogdan dan Biklen (2003), dengan peserta menandatangani transkrip tersebut. Berdampingan dengan temubual, pengkaji juga memanfaatkan senarai semak dan nota lapang sebagai instrumen pemerhatian. Kertas seperti nota reflektif dan rekod kes kaunseling kerjaya yang ditulis oleh peserta turut dikaji untuk meningkatkan ketelusan dan ketepatan maklumat kajian. Triangulasi kaedah telah ditelepitori melalui penggunaan semua tiga sumber data temubual, pemerhatian dan analisis dokumen untuk menaikkan kesahan dan kebolehpercayaan hasil. Data seluruh dikaji tema berdasarkan objektif kajian dan dipertumpukkan kepada tema-tema utama yang dijenistik dengan sendirinya melalui analisis kandungan menyeluruh terhadap transkrip dan dokumen berkaitan.

3.3 Pengumpulan Data

1. Temu Bual Semi-Struktur

Temu bual semi-struktur dilakukan menggunakan soalan yang telah disahkan oleh pakar. Rakaman audio digunakan dengan keizinan peserta, dan transkripsi disediakan untuk tujuan analisis.

2. Pemerhatian

Nota lapangan disediakan untuk mendokumentasikan pemerhatian terhadap pelaksanaan sesi kaunseling kerjaya.

3. Analisis Dokumen

Analisis dilakukan terhadap dokumen nota refleksi yang disediakan oleh peserta selepas sesi kaunseling kerjaya.

3.4 Kaedah Analisis Data

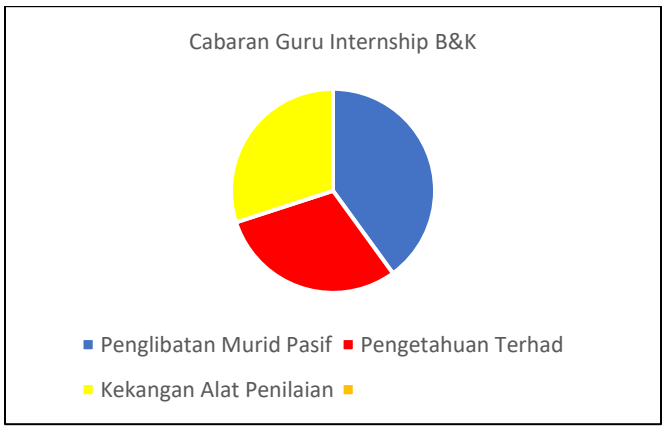
Data dianalisis menggunakan kaedah analisis tematik, yang mana tema-tema utama dibentuk berdasarkan objektif kajian.

4 DAPATAN DAN PERBINCANGAN

Jadual 1 Cabaran Guru Internship B&K

Tema	Peratus
Penglibatan Murid Pasif	40%
Pengetahuan Terhad	30%
Kekangan Alat Penilaian	30%

Dapatan menunjukkan seramai 40%Penglibatan Murid Pasif, 30% adalah pelajar yang mempunyai pengetahuan terhad dan 30% mempunyai kekangan Alat Penilaian. Berikut merupakan hasil dapatan dari subjek kajian.



Rajah 1 : Cabaran Guru Internship B&K

Hasil dapatan kajian telah mendapati bahawa cabaran yang dihadapi oleh guru Internship B&K dalam melaksanakan kaunseling kerjaya ialah penglibatan murid yang kurang positif. Pertama penglibatan Murid yang Pasif iaitu murid menunjukkan sikap tidak aktif dalam sesi kaunseling, seperti termenung dan enggan memberi respon. Cabaran ini menjejaskan usaha untuk mengenal pasti isu kerjaya murid. Keuda, pengetahuan kerjaya yang terhad. Peserta kajian menghadap kesukaran menjelaskan istilah kerjaya seperti "juruaudit" kepada murid, menunjukkan adanya keperluan pengetahuan tambahan. Ketiga, penggunaan Alat Penilaian yang tidak Berkesan, iaitu Inventori Minat Kerjaya dipertimbangkan kurang sesuai karena jumlah soal yang banyak, menyebabkan murid mudah bosan. Kajian ini melibatkan pendekatan kualitatif melalui triangulasi kaedah bagi mendapatkan gambaran menyeluruh berkenaan cabaran dan strategi guru internship B&K dalam pelaksanaan kaunseling kerjaya. Data gathered using the three primary sources namely temu bual semi-struktur, observation and document analysis. The thematic analysis result has generated some of the dominant themes as follows:

4.1 Dapatan Temu Bual Semi-Struktur

Separate structured interview conducted revealed challenges and reflective actions of internship teachers based on real life experience during career counseling sessions.

Theme 1: Lack of Career Information Knowledge

Subjek kajian tidak boleh membalas beberapa soalan murid berhubungan istilah kerja seperti "juruaudit" dan "trenkas", menunjukkan lemah dalam penguasaan maklumat kerjaya berkaitan. Ini mengganggu komunikasi lancar dan keyakinan guru dalam sesi.

Tema 2: Kesukaran Mengendalikan Inventori Minat Kerjaya (IMK)

Subjek kajian menuturkan cabaran menggunakan IMK yang mengandungi terlalu banyak item, mengakibatkan murid hilang fokus dan rasa bosan, sekaligus menjejaskan keberkesanan pentaksiran minat kerjaya.

Tema 3: Reflektif Strategi dan Penyesuaian Pembimbing Internship

Peserta membagikan strategi seperti membuat pembacaan awal tentang maklumat kerjaya, mempelbagaikan aktiviti (contohnya terapi seni dan puzzle bergambar), serta memberi ruang rehat semasa pelaksanaan ujian kerjaya sebagai usaha menyesuaikan diri dengan keperluan murid.

4.2 Dapatan berdasarkan Pemerhatian

Nota lapangan pemerhatian yang dipersiapkan oleh pengkaji terhadap pelaksanaan sesi kaunseling kerjaya menguatkan temuan dalam temu bual.

Tema 1: Penglibatan Murid yang Pasif

Observation indicates some of the murid are not giving active response to questions and instructions, particularly in activities that are in the form of formal assessment such as IMK, but are more engaged in visual and creative activities.

Topic 2: Tingkat Gaya Komunikasi Guru Pelatih yang Tambah

Pemerhatian terhadap interaksi antara peserta kajian menunjukkan peningkatan dari sudut keyakinan dan berkesan dalam komunikasi selepas sesi pertama, terutamanya jika guru menggunakan pendekatan permainan dan perbincangan terbuka.

4.3 Dapatan daripada Analisis Dokumen (Nota Refleksi)

Analisis terhadap nota reflektif yang ditulis oleh peserta selepas sesi kaunseling kerjaya memperkukuh dapatan melalui pendekatan kendiri.

Tema 1: Kesedaran Reflektif terhadap Kelemahan dan Potensi Penambahbaikan

Peserta mencatat pengakuan terhadap kelemahan pengetahuan kerjaya serta keperluan untuk menyediakan bahan dan maklumat lebih awal. Penekanan diberikan terhadap pentingnya membuat persediaan rapi sebelum sesi dijalankan.

Tema 2: Komitmen terhadap Peningkatan Profesionalisme

Refleksi menunjukkan peserta mempunyai niat tinggi untuk mengembangkan diri melalui membaca, bincang dengan guru pembimbing, dan pemerhatian ke atas tindak balas murid selama sesi dijalankan.

Dapatan kajian ini mendedahkan bahawa antara cabaran utama yang dihadapi oleh guru internship dalam pelaksanaan kaunseling kerjaya ialah kekurangan pengetahuan berkaitan maklumat kerjaya. Peserta kajian mengakui ketidakmampuan menjawab pertanyaan murid berkaitan beberapa istilah pekerjaan seperti "Juruaudit" dan "Trenkas" dalam Borang Minat Rothwell-Miller. Kekurangan pengetahuan asas ini secara langsung menjejaskan kredibiliti guru internship sebagai fasilitator kaunseling kerjaya dan boleh menimbulkan kekeliruan dalam kalangan murid, sekali gus melemahkan kesan intervensi yang dijalankan. Dapatan ini berselari dengan kajian Mohamad, Khalid dan Sulaiman (2021) yang mendapati bahawa kurang pendedahan terhadap maklumat pasaran kerja semasa ini merupakan salah antara titik halangan utama pelaksanaan kaunseling kerjaya yang efektif di kalangan guru pelatih.

Selain itu, kajian oleh Azhar dan Rahmat (2020) juga melaporkan bahawa kurang sumber rujukan kerjaya terkini menjadikan guru pelatih kurang bersedia apabila berhadapan dengan soalan kritikal oleh pelanggan muda. Namun demikian, penemuan ini berselarasan dengan penemuan Hashim dan Noor (2019) yang mengejanya bahawa guru pelatih boleh menggunakan dan akses maklumat kerjaya dengan berkesan melalui laman rasmi seperti myfuturejobs dan ilmiah.gov, sekaligus mengejanya bahawa efektiviti pelaksanaan merentasi inisiatif individu guru pelatih tersebut sendiri. Melainkan, penggunaan Inventori Minat Kerjaya (IMK) juga telah dikenal pasti sebagai satu penggalak kesukaran.

IMK, walaupun sah dari segi psikometrik, didapati sukar diaplikasikan dalam kalangan murid sekolah rendah disebabkan bilangan soalannya yang banyak dan masa yang panjang diperlukan untuk melengkapkannya. Murid menjadi letih, bosan dan hilang tumpuan, menyebabkan proses penilaian terbantut. Ini disokong oleh kajian oleh Lim dan Ishak (2022) yang melaporkan bahawa instrumen yang terlalu panjang dan bersifat kognitif tinggi tidak sesuai untuk golongan murid rendah, terutamanya jika tidak disediakan dalam bentuk interaktif atau permainan. Dalam usaha menangani cabaran ini, guru internship menunjukkan inisiatif tersendiri dengan mempelbagaikan aktiviti pelaksanaan. Antaranya termasuk penggunaan puzzle kerjaya bergambar dan terapi seni lukisan sebagai aktiviti selingan dalam sesi kaunseling kerjaya. Strategi ini terbukti membantu meningkatkan penglibatan murid dan menjadikan sesi lebih menyeronokkan serta interaktif. Pendekatan ini konsisten dengan model Experiential Learning oleh Kolb (1984), yang menekankan bahawa pembelajaran lebih bermakna apabila murid terlibat secara aktif dalam aktiviti yang bersifat praktikal dan reflektif.

Addition to that, peserta kajian menunjukkan keadaan proaktif dengan membuat pembacaan dan kajian awal tentang maklumat kerjaya sebelum memulakan sesi, sebagai persediaan menghadapi pertanyaan murid. Bahagian usaha ini bukan sahaja menampakkan tahap kesedaran kendiri yang tinggi dalam memperbaiki kelemahan, malahan juga mencerminkan pendekatan reflektif dalam profesion kaunseling seperti yang disarankan oleh Schön (1983). Persadaan tindakan ini menjadi asas penting dalam pembentukan kompetensi profesional yang berterusan dalam kalangan guru pelatih.

Satu lagi strategi yang efektif yang diketahui pasti ialah memberikan masa rehat kepada murid semasa menjawab IMK. Strategi ini, meskipun terdengar sesuatu yang sederhana, menunjukkan pemahaman guru terhadap keperluan psikologi murid serta prinsip pengurusan tingkah laku semasa sesi. Penjadualan semula pentadbiran inventori secara peringkat memungkinkan murid untuk mempertahankan fokus dan motivasi, bersama dengan temuan oleh Wong dan Teoh (2020) yang menemukan bahwa murid menunjukkan prestasi lebih baik dalam ujian psikometrik apabila diberi kesempatan untuk berehat secara sistematik.

Secara keseluruhannya, kajian ini bukan sahaja mendedahkan cabaran yang dihadapi oleh guru internship dalam pelaksanaan kaunseling kerjaya, malah membuktikan bahawa kreativiti, refleksi kendiri dan strategi pedagogi yang berinovatif dapat menjadi faktor mitigasi utama. Walau bagaimanapun, dapatan ini juga menunjukkan keperluan kepada sokongan sistemik yang lebih kukuh — termasuk penambahbaikan dalam latihan prainternship, pengukuhan modul kerjaya dalam kurikulum program pendidikan kaunselor, serta penyediaan instrumen kaunseling yang mesra murid dan kontekstual.

5 KESIMPULAN

Secara keseluruhan, penyelidikan ini telah mengenali secara nyata cabaran utama yang dihadapi oleh guru pelatih Bimbingan dan Kaunseling (B&K) dalam melaksanakan kaunseling kerjaya, iaitu perlibatan murid yang tidak aktif, kemusnahan pengetahuan berkenaan maklumat kerjaya, dan kesulatan dalam melaksanakan ujian minat kerjaya.

Penyelidikan ini juga telah menunjukkan bahawa dengan proses refleksi kendiri, guru pelatih boleh mengenali secara nyata kelemahan dan merangka strategi penambahbaikan berdasarkan pengalaman praktikum mereka (Magnuson & Norem, 2002). Antara inisiatif yang dikenal pasti adalah mempelbagaikan aktiviti sesi, memperbaiki kefahaman terhadap maklumat kerjaya semasa, dan melaksanakan penilaian kerjaya secara berperingkat mengikut kesesuaian murid. Bersama pandangan Lai-Yeung (2014), kemahiran mikro kaunseling seperti komunikasi berkesan, kepekaan interpersonal dan kemahiran kendiri adalah keperluan asas yang perlu dimiliki guru pelatih dalam menghadapi cabaran kerjaya pendidikan masa kini. Dapatan kajian ini bukan hanya berkaitan dengan konteks pendidikan di Malaysia, malah cerminkan isu global dalam latihan kaunselor pelatih, khususnya menyediakan diri terhadap realiti dinamik dunia pekerjaan. Di era ketidakpastian kerjaya yang semakin kompleks serta teknologi yang berkembang pesat, kajian ini menyerlahkan keperluan mendesak untuk memperkukuh latihan kaunseling kerjaya di peringkat global, selaras dengan misi pendidikan abad ke-21. Sebagai pengukuhan kepada dapatan kajian ini, pengkaji mencadangkan beberapa langkah berikut untuk kajian akan datang:

Fokus mendalam terhadap program kerjaya – Kajian lanjutan boleh memberi penekanan khusus terhadap cabaran guru internship B&K dalam merancang dan melaksanakan keseluruhan program kerjaya secara holistik di sekolah. Penglibatan berbagai etnik peserta – Artikel ini boleh dipanjang untuk melibatkan lebih ramai guru internship B&K daripada latar belakang berbeza-beza etnik (Melayu, Cina, India, etc.), untuk merentas kawasan pendekatan perspektif perbezaan dan kaedah budaya di dalam menjalankan kaunseling kerjaya. Penambah saiz sampel – Pengajian masa hadapan sepatah lagi mestilah melibatkan lebih ramai peserta agar memperoleh generalisasi lebih besar dan bersistem. Penerokaan aspek etika dan sikap – Pembabitannya berperangkap terhadap etika, nilai yang diamalkan dan profesionalisme sikap guru pelatih semasa melaksana internship juga harus diberi perhatian sebagai perkembangan tanda keberkesanan latihan dan kualiti melaksana kaunseling kerjaya. Kajian ini bukan hanya berkontribusi terhadap peningkatan mutu latihan guru B&K Malaysia, tetapi juga berpotensi sebagai landasan penambahbaikan kurikulum latihan kaunselor pelatih pada peringkat serantau. Dalam konteks pemahaman pendidikan antarabangsa yang semakin menuntut kecemerlangan sokongan psikososial dan kaunseling berdasarkan kerjaya, kajian ini berisiko memberikan suara penting terhadap keperluan menghasilkan kaunselor pelatih yang bersedia, reflektif, dan kompeten untuk menghadapi kesulitan masa depan pendidikan dan pembangunan murid.

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The Insight of Trainee Teachers on The Usage of Cognitive-Based Assessments on Second Language Learning

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ABSTRACT

This research explores the insights of TESL trainee teachers on the implementation and effectiveness of cognitive-based assessments in second language learning. It focuses on how these assessments are utilized during their practicum to enhance students' cognitive skills. Grounded in Bloom's Taxonomy and Piaget's theory of cognitive development, the study employs a qualitative research design involving thematic analysis of interviews with 10 TESL trainee teachers who completed their practicum. The findings reveal the significant role of differentiated teaching strategies, interactive and contextualized assessments, and collaborative feedback mechanisms in fostering higher-order thinking skills (HOTS) among second language learners. Trainee teachers highlighted the importance of activities such as diagnostic tests, KWL charts, and task-based projects in promoting critical thinking and problem-solving. Furthermore, the study underscores challenges in implementing cognitive-based assessments, including limited resources and the need for teacher training. These insights provide valuable implications for improving assessment practices, aligning them with Malaysia's educational goals and Sustainable Development Goal 4 (SDG 4). The research emphasizes the need for professional development and innovative strategies to prepare future educators to create dynamic learning environments that support cognitive development in second language learners.

KEYWORDS: Cognitive-based assessment, second language learning, Bloom's Taxonomy, Piaget's theory, TESL trainee teachers, higher-order thinking skills, formative assessment, qualitative research

1 INTRODUCTION

In today's educational system, there's a clear imbalance in how much importance is placed on exam questions, with a heavy focus on rote memorization of facts and definitions. This method often neglects the assessment of critical cognitive skills like analysis, synthesis, and problem-solving. As a result, students may complete their education without fully developing the skills needed to apply their knowledge in real-world

situations. This research aims to explore the consequences of this overemphasis on memorization in exams and propose strategies to bring balance back to assessments, fostering the development of higher-order thinking skills. By addressing this issue, the study seeks to enhance educational assessment practices, better preparing students for the complexities of the modern world. The next generation represents our future leaders, but true leadership requires individuals with deep intellect and knowledge. To achieve this, the educational system must evolve to meet the demands of a changing world. Therefore, classroom instruction needs to shift its focus toward developing cognitive skills. A study by Sepúlveda et al. (2020) on "Cognitive dimensions in the evaluation processes of pedagogy degrees" found that the most common dimension—remembering information—accounted for 55.8% of exam questions. In contrast, higher-level dimensions (like application, analysis, evaluation, and creation) were present in only 16.6% of the questions. This indicates that educators primarily teach basic skills to students in pedagogy degrees. Macgilchrist (2024) argues that a central goal of education is to help students engage with their community's cultural memory, which involves discerning what is worth remembering and understanding the consequences of these choices. This underscores the need to shift classroom instruction toward High-Order Thinking Skills (HOTS), helping students develop cognitive abilities through the use of cognitive-based assessments. For example, Jang (2017) suggests that teachers can use activities like reading comprehension to evaluate how students construct meaning from text by analyzing their eye movements and thought processes. This approach is supported by subsequent research by Xing and Yuen (2023), which shows that students who learn content through an additional language perform well in activities designed as cognitive-based assessments, demonstrating positive outcomes in skill development. The main purpose of this study is to investigate the insight of trainee teachers on the usage of cognitive-based assessments on second language learning. This study is conducted to fulfil the following objective.

To investigate the types of cognitive-based assessments implemented by trainee teachers during their practicum with school students.

2 LITERATURE REVIEW

Cognitive skills are crucial in enhancing the thinking abilities of TESL trainee teachers, especially when critical thinking is essential for their assessments, such as the final year project (FYP). In particular, these skills are vital for analysis and research, helping trainee teachers navigate their studies effectively. Furthermore, cognitive skills not only meet academic requirements but also enhance information processing speed, allowing them to absorb and process information swiftly. This capability enables TESL trainee teachers to adapt to various teaching environments and foster creative thinking. In the TESL context, creative thinking is especially important. TESL trainee teachers need to apply creative thinking in their classrooms to generate unique ideas, tackle challenges from different angles, and engage in innovative problem-solving. The current study, therefore, aims to explore TESL trainee teachers' knowledge of creative thinking and the activities they use to develop these skills (Saleem Masadeh, 2021). By nurturing creative thinking, TESL trainee teachers are better prepared to meet the dynamic demands of the teaching profession and enhance the cognitive skills of their future students through engaging classroom activities. Moreover, cognitive skills are fundamental for second language learners to master their target language. These skills encompass functions such as thinking, reading, learning, remembering, reasoning, and attention (Mind Matters, 2018). As noted by Coursera (2023), cognitive skills support thought processes, attention, information processing, and memory retention, which are vital for future learning, especially in English-speaking academic settings. In this regard, cognitive-based assessment methods, also known as scaffolding, provide essential support to learners by gradually reducing assistance as they become more proficient (Main, 2021). Therefore, selecting appropriate cognitive-based assessments is crucial for TESL trainee teachers to effectively teach and evaluate their students. Research by Randy E. Bennett (2010) highlights the importance of cognitively based assessments (CBAL). According to Bennett, CBAL assessments not only evaluate what students know but also help teachers improve their teaching practices and enhance the learning experience. These assessments are designed to align with students' learning goals and support their growth, identifying areas where students may need additional help and making the learning process more effective and

meaningful. This underscores the significance of cognitive-based assessments in developing TESL trainee teachers' language skills and cognitive abilities.

2.1 Teaching Theories in Second Language Learning

Bloom's Taxonomy and Jean Piaget's theory of cognitive development are fundamental to this research on second language learning. Bloom's Taxonomy categorizes cognitive skills from lower-order to higher-order thinking (Shabatura, 2022), guiding educators in designing assessments that address various cognitive levels. For example, quizzes may assess recall, while projects and essays gauge higher-order skills like analysis and creation. Past research, such as Mathews Nkhoma, TRI K LAM, Joan Richardson, Booi H Kam and Kwok Hung Lau study on Bloom's Taxonomy (2016), highlights its practical application in developing comprehensive educational activities. Complementing this, Piaget's theory of cognitive development outlines four stages: sensorimotor, preoperational, concrete operational, and formal operational (Cherry, 2023). This theory emphasizes that cognitive abilities evolve through these stages, influencing how students engage with assessments. For instance, younger students benefit from visual aids, while older students can handle abstract reasoning tasks. This perspective ensures assessments are developmentally appropriate and tailored to students' cognitive stages. Together, Bloom's Taxonomy provides a framework for assessing various cognitive skills, while Piaget's theory offers insights into developmental appropriateness. This combination helps in designing and evaluating assessments that align with students' cognitive abilities, ultimately supporting effective learning and teaching strategies.

3 METHODOLOGY

For this research, a qualitative research design is employed. Qualitative research involves gathering and analysing non-numerical data to gain insights into participants' experiences, perspectives, and understanding. It is particularly useful for exploring complex phenomena, understanding patterns, and obtaining in-depth feedback. The research problem involves examining the types of assessments implemented by trainee teachers during their practicum with school students. This requires detailed feedback from participants about their experiences regarding the enhancement of cognitive skills through different types of cognitive-based assessments. In this research, the target population of the current research are 10 participants, in which were selected from the TESL program at UPTM who have completed their practicum to be in the interview. Criteria of the participants are being carefully selected as they need to have already gone for practicum and finished the practicum. The participants are also selected among the UPTM TESL students in both diploma and degree with a deeper insight on the type of assessments that are being done towards different ages of the students. Lastly, the participants are also being selected by suggestions of lecturer and past participants in other ways, snowball method.

3.1 Data Collection

Interviews were conducted through Google Meet, using open-ended questions to encourage detailed responses. This online platform was chosen to facilitate convenient access, allowing participants to respond from any location without the need for physical attendance. As a result, the researcher could efficiently collect data while ensuring accessibility for all participants. Additionally, the interviews were conducted over two weeks, primarily in the evening and at night, to accommodate participants' schedules, as some were occupied with work during the day and others had ongoing classes. The interview questions were adapted from Eltanahy (2017), that focuses on investigating the types of assessments implemented by trainee teachers during their practicum with school students.

3.2 Data Analysis

The data analysis methods used in this research are divided into several key steps. The process begins with collecting detailed responses, followed by familiarisation with the data through careful reading. During this stage, the researcher takes notes, paying particular attention to recurring words or phrases that appear frequently across responses. Next, the data is coded. In this step, the researcher uses qualitative analysis software, such as Atlas.ti, to organise and analyse the data. This allows for a clearer view of the themes emerging from the responses, facilitating a thorough thematic analysis.

4 RESULT AND FINDINGS

4.1 Differentiated and Adaptive Teaching Strategies

Following the thematic analysis, the central theme identified from both parts of the interview is "differentiated and adaptive teaching strategies." This theme captures how trainee teachers modify their teaching and assessment methods to meet diverse student needs. For example, they may create multiple versions of tasks or worksheets to support different skill levels, such as using distinct worksheets for advanced and beginner students. Teachers also adapt their approaches based on assessment data, allowing them to address specific student strengths and weaknesses. This includes simplifying instructions or adjusting delivery to accommodate various levels of understanding within linguistically diverse classrooms. In addition, scaffolding techniques help gradually foster students' independence in learning, particularly when comprehending complex tasks. These findings align with Bloom's Taxonomy and Piaget's Theory, as discussed in Chapter 2. These theories emphasize the importance of tailoring instruction based on cognitive levels, supporting differentiated teaching strategies by addressing various stages of cognitive development (Shabatura, 2022; Cherry, 2023). Additionally, scaffolding, as noted in Chapter 2, serves as a cognitive-based assessment method that helps teachers gradually reduce assistance as students' skills improve, thereby supporting differentiation in teaching (Main, 2021).

4.2 The Role of Interactive and Contextualized Assessments

The second central theme is the role of interactive and contextualized assessments. This theme emphasizes how assessments can be designed to reflect real-world contexts and actively engage students in their learning process. Based on the findings, diagnostic and pre-lesson assessments such as quizzes, KWL charts, and diagnostic tests play a significant role in this type of assessment. Interviews revealed that teachers used diagnostic tests to identify gaps in grammar and vocabulary, targeting specific areas of weakness. These assessments, along with formative methods like quizzes and reflective journals, provide regular opportunities to monitor comprehension and cognitive progress. Additionally, teachers employed contextualized tools such as role-play, town layouts, and other relatable activities to assess comprehension and application. These tools enable students to learn through play, supporting their attention span and engagement. Furthermore, teachers used hands-on projects, like recycling activities, to help students think critically and apply knowledge practically. These hands-on projects allow students to directly engage with the subject matter, such as experiencing recycling firsthand. Scaffolding assessments also guided students from basic understanding to more complex cognitive tasks, which is essential for developing critical and independent thinking (Main, 2021). According to Patel (2021), as reviewed in this research, cognitive skills developed through interactive assessments are crucial for processing information, problem-solving, and decision-making—all essential in real-world contexts. Additionally, Vani and Naik (2023) highlight listening and speaking skills as integral to cognitive-based assessment, fostering comprehension through contextualized language use.

4.3 Conclusion

In conclusion, this research has highlighted the importance of differentiated and adaptive teaching strategies, interactive and contextualized assessments, and collaborative learning and feedback mechanisms in supporting student learning outcomes. The findings underscore how trainee teachers leverage these strategies to foster cognitive development and critical thinking in second language learning environments. By adapting instructional techniques to meet diverse learning needs, employing assessments that connect to real-world contexts, and promoting collaboration among students, teachers, and parents, educators can significantly enhance both engagement and comprehension (Jones, 2022; Razak et al., 2023).

This study contributes to the field by emphasizing that cognitive-based assessments and differentiated teaching approaches are essential for helping students reach their full potential. Diagnostic tools, scaffolding, and collaborative assessments support students' cognitive progress by providing targeted feedback and fostering an environment that encourages active learning (Srivani & Murugappan, 2023; Bennett, 2010). It also will help them to communicate more efficiently and be able to solve problems and have critical thinking skills in an early age in order to solve problems. These approaches align with foundational theories such as Bloom's Taxonomy and Piaget's Theory, which advocate for the adaptation of instruction to support different stages of cognitive development (Shabatura, 2022; Cherry, 2023).

Overall, this research demonstrates that an integrated approach—where assessments, differentiated instruction, and collaboration work in harmony—can enhance students' cognitive skills, critical thinking, and language comprehension. This approach offers a promising framework for future educational practices and paves the way for further studies to explore its applications across diverse learning contexts (UNESCO, 2023). It is important for future generations to be able to master all the language skills, in which the 4 skills (speaking, listening, reading, and writing), while being able to closely relate what they learn in real-world contexts.

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Bridging Theory and Practice in Control Systems Education: A Multimodal Approach for Enhanced Learning

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ABSTRACT

Traditional lecture-based teaching in Control Systems education often focuses on mathematical derivations, making it difficult for students to grasp conceptual understanding, visualise system behaviour, and apply knowledge to real-world scenarios. This gap limits their ability to design and analyse control systems effectively. This paper introduces a multimodal learning approach that integrates theoretical instruction, visual tools, hands-on experimentation, collaborative problem-solving, and reflective learning to address these challenges. The approach is grounded in established learning style models, including VARK, Kolb's experiential learning and Felder-Silverman's learning styles. The study implemented three case studies within a Control Systems course to evaluate the effectiveness of this approach. Results showed a significant improvement in student comprehension, engagement, and confidence. Post-assessment analysis revealed an 85–88% increase in understanding across various activities and enhanced problem-solving abilities. These findings demonstrate that multimodal strategies bridge the gap between theory and practice, improve learning outcomes, and foster greater student engagement in Control Systems education.

KEYWORDS: Multimodal learning, control systems education, learning style models, hands-on experimentation, pedagogy

1 INTRODUCTION

Traditional teaching methods in engineering education, particularly in control systems courses, often rely heavily on lecture-based instruction, mathematical derivations, and textbook learning. While these methods effectively communicate theoretical concepts, they frequently fall short of engaging students with diverse learning preferences. Many learners struggle to visualize system behaviour, apply abstract ideas, and connect theoretical knowledge to real-world applications. Furthermore, these conventional approaches typically do not emphasize hands-on experimentation, which is crucial for mastering control system design and analysis. This passive learning environment can lead to low retention rates, limited student engagement, and a lack of critical thinking skills. Consequently, students may memorize formulas yet struggle to apply control techniques in practical scenarios, leaving them ill-prepared for industry challenges.

To address these limitations, the multimodal learning approach has emerged as a viable solution for teaching control systems. By integrating visual aids, interactive simulations, hands-on experimentation, and collaborative problem-solving, multimodal learning accommodates a range of cognitive preferences. Learning style models, such as VARK, Kolb's Experiential Learning, Felder-Silverman, Honey & Mumford, and Gregorc's Model, highlight the importance of engaging students through multiple sensory modalities and active learning techniques. This approach effectively bridges the gap between theory and practice, enhancing conceptual understanding and improving knowledge retention. Moreover, multimodal learning promotes student engagement and fosters the development of essential skills such as critical thinking, teamwork, and problem-solving, which are vital for future engineering professionals.

Several studies support the effectiveness of multimodal learning in engineering education. El-Saftawy et al., 2024 have found that applying VARK learning styles significantly enhanced students' comprehension and engagement. Conceptual mapping, aligned with learning styles, outperformed traditional lectures in knowledge retention (Amaniyan et al., 2020). (Idkhan & Idris, 2021) highlighted that Kolb's learning cycle improved student performance by integrating theory and active experimentation. The Felder-Silverman model's role in personalised learning shows that students learn better when teaching methods align with their preferences (Nafea et al., 2019). The importance of learning style frameworks in STEM education has been concluded, and a diverse approach enhances theoretical and applied learning outcomes (Childs-Kean et al., n.d.).

Motivated by the above, this paper proposes a multimodal learning framework integrating diverse instructional strategies for effective Control Systems education.

2 LEARNING STYLES

This section offers an overview of three learning styles that classify individual learning preferences. It also presents key components of each model and its implications for effective teaching and learning.

2.1 VARK Learning Style

The VARK learning style model shown in Fig. 1 identifies individual learning preferences based on four primary sensory modalities (El-Saftawy et al., 2024), which are defined as follows:

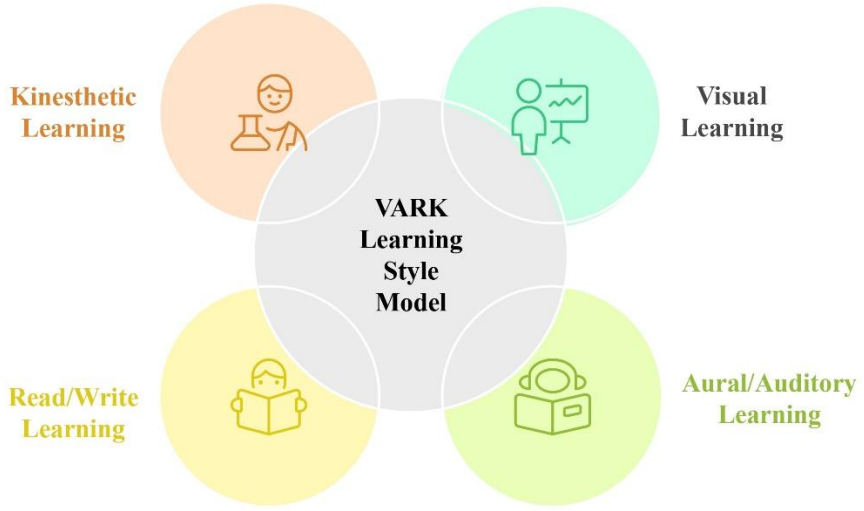


Figure 1: Framework of VARK Learning Style

- Visual (V): Learners prefer understanding concepts using images, videos, and animations. They learn best when information is presented visually.
- Aural/Auditory (A): Learners absorb information best through listening, so they prefer lectures, discussions, and verbal explanations.

- Read/Write (R): Learners learn best through reading and writing. So, they prefer text-based materials like books, lecture notes, and written instructions.
- Kinesthetic (K): Learners retain information best through hands-on experiences and physical activities. So, they prefer practical demonstrations, experiments and real-world examples.

2.2 Kolb's Learning Style

Kolb's learning style model explains how individuals learn from their experiences. It is based on Kolb's experiential learning, which suggests that learning is an ongoing process that consists of four distinct stages, as shown in Fig. 2 (Idkhan & Idris, 2021). Kolb proposed that effective learning occurs when a person progresses through the following stages:

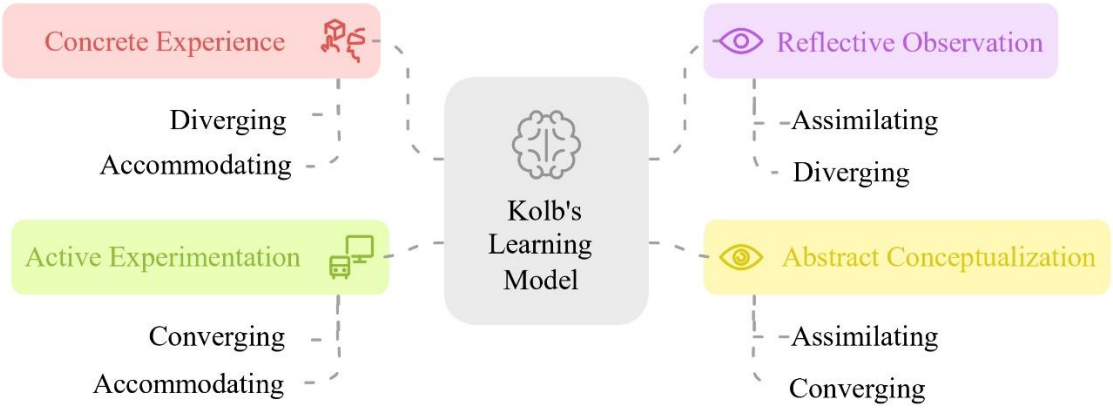


Figure 2: Framework of Kolb's Learning Style

- Concrete Experience (CE): Learning through direct experiences, hands-on activities, or real-world engagement.
- Reflective Observation (RO): Learning through analysing and thinking about the experience from various perspectives.
- Abstract Conceptualisation (AC): Learning through developing theories, concepts, or models based on those reflections.
- Active Experimentation (AE): Learning through applying the learned material to observe the outcomes in new situations.

Based on how individuals prefer to engage with the learning cycle, Kolb's model identified four learning styles:

- Diverging (CE + RO): Imaginative, emotional, and people-oriented individuals enjoy brainstorming, exploring different perspectives, and working in groups.
- Assimilating (RO + AC): Logical, analytical, and detail-oriented individuals prefer structured learning, theories, and abstract concepts.
- Converging (AC + AE): Problem-solvers who are practical and hands-on learners enjoy applying theories to real-world situations and solving technical problems.
- Accommodating (AE + CE): Action-oriented, intuitive, and adaptable individuals who learn best through trial-and-error, hands-on experiences, and gut feelings.

2.3 Felder-Silverman Learning Style

The Felder-Silverman learning style model describes how learners prefer to learn in an academic setting, particularly in engineering and science education. This model classifies learners along four dimensions, each representing a spectrum of learning preferences, as shown in Fig. 3 (Nafea et al., 2019).

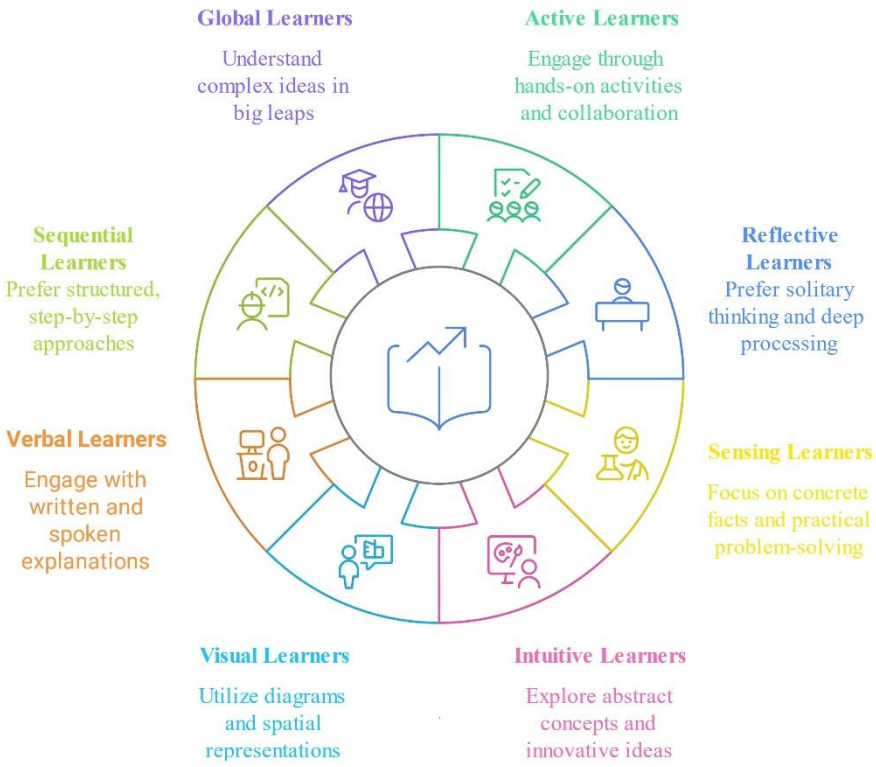


Figure 3: Framework of Felder-Silverman Learning Style

The four dimensions of the Felder-Silverman learning style model are given as

5) Processing: Active vs. Reflective
   - Active: Learners prefer learning through hands-on activities, discussions, and collaboration.
   - Reflective: Learners prefer thinking deeply about concepts before acting, often working alone or taking time to process information.
6) Perception: Sensing vs. Intuitive
   - Sensing: Learners prefer concrete facts, real-world applications, and practical problem-solving.
   - Intuitive: Learners prefer abstract concepts, theories, and discovering patterns.
7) Input: Visual vs. Verbal
   - Visual: Learning through diagrams, images and videos.
   - Verbal: Learners prefer written and spoken explanations, such as reading textbooks, listening to lectures, or engaging in discussions.
8) Understanding: Sequential vs. Global
   - Sequential: Learners prefer logical, step-by-step learning. Need a structured approach to grasp concepts.
   - Global: Learners learn in big leaps, often struggling with step-by-step explanations but understanding complex ideas simultaneously.

3 MULTIMODAL LEARNING APPROACH

This section proposes two multimodal learning activities that integrate multiple learning style models given in Section 2 to enhance learners' understanding of “Control Systems.”

3.1 Activity 1

This activity focuses on an Interactive Workshop on PID Controller Tuning. The main objective is to introduce learners to the Proportional-Integral-Derivative (PID) controller, one of the most widely used control techniques. This activity provides learners hands-on experience tuning PID parameters and understanding their impact on system behaviour. In a conventional approach, PID control is often taught using mathematical derivations alone, making it difficult for learners to understand how tuning parameters affect system behaviour. Without hands-on experience, learners may memorise formulas but struggle to apply PID tuning principles in the real world.

To accommodate various learning styles, this proposed activity integrates multiple learning methods, as follows:

6) Theoretical Foundation (*Felder-Silverman - Sequential Learners, Kolb - Abstract Conceptualization, VARK - Reading/Writing Learners*)
   PID control theory involves a mathematical framework widely used in various industries. It provides a strong conceptual foundation through structured lecture material and written explanations for learners who prefer a logical, step-by-step approach.
7) Visual Learning (*VARK - Visual Learners, Felder-Silverman - Visual Learners*)
   Graphical representations like step response plots and block diagrams help visualise system behaviour. Additionally, animated simulations visualising various parameters' impacts could further enhance conceptual understanding.
8) Hands-on Experimentation (*Kolb - Active Experimentation, Felder-Silverman - Sensing Learners, VARK - Kinesthetic Learners*)
   Learners participate in PID tuning exercises using MATLAB/Simulink simulations. This hands-on experience helps reinforce theoretical concepts through direct application.
9) Collaborative Learning (*Felder-Silverman - Active Learners, Kolb - Concrete Experience*)
   Group discussions and teamwork enable learners to analyse various PID tuning strategies and their effectiveness. This peer-to-peer interaction fosters active engagement and encourages diverse approaches to problem-solving.
10) Reflective Learning (*Kolb - Reflective Observation, Felder-Silverman - Reflective Learners*)
   Learners reflect on their activities by analysing the impact of changes in PID parameters on system behaviour. At the same time, structured self-assessment questions promote deep learning and critical thinking.

This proposed activity will enhance the learners' theoretical and practical understanding of PID controllers. It will also enhance their ability to analyse system responses and adjust parameters for improved performance, strengthening their problem-solving and teamwork skills.

3.2 Activity 2

Similarly, this activity focuses on a Case Study of Control System Failures. This activity bridges the gap between control system theory and real-world applications by analysing engineering failures caused by control system malfunctions. Many learners perceive control systems as theoretical, with little exposure to practical challenges. Traditional teaching methods often focus on mathematical derivations rather than emphasising problem-solving and critical thinking, which are crucial for diagnosing and preventing failures. To address this gap, the proposed learning activity is structured as follows:

4) Case Study Analysis (*Kolb - Reflective Observation, Felder-Silverman - Global Learners*)
   Learners explore real-world failures in control systems, like aircraft autopilot malfunctions and unstable power grids. This hands-on approach enhances their understanding of the practical implications of control system design and stability.
5) Collaborative Problem-Solving (*Felder-Silverman - Active Learners, Kolb - Active Experimentation*)

Teams evaluate failure cases while proposing corrective measures and alternative control strategies. This process encourages brainstorming and discussions, which enhance critical thinking and practical problem-solving skills.

6) Presentation & Report Writing (*VARK - Reading/Writing Learners, Felder-Silverman - Verbal Learners*)

Learners present their case study analysis and proposed solutions in a structured format, enhancing their technical communication skills through written reports. Verbal presentations also cater to auditory and verbal learners.

The proposed activity will enhance critical thinking and problem-solving skills and the ability to apply control system concepts to real-world engineering challenges.

4 CASE STUDIES

This section presents two case studies conducted with 45 undergraduate students in an "EFB3023 - Control Systems" engineering course taught to Bachelor of Electrical and Electronics Engineering with Honours students at Universiti Teknologi PETRONAS to assess the effectiveness of the proposed multimodal learning activities. All the case studies have been evaluated using pre- and post-activity assessments, learner surveys, project evaluations, and observational analysis. Pre-tests were administered before each activity to assess learners' baseline knowledge. Post-tests were conducted afterwards to measure learning improvement. Learner surveys are conducted to evaluate the different learning methods and open-ended feedback to gather insights on challenges, engagement levels, and areas for improvement. Group project evaluations have been conducted with faculty members assessing their presentations based on a structured rubric considering technical accuracy, problem-solving skills, collaboration, and communication. Further, an instructor conducted an observational analysis to monitor learner engagement and problem-solving strategies during activities.

4.1 Case Study 1

This case study assesses the impact of multimodal teaching strategies on students' understanding of PID controllers, focusing on how theoretical instruction, visual tools, hands-on experimentation, and collaboration enhance learning. Activity 1, given in Section 3.1, was implemented in four steps. First, students were randomly grouped into small teams and provided with MATLAB/Simulink for hands-on learning of PID control. Next, a pre-assessment measured their knowledge and confidence in PID theory and tuning methods. The third step involved a multimodal learning approach, combining lectures, visuals, experiments, and discussions. Finally, a post-assessment measured knowledge improvements and confidence in applying PID tuning alongside a feedback questionnaire to gather insights on engagement and challenges faced during the activity.

The case study results in Table 1 indicate significant improvement in students' understanding and confidence in PID controller tuning. Post-tests revealed that 85% of students showed improved comprehension, while 90% preferred hands-on experimentation in MATLAB/Simulink over traditional lectures. Additionally, 80% reported increased confidence in adjusting PID parameters for system stability. Qualitative feedback highlighted the value of interactive simulations and hardware testing, reinforcing theoretical concepts and demonstrating the effectiveness of multimodal learning strategies in control systems education.

Table 1 Summary of Case Study Results for Multimodal Learning Activities

Assessment Criteria	Activity 1	Activity 2
Improvement in Test Scores	85% of students improved post-test scores	82% of students showed a better understanding of real-world failures
Increase in Confidence	80% felt more confident in PID tuning	86% felt more prepared to analyze and prevent failures
Effectiveness of Hands-on Learning	90% found MATLAB/Simulink experimentation beneficial	78% appreciated case-based problem-solving

Engagement & Participation	88% reported high engagement in group discussions	92% actively participated in the case study analysis
Qualitative Feedback	Interactive tuning helped visualize theoretical concepts	Real-world relevance made learning more meaningful

4.2 Case Study 2

This case study evaluates the effectiveness of multimodal learning strategies in enhancing students' ability to apply theoretical control system concepts to real-world failures. The study focuses on how case-based analysis, collaborative problem-solving, and structured technical communication improve critical thinking and practical application skills. Activity 2, given in Section 3.2, was implemented in four steps. First, students were introduced to three real-world control system failures: the Boeing 737 MAX autopilot failure, the 2003 North American blackout, and a failed industrial process control system. Next, teams conducted an in-depth analysis of the failures, identifying control system deficiencies and their root causes. In the third step, students collaborated to propose corrective measures and alternative control strategies, preparing group presentations and technical reports. Finally, assessments were conducted through group presentations and individual reports, evaluating their critical thinking, technical communication, and problem-solving abilities.

The case study results in Table 1 highlight the strong impact of real-world problem-based learning. 92% of students reported that analysing real-world failures helped them bridge the gap between theory and practical applications. 85% of students demonstrated improved problem-solving skills, particularly in diagnosing failures and formulating corrective strategies. Additionally, 78% of students indicated that presenting their findings improved their ability to communicate technical concepts effectively. Qualitative feedback emphasised that case-based learning enhanced engagement and provided a deeper understanding of control system challenges beyond theoretical instruction.

5 CONCLUSIONS

This study highlights the effectiveness of multimodal learning strategies in enhancing students' understanding of control systems through activities focused on PID controller tuning and case studies of control system failures. Traditional teaching methods often emphasise theoretical derivations, which can hinder practical application. The approach engages students with various cognitive preferences by integrating diverse learning models such as VARK and Kolb's Experiential Learning. The findings reveal a significant improvement in comprehension by 85-88%, with students expressing increased confidence in applying control system concepts. Hands-on activities, interactive simulations, and collaborative problem-solving were particularly effective. Additionally, qualitative feedback showed that students valued the material's real-world relevance and found visual tools essential for learning. In conclusion, a multimodal approach enhances conceptual understanding, problem-solving skills, and student engagement. Future research could explore its scalability across other engineering disciplines and its effects on long-term knowledge retention.

6 ACKNOWLEDGEMENTS

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Evaluating the Effectiveness of Scrum-Based Learning in Engineering Education Via Gibbs' Reflective Cycle

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ABSTRACT

This study evaluates the effectiveness of Scrum-based learning in engineering education for undergraduate program level through a structured workshop and participant feedback analysis. The data collected from an end-of-workshop survey highlights student perceptions, knowledge acquisition, and the applicability of Scrum methodologies in engineering projects. Using Gibbs' Reflective Cycle, the study critically analyses the learning experience by examining student engagement, teamwork, challenges, and areas for improvement. Findings suggest that while Scrum enhances collaboration and problem-solving, refinements in workshop structure and instructional clarity could further optimize learning outcomes.

KEYWORDS: Engineering Education, Scrum, Agile Learning, Project-Based Learning, Student Feedback, Gibbs' Reflective Cycle

1 INTRODUCTION

Engineering education must continually evolve to incorporate industry-relevant methodologies. However, traditional teaching methods are no longer able to provide students with the necessary skills for collaborative problem-solving, adaptability, and iterative project execution to prepare them for the fast-changing industry world. The engineering profession demands a shift from traditional pedagogy towards an active, collaborative, and project-based learning approach. This gap highlights the need for innovative educational strategies that enhance student engagement and practical knowledge application. Agile methodologies, specifically Scrum, have gained traction in project-based learning. It has emerged as a potential solution to bridge this gap by promoting teamwork, continuous feedback, iterative progress, adaptability, and structured project execution (Mishra, 2024).

Scrum has several core components to function, which are roles, events, and artifacts. There are three roles under Scrum: Scrum Master, Product Owner, and Development Team, as illustrated in Figure 1. Another important role is the stakeholders, who will define the user stories. Scrum Master facilitates the Scrum process and ensures the team follows Scrum principles and practices. Product Owner manages product backlog while the Development Team is cross-functional, self-organizing team meant to deliver the product increments during each sprint. Scrum has a collection of events which support the principle, the first is sprint planning, whereby the team plans the work to be performed during the sprint. A sprint is a small collection of tasks. Second, daily scrum is a short meeting to synchronize activities and create a plan for the next 24 hours. Third, the sprint review is an event where the team presents the product increment to stakeholders and discusses feedback. Fourth, the sprint retrospective, the team reflects on the past sprint to identify improvements for the next sprint. Scrum uses several artifacts to record the planned tasks, progress, and improvements. The product backlog lists everything needed in the product. The sprint backlog lists a set of product backlog items and a plan to deliver the tasks. Increment sums up all product backlog items completed during a sprint and the value of increments of all previous sprints.

Despite its growing adoption in education field, there is limited empirical evidence on its effectiveness in engineering education. This study aims to evaluate the impact of Scrum-based learning through student feedback, knowledge acquisition assessments, and perceptions of future applicability in engineering projects. It assesses the impact of a Scrum-based learning approach in an engineering workshop setting.

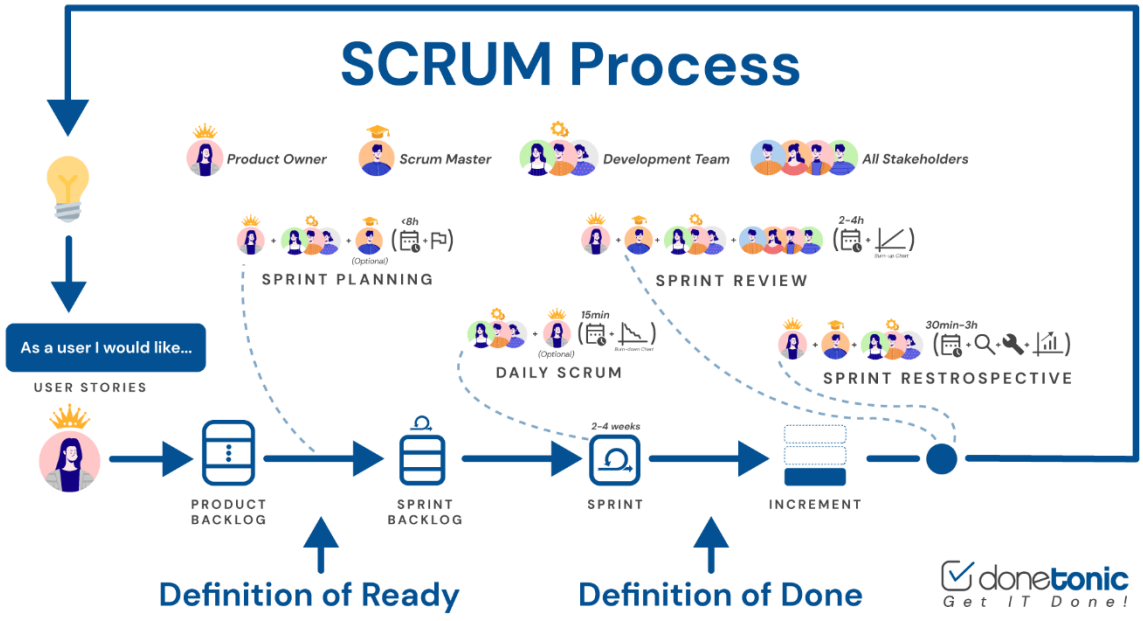


Figure 1. Scrum Process, extracted from [Donetonic, 2022]

To systematically analyse student reflections and experiences, this study employs Gibbs' Reflective Cycle (Gibbs, 1988) as a structured framework. Gibbs' Reflective Cycle (GRC) is a widely used model for experiential learning, which facilitates critical reflection through six key stages: Description, Feelings, Evaluation, Analysis, Conclusion, and Action Plan, as shown in Figure 2.

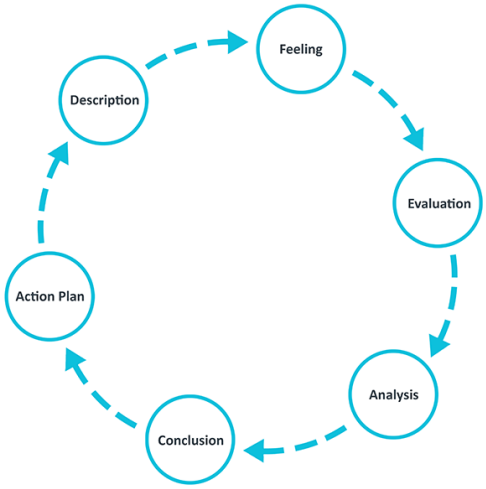


Figure 2. Gibbs' Reflective Cycle.

The description stage details the event or experience, while the feelings stage explores the personal emotions and thoughts during the event or experience. During the evaluation stage, an assessment of whether a positive or negative experience is explored. Understanding why things happened in a certain way is explored during the analysis stage. Within the conclusion stage, what can be done differently will be discussed, and finally, at the action plan stage, certain steps shall be planned for future similar situations for both preventive and corrective action (Ahmadpour, 2025). By applying this cycle, the study examines not only what students learned but also their engagement levels, teamwork experiences, challenges faced, and areas for future improvement. This approach allows for a deeper understanding of how Scrum methodologies influence student learning and provides actionable insights for refining engineering education practices.

2 METHODOLOGY

The study was conducted through a structured workshop in an undergraduate-level course named Engineering Team Project (ETP), designed to integrate Scrum practices into engineering education. The workshop lasted two hours and involved 460 undergraduate engineering students, who were divided into groups of five members. The group composition was carefully structured to ensure diversity in terms of engineering programs, gender, and nationalities. Each group was assigned one lecturer as a coach to facilitate discussions, provide feedback, and guide students through Scrum-based project tasks. The six undergraduate engineering programs involved were Chemical Engineering, Civil Engineering, Electrical and Electronic Engineering, Computer Engineering, Mechanical Engineering, and Petroleum Engineering. Participants were evaluated through quizzes and a survey questionnaire at the end of the workshop session that captured their understanding, perceived knowledge gains, and future applicability of Scrum principles. The methodology flowchart of the Scrum-based learning into engineering education via workshop activity is shown in Figure 3.

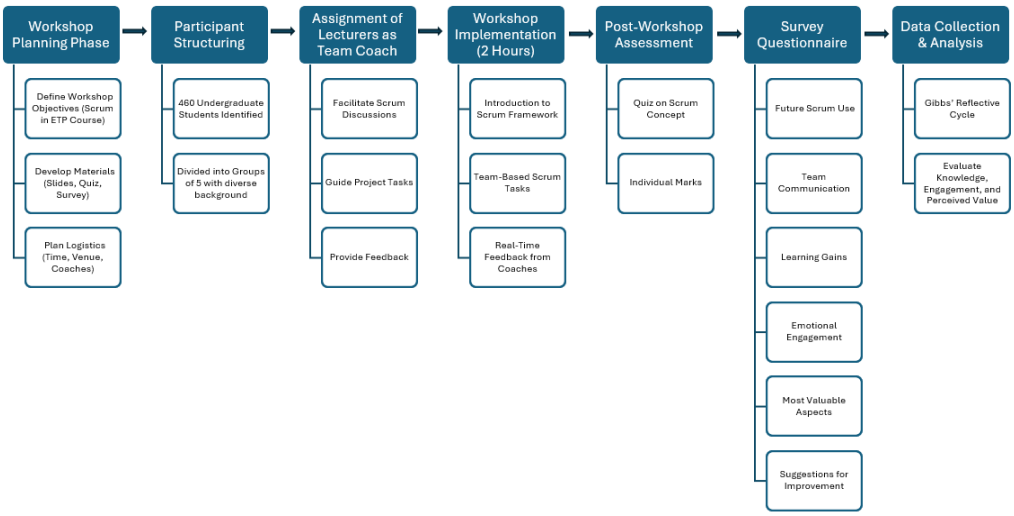


Figure 3. Scrum-Based Learning in Engineering Education via Workshop Activity

The quiz was designed to test students' comprehension of fundamental Scrum concepts. It consisted of five multiple-choice questions, each focusing on a key aspect of Scrum: Identification of key Scrum artifacts, understanding the output of a Sprint, purpose of the Daily Stand-up, role of the Sprint Retrospective, and differences between the Sprint Backlog and Product Backlog. Meanwhile, the survey questionnaire was structured to capture participants' perspectives on the workshop experience and their level of engagement. It included Likert-scale questions measuring the likelihood of applying Scrum principles in future projects; questions on team collaboration, evaluating effectiveness in communication and teamwork; perceptions of learning gain, assessing how well the workshop improved their understanding of Scrum; emotional engagement questions, measuring participants' feelings before, during, and after the session; and open-ended questions on the most valuable aspects of the workshop and areas for improvement. The structured feedback mechanism such as quiz and questionnaire allowed for a comprehensive assessment of how effectively students grasped and applied Scrum methodologies in an engineering context.

Gibbs' Reflective Cycle can be a valuable framework in analysing the qualitative data from the Scrum workshop study. The model encourages a structured process of reflection through six stages: Description, Feelings, Evaluation, Analysis, Conclusion, and Action Plan. Applying this cycle helps researchers deeply interpret the subjective experiences of participants by not only examining what happened during the workshop (Description) and how students felt about it (Feelings), but also by critically evaluating what worked well and what didn't (Evaluation).

3 RESULTS AND DISCUSSION

3.1 Reflection on Knowledge Acquisition

Beginning with the first stage of Gibbs' Reflective Cycle description of the students' learning outcomes, where the workshop included a quiz assessing Scrum artifacts such as the Product Backlog and Sprint Backlog, data analysis shows that 98.7% of students correctly identified key Scrum artifacts; 94.6% correctly answered the question on Sprint outputs; 96.7% understood the purpose of the Daily Stand-up; 96.5% demonstrated knowledge of the Sprint Retrospective; and 98.9% correctly distinguished between the Sprint and Product Backlog.

From GRC's Evaluation Stage standpoint, these results indicate a strong grasp of Scrum principles among participants, confirming the workshop's effectiveness in knowledge transmission. GRC's Analysis Stage suggests that the high retention rates may be attributed to the interactive nature of the learning process, where students engaged in discussions and practical activities rather than passive lecture-based learning.

3.2 Teamwork and Collaboration

In terms of teamwork, **74.6%** of students rated their collaboration as highly effective (5/5), and **22.8%** rated it at 4/5. Reflecting on GRC's Feeling Stage, the results suggested that students believed that structured teamwork within diverse groups allowed for effective task delegation and problem-solving. The GRC evaluation suggests that the combination of team diversity and coaching support created a positive learning environment. Using GRC, analysis of the lower-rated responses indicates that while most teams adapted well, some experienced minor challenges such as uneven participation among the team members, role ambiguity or minor communication gaps within their teams.

3.3 Engagement and Learning Experience

Applying Gibbs' Reflective Cycle, the evaluation shows that engagement increased significantly as students became more familiar with the workshop structure. 55.7% of participants started the session feeling excited and eager to learn while 40.0% felt neutral at the beginning. Participant engagement evolved throughout the workshop where 75.0% became more engaged as the workshop progressed, as shown in Figure 4.

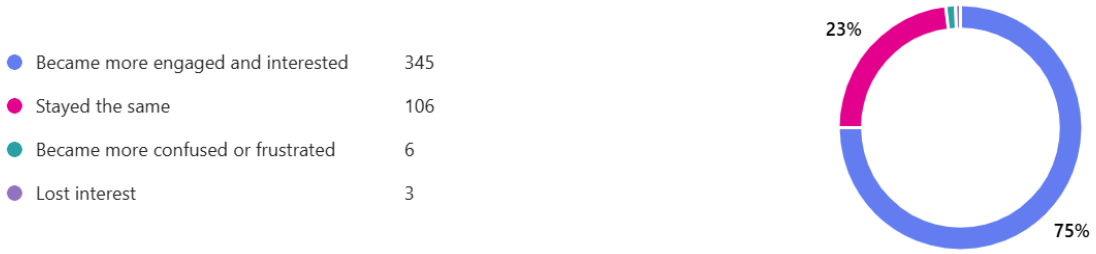


Figure 4. Engagement and Learning Experience

The GRC analysis suggests that initial neutrality could be attributed to uncertainty about Scrum concepts, but as students actively participated in team exercises, engagement levels rose. The action plan for future workshops could include pre-session icebreakers to boost initial enthusiasm.

3.4 Challenges and Areas for Improvement

While most feedback was positive, some challenges were identified as shown in Figure 5 where 41.3% of participants found everything to be good with no major issues, 29% noted limited time for activities, 24.3% felt instructions could have been clearer, and 5.4% mentioned a lack of engagement from certain team members.

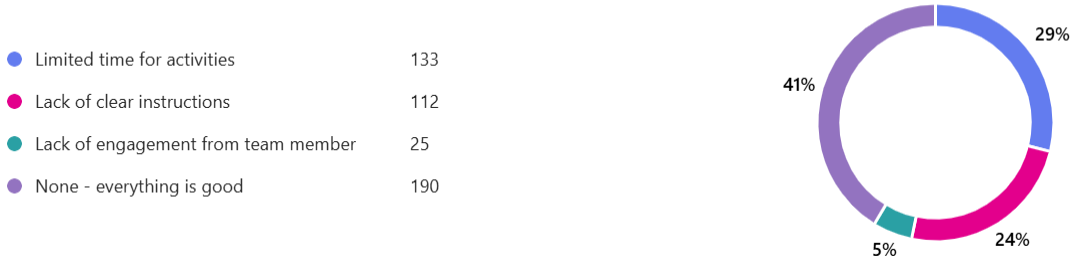


Figure 5. Identified Challenges

From the GRC reflection perspective, students appreciated the workshop but identified time constraints and clarity of instructions as key areas for improvement. GRC evaluation indicates that limited time restricted deeper discussions and iterative refinements in Scrum-based projects. Through GRC analysis, it is suggested that a slightly extended session or pre-session materials could help address these issues. The action plan involves refining instructional materials and ensuring sufficient time for hands-on activities.

3.5 Suggestions for Future Improvement

Applying Gibbs' Cycle, the suggestions provided by the participants reflect a strong desire for practical application of Scrum principles such as more real-world examples during the workshop, additional interactive sessions, and industry guest lectures to contextualize Scrum applications in the engineering field. GRC evaluation suggests that while the theoretical foundation was strong, students saw value in industry exposure. The analysis implies that integrating industry case studies could make the learning experience more relevant. The action plan for future workshops are incorporating real-world engineering challenges and guest lectures.

4 CONCLUSIONS

The findings suggest that Scrum-based learning effectively enhances engineering education by fostering teamwork, adaptability, and iterative problem-solving. By applying GRC, this study highlights areas of success and opportunities for refinement for Scrum methodology in engineering courses. Future implementations should emphasize practical applications, improved instructional clarity, and extended time for activities to optimize learning outcomes.

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Mata Pelajaran Umum Penghayatan Etika Dan Peradaban Pemacu Kepada Pembentukan Perpaduan Baharu Menerusi Pendidikan

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ABSTRAK

Mata Pelajaran Umum (MPU) telah diperkenalkan oleh Kementerian Pendidikann Tinggi (KPT) dalam usaha untuk meningkatkan peranan generasi muda dalam memahami pembinaan tamadun Malaysia. Salah satu Mata Pelajaran Umum (MPU) iaitu Penghayatan Etika dan Peradaban (PEP) merupakan salah satu mata pelajaran khusus yang memfokuskan kepada pembinaan perpaduan dan negara bangsa mengikut acuan Malaysia. Dalam era globalisasi ini, penghayatan etika dan peradaban telah berubah cara dan gaya pemahaman perlu disesuaikan mengikut arus perkembangan masyarakat kini. Oleh itu, satu kajian telah dilaksanakan di Universiti College Bestari menerusi edaran borang soal selidik. Kajian ini menggunakan kaedah campuran bagi memudahkan kajian dilaksanakan. Seramai 112 mahasiswa Universiti College Bestari mengambil bahagian terhadap model soalan yang telah dirangka khusus terhadap mata pelajaran Penghayatan Etika dan Peradaban. Penyelidik menggunakan kaedah analisis dokumen menerusi pendekatan teknik Krejcie and Morgan bagi memudahkan penentuan sample saiz dan analisis data. Fokus kajian ini bagi menjelaskan elemen pembentukan perpaduan menerusi pendidikan di institut pengajian tinggi. Dapatan kajian ini, mendapati terdapat tiga elemen dapat diketengahkan iaitu nilai budaya dan agama, tamadun dan patriotisme. Kesimpulan daripada kajian ini dapat digunakan oleh kementerian pengajian tinggi sebagai pendekatan baharu untuk menggerakan unsur perpaduan dalam elemen pendidikan selain dapat mengkelaskan nilai patriotisme pada peringkat institusi pengajian tinggi.

KATA KUNCI: Mata pelajaran Umum (MPU), Penghayatan Etika dan Peradaban (PEP), Perpaduan, Pendidikan, Mahasiswa Universiti College Bestari

ABSTRACT

The Role of Ethics and Civilization Appreciation (PEP) in Promoting Unity through Higher Education: A Study at Universiti College Bestari

General Subjects (MPU) were introduced by the Ministry of Higher Education (MOHE) to foster a deeper understanding of Malaysian civilization among the younger generation. One such subject, Ethics and Civilization Appreciation (PEP), plays a crucial role in shaping unity and promoting the concept of a nation-

state based on the Malaysian context. In the era of globalization, the appreciation of ethics and civilization has evolved, requiring new approaches and styles of understanding that align with contemporary societal developments.This study was conducted at Universiti College Bestari using a mixed-method approach, with data collected through the distribution of specially designed questionnaires. A total of 112 students participated in this study. To determine the appropriate sample size and guide data analysis, the researchers applied the Krejcie and Morgan technique alongside document analysis methods.
The primary objective of this study was to explore the elements contributing to unity formation through education in higher learning institutions. Findings revealed three significant elements that support unity: cultural and religious values, civilizational heritage, and the role of educational institutions.The study concludes that these elements can serve as a foundation for the Ministry of Higher Education to enhance its strategies in embedding unity within educational practices. Furthermore, it provides insights into how patriotism can be better cultivated at the tertiary education level.

KEYWORDS: General Subjects (MPU), Ethics and Civilization Appreciation (PEP), Unity, Education, Patriotism, Universiti College Bestari

1 PENGENALAN

Kursus bagi mata pelajaran umum universiti merupakan sebahagian daripada cabang falsafah pendidikan kebangsaan yang telah dirangka khusus bagi memenuhi tuntutan untuk melahirkan mahasiswa yang holistik. Kementerian Pengajian Tinggi telah memperkenalkan mata pelajaran umum bagi Penghayatan Etika dan Peradaban pada tahun 2020 (Emie Sylviana Mohd Zahid, 2021) selaras dengan aspirasi negara untuk membina sebuah negara bangsa yang idealis. Sebagaimana dasar perpaduan negara yang telah dijadikan batu asas yang dijadikan panduan kepada kluster pendidikan dalam menyeru seruan kerajaan. Dasar perpaduan yang berkonsepkan perpaduan dalam kepelbagaian merupakan teras utama bagi membina pemahaman baharu mengenai perpaduan (Wan Azizah Wan Omar, 2021). Kementerian Pengajian Tinggi begitu komited dalam melaksanakan segala usaha untuk membina sebuah naratif perpaduan baharu dalam masyarakat mengikut acuan Malaysia. Oleh itu, institusi pengajian tinggi merupakan sebuah pusat pengajian yang terbaik bagi melahirkan generasi muda yang faham akan pentingnya perpaduan dalam kalangan masyarakat yang pelbagai bangsa. Sebagaimana perkembangan idea untuk membina sebuah negara bangsa maka kerjasama di antara Kementerian Pengajian Tinggi (KPT) dengan institut pengajian tinggi terutamanya institusi pengajian tinggi swasta menyahut seruan kerajaan bagi menggerakan falsafah pendidikan kebangsaan secara langsung menerusi pendidikan. Universiti College Bestari (UCB) merupakan salah sebuah institusi pengajian tinggi swasta (IPTS) yang telah menggerakan pelan tindakan pengajaran dan pembelajaran mata pelajaran umum universiti sebagaimana tuntutan daripada pihak kementerian untuk membina pendekatan baharu bagi memupuk nilai perpaduan mengikut acuan Malaysia.

2 OBJEKTIF KAJIAN

Objektif kajian untuk kertas kerja ini untuk mengenal pasti tahap pemahaman mahasiswa terhadap mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) terhadap pembentukan perpaduan baharu menerusi pendidikan**.**

3 METODOLOGI KAJIAN

Kajian ini menggunakan kaedah campuran bagi memudahkan kajian dilaksanakan. Seramai 112 mahasiswa Universiti College Bestari mengambil bahagian terhadap model soalan yang telah dirangka khusus terhadap mata pelajaran Penghayatan Etika dan Peradaban. Penyelidik menggunakan kaedah analisis dokumen menerusi pendekatan teknik Krejcie and Morgan bagi memudahkan penentuan sample saiz dan analisis data.

4 SOROTON LITERATUR

Berdasarkan kajian lepas, pengkaji mendapati terdapat beberapa kajian yang telah dijalankan berkenaan dengan impak mata pelajaran umum Penghayatan Etika dan Peradaban (PEP). Kajian lepas yang telah dijalankan oleh (Abdullah, et.al 2022) memfokuskan kajiannya terhadap kepentingaan mata pelajaran umum Penghayatan Etika dan Peradaban dalam menyemai semangat kesepaduan kaum dalam kalangan rakyat Malaysia. Berpandukan kepada kajian ini, pengkajiberpendapat sorotan ini mempunyai kesinambungan idea dalam menyediakan semangat kebersamaan dan kekitaan dalam setiap lapisan kelas sosial tanpa mengira agama dan etnik. Dalam masa yang sama, kajian yang dilaksanakan oleh (Fatmi Talib, 2021) turut memfokuskan kepada nilai perpaduan dan patriotisme sebagai impak positif yang diperolehi sepanjnag proses pengajaran dan Pembelajaran (PdP) mata pelajaran umum Penghayatan Etika dan Peradaban (PEP). Mata pelajaran ini memberi kesan positif terhadap perkembangan nilai perpaduan yang turut disertakan dengan elemen menjaga keharmonian dan nilai kesejahteraan yang ada dalam kehidupan pelbagai bangsa.

Selain itu kajian yang dilaksanakan oleh (Rosli, 2023) yang lebih memberikan penekanan kepada kefahaman dan pengamalan nilai-nilai murni menerusi mata pelajaran umum Penghayatan Etika dan Peradan (PEP) dalam kalangan pelajar politeknik Mersing. Berdasarkan kepada fokus kajian ini, penulis me,fokuskan kepada nilai-nilai murni dalam kehidupan seharian masyarakat Malaysia. Justeru itu, satu kajian yang dijalankan oleh (Mahfuzah, 2024) lebih menumpukan kepada analisis domain afektif dalam kursus Penghayatan Etika dan Peradaban (PEP) di institut pengajian tinggi awam. Fokus kajian ini lebih menumpukan kepada reaksi terhadap penyampaian maklumat, nilai-nilai dan tahap kebolehfahaman pelajar terhadap mata pelajaran umum Penghayatan Etika dan Peradaban (PEP). Kajian yang dilakukan oleh (Ng Ming Yip, 2017) terhadapmata pelajaran umum (MPU) pemeraju transformasi pendidikan holistik. Selaras dengan kajian memfokuskan kepada kesedaran terhadap peningkatan kualiti modal insan sejajar dengan matlamat Pelan Strategik Pengajian Tinggi Negara (PSPTN). Oleh itu kajian ini memberi nilai tambah terhadap hasil yang diperolehi daripada mata pelajaran umum ini. Sejajar dengan analisis yang dilakukan, pengkaji cuba meletakkan perspektif baharu mengenai kajian ini supaya teras pemahaman terhadap pembentukan perpaduan menerusi pendidikan khususnya di institusi pengajian tinggi swasta selaras dengan hasrat Kementerian Pengajian Tinggi (KPT) dan Kemnterian Perpaduan Negara (KPN).

5 DAPATAN KAJIAN

Mata pelajaran umum bagi Penghayatan Etika dan Peradan (PEP) menilai kesinambungan terhadap proses pembinaan sebuah negara bangsa dan menanamkan semangat patriotisme dalam membina naratif perpaduan baharu mengikut acuan Malaysia. Objektif kajian ini bagi mengukur tahap kesatuan pelajar dalam menghidupkan suasana perpaduan yang harmoni menerusi kepelbagaian bangsa di Malaysia. Dalam masa sama, pemberian kursus mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) di universiti awam dan swasta adalah bagi melahirkan pelajar yang memahami konsep negara bangsa menerusi kepelbagaian bangsa di Malaysia.

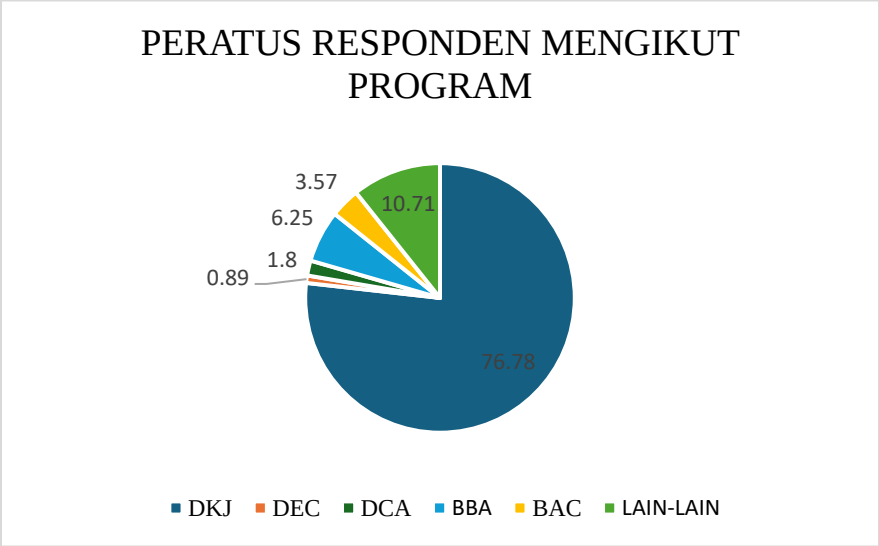
Berdasarkan hasil kajian yang diperolehi daripada borang soal selidik yang telah diedarkan dalam kalangan pelajar diploma dan ijazah sarjana muda yang mengambil mata pelajaran Penghayatan Etika dan Peradaban (PEP), boleh dilihat menerusi carta di bawah berdasarkan kepada pecahan kepada program, jantina,

umur dan min purata bagi setiap elemen yang telah diukur seperti agama, budaya, semangat patriotisme dan tamadun.

Jadual 1: Program Pengajian di Universiti College Bestari, (UCB)

Bil.	Program Pengajian	Bilangan Responden (orang)	Peratus (%)
1	Diploma Kejururawatan	86	76.78
2	Diploma Pendidikan Awal Kanak-Kanak	1	0.89
3	Diploma Seni Kulinari	2	1.80
4	Ijazah Sarjana Muda Pentadbiran Perniagaan	7	6.25
5	Ijazah Sarjana Muda Kaunseling	4	3.57
6	Lain-Lain	12	10.71
	Jumlah	112	100

Berdasarkan jadual 1 di atas, jumlah responden yang menjawab soalselidik adalah 112 orang pelajar yang terdiri daripada beberapa program yang terdiri daripada 95 pelajar perempuan bersamaan 84.82% dan dan 17 atau 15.17 adalah pelajar lelaki. Taburan pelajar mengikut Program adalah seperti berikut. Program pengajian diploma kejururawatan seramai 86 orang pelajar atau 6.78 peratus. Diploma Pendidikan awal Kanak-kanak seramai 1 orang atau 0.89 peratus. Diploma Seni Kulinari. Ijazah Sarjana Muda Perniagaan seramai 7 orang atau 6.25 %. Pelajar Ijazah Sarjana Muda Kaunseling 4 orang bersamaan 3.5% dan lain-lain 12 orang atau bersamaan 10.71% serta kesemua responden telah mengikut kursus bagi mata pelajaran umum Penghayatan Etika dan Peradaban (PEP). Data di atas dipamerkan dalam bentuk carta pai bagi memaparkan peratusan mengikut program pengajian yang diambil di Universiti College Bestari.



Rajah 1: Peratus responden mengikut program

Berdasarkan pada jadual 2 di bawah menunjukkan jantina dan umur responden pelajar universiti College Bestari yang telah mengambil mata pelajaran umum bagi Penghayatan Etika dan Peradaban untuk program diploma dan ijazah sarjana muda.

Jadual 2 Jantina Responden

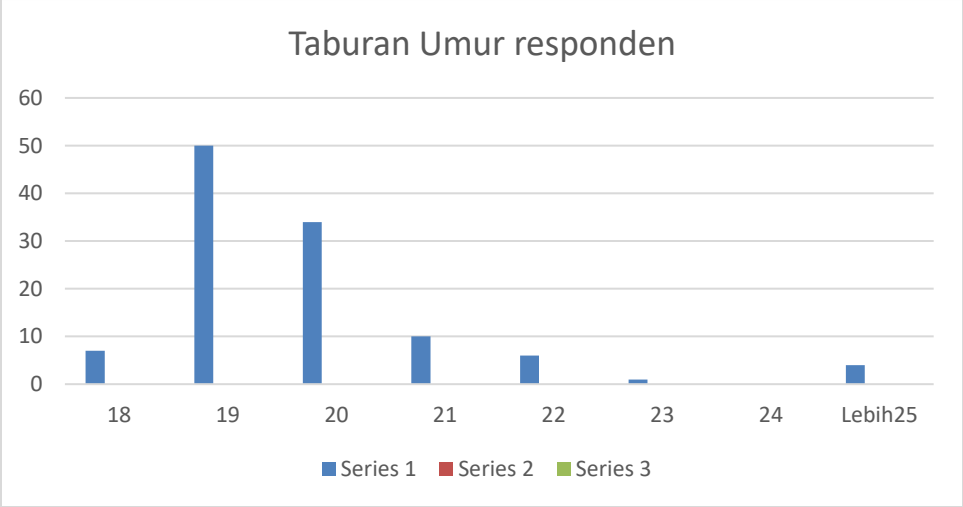
Bil.	Jantina	Bilangan Responden	Peratus (%)
1	Perempuan	95	84.82
2	Lelaki	17	15.17
	Jumlah	112	100

Taburan dari segi Jantina adalah 95 responden adalah terdiri daripada responden perempuan bersamaan 84.89 peratus manakala responden lelaki adalah seramai 17 bersamaan 15.17 lelaki.manakala dari segi taburan umur pula adalah dipaparkan dalam Jadual 3.

Jadual 3 Umur Responden

Bil.	Umur	Bilangan Responden	Peratus (%)
1	18	7	6.25
2	19	50	44.64
3	20	34	30.35
4	21	10	8.93
5	22	6	5.35
6	23	1	0.89
7	24	0	0
8	Lain-lain	4	3.57
	Jumlah	112	100

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Rajah 2: Taburan Umur Responden

Berdasarkan jadual 3 di atas, jumlah responden yang menjawab soalselidik adalah 112 orang pelajar yang terdiri daripada mereka yang berumur 18 tahun seramai 7 orang pelajar bersamaan dengan 6.25% manakala bagi umu 19 dan 20 tahun masing masing adalah sebanyak 50 orang pelajar mewakili 44.64% dan 34 orang pelajar mewakili 30.35%. seterusnya bagi umu 21 tahun seramai 10 orang pelajar bersamaan 8.93%, manakala pada umur 22 dan 23 tahun mewakili 6 orang pelajar bersamaan 5.35% serta 1 orang pelajar bersamaan 0.89%. Manakala pada umur 24 tahun tidak mempunyai sebarang penglibatan manakala akhir sekali lain-lain umur hanya mewakil 4 orang pelajar bersamaan 3.57%. Kekerapan data ini menunjukkan penglibatan golongan muda dalam kajian ini.

6 ANALISIS DAN PERBINCANGAN

Jadual 4: Analisis Kajian

	SKALA LIKERT	5	4	3	2	1	
Bil.	Soalan	Sangat Setuju (%)	Setuju (%)	Tidak Pasti (%)	Tidak Setuju (%)	Sangat Tidak Setuju (%)	Min Item
1	Pendidikan moral adalah selaras dengan matlamat Falsafah Pendidikan Negara untuk melahirkan modal insan yang seimbang	41 36.6%	63 56.3 %	6 5.64 %	1 0.9%	1 0.9 %	4.268
2	Nilai murni perlu diterapkan dalam pendidikan untuk membawa kesan yang baik kepada kehidupan pelajar	66 58.9%	44 39.3 %	1 0.9 %	0	1 0.9%	4.598
3	Pembentukan moral perlu dipupuk sepanjang hayat.	54 48.2%	54 48.2 %	2 1.8 %	1 0.9%	1 0.9%	4.420
4	Pengukuhan pembentukan moral perlu dibuat sejak kanak-kanak	59 52.7%	46 41.1 %	5 4.5 %	0	2 1.8%	4.422
5	Pusat pengajian tinggi berperanan dalam pembentukan nilai moral	40 35.7%	65 58%	4 3.6 %	2 1.8%	1 0.9%	4.529
	ITEM 1-5 MORAL Purata min						**4.394**
6	Budaya penting dalam pembentukan negara bangsa	60 53.6%	49 43.8 %	2 1.8 %	0	1 0.9%	4.491
7	Budaya membantu cara berfikir dan berkelakuan	51 45.5%	53 47.3 %	5 4.5 %	2 1.8%	1 0.9%	4..393
8	Budaya membantu perpaduan dan keharmonian kaum	61 54.5%	44 39.3 %	4 3.6 %	1 0.9%	2 1.8%	4.438
9	Budaya membantu memahami adat masyarakat pelbagai kaum	62 55.4%	45 40.2 %	1 0.9 %	1 0.9%	2 1.8%	4.438
10	Budaya kepelbagaian menjadi kekuatan masyarakat Malaysia	58 44.6%	56 50%	4 3.6 %	1 0.9%	1 0.9%	4.728
	ITEM 6-10 BUDAYA Purata Min						**4.518**
11	Kursus etika dan peradaban memupuk patriotism	48 42.9%	53 47.3 %	8 7.1 %	1 0.9%	2 1.8%	4.286
12	Penghayatan etika dan peradaban memupuk perpaduan dalam kalangan pelajar.	48 42.9%	54 48.2 %	7 6.3 %	2 1.8%	1 0.9%	4.304
13	MPU melahirkan insan yang holistik, bernilai murni dan bertanggungjawab	50 44.6%	52 46.4	8 7.1	1 0.9%	1 0.9%	4.317

			%	%			
14	Semangat cintakan negara membantu Malaysia menjadi sebuah negara maju	63 56.3%	45 40.2 %	2 1.8 %	0	2 1.8%	4.716
15	Patrotisme penting untuk mengekalkan perpaduan kaum	55 49.1%	55 49.1 %	1 0.9 %	0	1 0.9%	4.947
	ITEM 11-15 PATROTISME Purata Min						**4.450**
16	Mata pelajaran MPU menjelaskan asas-asas kebudayaan masyarakat berbilang kaum	48 42.9%	61 54.5 %	1 0.9 %	1 0.9%	1 0.9%	4.375
17	Tamadun mempamerkan kebolehan berkomunikasi sosial dalam kepelbagaian langskap budaya.	45 40.2%	60 53.6 %	5 4.5 %	1 0.9%	1 0.9%	4.313
18	Tamadun sesuatu bangsa menunjukkan struktur organisasi sosial masyarakat	47 42 %	59 52.7 %	5 4.5 %	0	1 0.9%	4.3480
19	Mata pelajaran umum (MPU) memjelaskan hubung kait elemen ketamadunan dengan isu kemasyarakatan semasa	47 42%	59 52.7 %	4 3.6 %	1 0.9%	1 0.9%	4.339
20	Tamadun memberi kefahaman tentang pembentukan sistem nilai masyarakat Malaysia.	54 48.2%	53 47.3 %	3 2.7 %	0	2 1.8%	4.401
	ITEM 16-20 TAMADUN Purata Min						**4.355**

Moral diukur melalui lima persoalan untuk melihat persepsi pelajar terhadap peranan kursus mata Pelajaran umum dalam pembentukan moral pelajar di Institusi pengajian tinggi. Item pertama iaitu Pendidikan moral adalah selaras dengan matlamat Falsafah Pendidikan Negara untuk melahirkan modal insan yang seimbang dengan min 4.333.dalam keadaan lebih tinggi darpada min purata 4.3320. Hal ini menunjukkan kursus pengajian umum mempubyai pengaruh yang kuat dalam pembentukan moral pelajar. Item kedua adalah nilai murni perlu diterapkan dalam pendidikan untuk membawa kesan yang baik kepada kehidupan pelajar.seramai 110 responden berada dalam kategori setuju dan amat setuju bersamaan 91.67 peratus engan min 4.583 yang merupakan min tertinggi dalam item moral.

Item penilaian pertama adalah pemupukan nilai moral dalam kalangan pelajar diinstitusi pengajian tinggi. Terdapat beberapa item penilaian untuk melihat keberkesanan mata pelajaran pengajian umum dalam pembentukan nilai moral. Sebanyak 36.6% responden sangat bersetuju dengan pendidikan moral adalah selaras dengan matlamat Falsafah Pendidikan Negara untuk melahirkan modal insan yang seimbang. Seramai 56.3 % bersetuju dengan min item sebanyak 4.268. Sebanyak 58.9% sangat bersetuju dan 39.3% bersetuju bagi item nilai murni diterapkan dalam item pendidikan untuk membawa kesan yang baik kepada kehidupan pelajar dengan min 4.554. Seramai 48.2% responden sangat bersetuju dan 48.2% responden sangat setuju dengan min sebanyak 4.420. Seterusnya seramai 52.7% sangat bersetuju dan 41.1% setuju dengan item pengukuhan pembentukan moral perlu dibuat sejak kanak-kanak dengan min 4.428. Manakala 35.7% daripada responden sangat bersetuju dan 58% bersetuju dengan item pusat pengajian tinggi berperanan dalam pembentukan nilai moral dengan min 4.529 min secara purata bagi item moral adalah 4.394, Hal ini menunjukkan mata Pelajaran pengajian umum amat signifikan dalam memupuk nilai moral dalam kalangan pelajar di institusi pengajian tinggi.

Bagi item penilaian kedua adalah mata pelajaran pengajian umum berupaya membentuk budaya dalam kalangan pelajar. Bagi item pertama 53.6% responden sangat bersetuju dan 43.8% budaya penting dalam pembentukan negara bangsa dengan min 4.491. Seramai 45.5% responden amat bersetuju dan 47.3% bersetuju

bahawa budaya membantu cara berfikir dan berkelakuan dengan min sebanyak 4.366. Seramai 54.5% sangat bersetuju dan 39.3% bersetuju dengan mata pelajaran umum membantu pelajar memahami adat mesyarakat pelbagai kaum dengan min 4.438 Sebanyak 44.6% pelajar sangat bersetuju dan 50% bersetuju dengan budaya kepelbagaian menjadi kekuatan masyarakat Malaysia dengan min 4.723. Hal ini menunjukkan mata pelajaran umum membantu memupuk budaya dalam masyarakat pelbagai kaum di Malaysia dengan purata min 4.518.

Item penilaian ketiga adalah melihat hubungan mata pelajaran umum dengan pembentukan semangat patriotisme. Patriotisme mengandungi lima item penilaian. Sebanyak 42.9% amat bersetuju dan 47.3% bersetuju dengan kursus etika dan perdaban memupuk patriotisme dalam kalangan pelajar institusi pengajian tinggi dengan min 4.286 yang menunjukan hubungan yang amat signifikan. Bagi penghayatan etika dan peradaban memupuk perpaduan dalam kalangan pelajar pula sebanyak 42.9% amat bersetuju dan 48.2% bersetuju menjadikan 91.1% bersetuju dengan min 4.304. untuk item keempat patrotisma, sebanyak 44.65% sangat bersetuju dan 46.4% bersetuju mata pelajaran pengajian umum melahirkan insan yang holistik, bernilai murni dan bertanggung jawab dengan min 4.317. Seramai 56.3% amat bersetuju dan 40.2% bersetuju dengan semangat cintakan negara membantu Malaysia menjadi sebuah negara maju dengan min 4.716 yang menunjukkan min yang kedua tertinggi bawah item patriotisme. Bagi item patriotisme penting untuk mengekalkan perpaduan kaum 49.1% amat bersetuju dan 49.1% bersetuju dengan min 4.947 yang merupakan min tertinggi. Purata min patriotisme adalah sebanyak 4.450.

Item terakhir penilaian adalah item di bawah tamadun. Terdapat lima soalan soalselidik yang dikemukakan kepada responden. Bagi item pertama iaitu mata pelajaran umum, (MPU) menjelaskan asas-asas kebudayaan me syuarat berbilang kaum, 42% responden sangat setuju dan 54.5% setuju dengan jumlah peratusan bersetuju sebanyak 96.5% dengan min 4.375. Bagi item kedua 40.2% sangat bersetuju dan 53.6%, menyumbang sebanyak 93.8% bersetuju dengan min 4.349. bagi item ketiga iaitu tamadun sesuatu bangsa menunjukkan struktur organisasi sosial masyarakat, sebanyak 42% sangat bersetuju dan 52.7% bersetuju dengan min 4.348. Sebanyak 42% sangat bersetuju dan 52.7%bersetuju dengan min sebanyak 4.339. Bagi item terakhir tamadun memberi kefahama tentang pembentukan sistem nilai Masyarakat dengan peritus persetujan sebanyak 95.5% dan min sebanyak 4.401. Secara umumnya purata min tamadun adalah 4.355.

Jadual 5: Jumlah Purata Min

Bil.	ITEMS	Min Purata
1	MORAL	4.394
2	BUDAYA	4.518
3	PATRIOTISME	4.450
4	TAMADUN	4.353
	PURATA	4.429

Dari segi kedudukan darjah kesignifikanan yang tinggi. Budaya mempunyai min purata tertinggi iaitu 4.518 diikuti oleh patriotisme 4.450 min purata moral berada ditempat yang ketiga dengan min 4.394 dan yang paling rendah adalah moral tamadun min purata 4.353. secara umumnya mata pelajaran umum mempunyai darjah signifikan yang tinggi.

Selaras dengan hasrat Kementerian Perpaduan Negara (KPN) dan berdasarkan kepada Pelan Tindakan Perpaduan Negara 2021-2030,(PTPN) institusi pengajian tinggi swasta berperanan dalam menggerakan dasar kerajaan Malaysia untuk membina generasi baharu yang mampan terhadap pemahaman pembinaan negara bangsa berpandukan kepada konsep Rukun Negara dan Falsafah Pendidikan Kebangsaan. Menerusi teras strategik Pelan Tindakan Perpaduan Negara 2021-2030, Universiti College Bestari mengambil langkah proaktif dalam membina naratif baharu perpaduan mengikut acuan Malaysia selaras dengan TS1, TS2 dan TS4. Berpandukan kepada Teras Strategik 1 (TS1) dalam memelihara sistem demokrasi Raja beperlembagaan, maka mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) mampu membentuk mahasiswa dalam memahami kerangka sebenar naratif negara bangsa menerusi konsep tiang seri utama (Kementerian Perpaduan Negara, 2021).

Dalam masa sama, proses pengajaran dan pembelajaran menerusi silibus Penghayatan Etika dan Peradaban (PEP), juga dapat menyalurkan elemen-elemen kesatuan melalui pendidikan kepada mahasiswa secara langsung apabila teras ini bertujuan untuk memberi tumpuan khusus membangunkan rakyat yang patriotik dan demokratik menerusi pendidikan di institusi pengajian tinggi, serta dapat meningkatkan pemahaman dan penghayatan sistem demokrasi dalam perlembagaan persekutuan. Menerusi teras strategik 1 (TS1), usaha ini dilihat akan dapat meningkatkan semangat patriotisme (Abdul Rahman Ismail, 1985) sebagai seorang rakyat Malaysia. Berdasarkan dapatan kajian terhadap nilai min purata patriotisme 4.450, maka dapat dijelaskan bahawa mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) dapat menanam kefahaman bahawa ketaatan kepada undang-undang adalah sebahagaian daripada tanggunjawab sosial sebagai warganegara. Walau bagaimanapun, silibus Penghayatan Etika dan Peradaban dapat memberikan pemahaman yang mendalam tentang struktur pemerintahan Malaysia serta dalam masa yang sama mahasiswa akan dapat memahami mekanisme pemerintahan dan fungsinya secara proaktif yang mendorong kepada pengukuhan pemahaman sejarah dan prinsip asas negara Malaysia.

Seterusnya, penyemaian nilai perpaduan dalam pendidikan turut diukur dalam konteks mata pelajaran umum khususnya bagi kursus Penghayatan Etika dan Peradaban dalam konteks budaya dan tamadun (Shamsul Amri Baharudin, 1996). Hal ini amat signifikan dengan teras strategik (TS2). Selaras dengan dasar yang dibuat oleh Kementerian Perpaduan Negara, (KPN) melalui Pelan Tindakan Perpaduan Negara 2021-2030 (PTPN) memaparkan usaha yang dilaksanakan oleh Kementerian Pengajian Tinggi (KPT) bertepatan dengan Falsafah Pendidikan Kebangsaan (FPK) (Alias Mat Saad,2011) dalam membentuk mahasiswa sekaligus sebagai masyarakat yang menghargai dan mengamalkan perpaduan baik di institusi pengajian tinggi dan mampu diterjemahkan sebagai rakyat Malaysia yang idealis (Mohamed Mustafa Ishak,2014). Kepentingan teras strategik (TS2) mempunyai matlamat yang jelas dalam usaha untuk mengukuhkan perpaduan menerusi saluran pendidikan. Bagaimana institusi pengajian tinggi memainkan peranannya untuk menyemai nilai-nilai murni menerusi pendidikan formal. Dalam masa yang sama, silibus pendidikan mata pelajaran Penghayatan Etika dan Peradaban (PEP) turut mampu mengukuhkan komunikasi dalam kalangan pendidikan dan mahasiswa sekaligus idea berkenaan budaya dan tamadun akan dapat disalurkan secara langsung secara bilateral. Kajian mendapati bahawa purata tertinggi dalam konteks pemahaman tamadun iaitu 4.353 sekaligus menggambarkan pemahaman mahasiswa Universiti College Bestari menunjukkan darjah ketertinggian dalam memahami adat dan warisan yang terdapat dalam konteks sejagat di Malaysia. Pendekatan etika dan peradaban mengikut acuan Malaysia turut menjadi faktor utama dalam membentuk prinsip keadilan sosial tanpa mengira etnik. Dalam masa yang sama, nilai empati dalam tanggungjawab sosial turut menjadi asas yang kukuh untuk membentuk mahasiswa yang holistik.

Pemerkasaan perpaduan dalam pendidikan bukan sahaja mampu menggerakan aspirasi negara malah dapat meningkatkan tahap pemahaman dan keterjaminan penerimaan nilai kerjasama dalam bentuk etika dan peradaban. Oleh hal yang demikian, pendekatan untuk membina perpaduan menerusi pendidikan dilihat sebagai jalan altrnatif dalam membina hubungan etnik secara asimilasi segmented (Najjah Salwa, 2011) yang mana bentuk inilah digambarkan oleh masyarakat di Malaysia pada ketika ini. Keseragaman dasar kerajaan dan institusi pengajian tinggi dalam memastikan berlakunya kerjasama secara bilateral telah dapat dijalankan menerusi saluran pendidikan. Dalam masa sama, kelebihan mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) bukan sahaja dapat dipraktikkan kepada generasi baharu malah pendedahan silibus pendidikan yang menekankan kepada konsep 3R juga mampu memastikan mahasiswa mempunya kadar literasi yang tinggi dalam menggerakan proses perpaduan di Malaysia sama ada secara tawar menawar, perantaraan dan perundingan (Shamsul Amri Baharudin, 2012).

Tiang seri utama dalam membina perpaduan amat berkait dengan keagamaan yang menjadi amalan dalam setiap kepercayaan di Malaysia. Keberadaan nilai agama sangat penting dalam memastikan adanya keterbukaan dan toleransi terhadap perbezaan agama dan tradisi kebudayaan yang ada di Malaysia. Pemupukan nilai agama begitu penting dalam meningkatkan kefahman dan sifat saling menghormati dalam kepelbagaian warisan budaya dan agama yang bercirikan kepelbagaian bangsa. Hal ini juga telah dilaksanakan menerusi saluran pendidikan sebagai perkongsian nilai-nilai murni dalam setiap agama. Hal ini sejajar dengan matlamat utama Kementerian Pengajian Tinggi (KPT) dan Kementerian Perpaduan Negara (KPN) dalam usaha melaksanakan dasar yang telah ditetapkan menerusi kluster pendidikan. Teras strategik akhir iaitu (TS4) turut

menekankan kepada kebersamaan mahasiswa dalam memahami perbezaan agama dan penghayatan dalam budaya. Berdasarkan hasil kajian menunjukkan nilai min bagi moral iaitu 4.394 manakala budaya menduduki tempat pertama dengan nilai 4.518. kesinambungan antara moral dan budaya merupakan satu hubungan bilateral yang boleh dijadikan sebagai asas bagi membina perpaduan mengikut acuan Malaysia (Mohd Ra'in Shaari, 2019).

Walau bagaimanapun, Malaysia yang terdiri daripada pelbagai etnik dan agama mendorong kepada terbentuknya hubungan bilateral antara dua elemen utama ini. Pertembungan pada 13 Mei 1969 merupakan insiden yang dapat diketengahkan sebagai kesan kepada perpecahan kesatuan dalam masyarakat dan gambaran inilah yang menjadi pemangkin kepada adanya mata pelajara umum Penghayatan Etika dan Peradaban, (PEP). Kepentingan mata pelajaran umum di institusi pengajian tinggi bukan sahaja dapat dijadikan sebagai alternatif kepada tapak intergrasi (Shamsul Amri, 2019) namun, dengan adanya mata pelajaran ini maka perpaduan mengikut acuan Malaysia akan dapat dibentuk bukan sahaja menerusi kluster pendidikan malah kesan secara positif daripada kursus pengajian ini akan dapat dipraktikkan sebagai suatu teori baharu penyatupaduan dalam kalangan masyarakat Malaysia pada masa akan datang.

7 KESIMPULAN

Secara keseluruhannya, kajian ini mendapati bahawa penawaran kursus mata pelajaran umum Penghayatan Etika dan Peradaban (PEP) di institusi pengajian tinggi khususnya Universiti College Bestari telah menunjukkan kesan positif terhadap pemahaman baharu dalam membina perpaduan mengikut acuan Malaysia. Peranan institusi pengajian tinggi swasta bukan sahaja telah mengambil langkah yang progresif dalam menyampaikan seruan Kementerian Pengajian Tinggi (KPT) dan Kementerian Perpaduan Negara (KPN), malah usaha ini diambil secara proaktif oleh para pensyarah untuk membentuk naratif baharu mengenai tujuan sebenar pentingnya perpaduan dalam konteks acuan Malaysia. Keberadaan nilai perpaduan yang baharu ini akan dapat membentuk mahasiswa progresif terhadap pembinaan negara bangsa. Justeru itu, kepentingan daripada kajian ini bukan sahaja memaparkan usaha daripada institusi pengajian tinggi swasta, namun pergerakan ideologi kesatuan dalam membina perpaduan secara lansgung digerakkan bagi memastikan adanya pergerakan idea secara mutlak dalam tindakan generasi baharu sentiasa dikembangkan supaya terbinanya masyarakat yang berbilang bangsa hidup secara harmoni dan saksama.

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From Campus to Career: Employer Insights on Bridging Graduate Skill Gaps

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ABSTRACT

The rapid advancement of technology has profoundly reshaped workplace dynamics, creating significant skill mismatches across industries, particularly in Malaysia. As the job market evolves, fresh university graduates often find themselves unprepared to meet employer expectations, with notable gaps in communication, entrepreneurial thinking, and digital skills. This misalignment raises concerns about graduates' workforce readiness and employability in a fast-changing global economy. Addressing this issue is crucial, as the success of Malaysia's future workforce depends on closing these skill gaps and fostering a more adaptable, future-ready labour market. This study explores the challenges in addressing skill gaps and proposes targeted strategies for bridging these gaps, drawing insights from employer feedback. Key challenges identified include resistance to change, intergenerational differences, unclear job expectations, and limited access to training resources, all hindering graduates' seamless transition into the workforce. By emphasising the importance of tailored training programmes, mentorship initiatives, and leadership-driven strategies that promote continuous learning and adaptability, the study highlights actionable solutions to address these barriers. Furthermore, it highlights the vital role of educational institutions in aligning graduate competencies with labour market demands. A stronger focus on developing entrepreneurial mindsets, enhancing English proficiency, and fostering continuous learning through technology-enabled, adaptive training frameworks is essential to equip graduates with the skills employers seek. This study offers actionable recommendations for policymakers, educators, and employers to collaborate in building a skilled and adaptable workforce. By addressing these challenges, the study aims to enhance graduate employability, reduce skill mismatches, and contribute to Malaysia's more resilient and competitive economy.

KEYWORDS: Skill gaps, continuous learning, workforce adaptability, technology advancement, employability

1 INTRODUCTION

Skill mismatches refer to imbalances between the skills and qualifications available in the labor market and those required for jobs. The broad concept encompasses several distinct types of imbalances, including skill shortages, qualification mismatches, skills gaps, skills obsolescence, and over/underskilling. Mismatches can be categorised as horizontal or vertical. Horizontal mismatches refer to disparities in fields of study, while vertical mismatches pertain to overqualification or underqualification (ILO & OECD, 2023).

The misalignment of skills in the job market presents a global challenge. More than 57 of the 108 countries studied have a skills mismatch rate exceeding 50%, indicating that over half of the workforce in these nations holds jobs that do not correspond with their educational qualifications. Among these mismatched workers, 72% are undereducated, emphasising the global scale of this issue. The severity and nature of skills mismatches vary across different regions and countries. Additionally, 22.5% of the worldwide youth population is not engaged in education, employment, or training (NEET), with the highest concentrations of NEET youth found in Africa, Asia, and the Arab States (UNICEF, 2022).

Global job growth is expected, but the widening skills gap between expanding and declining roles poses a pressing challenge by 2030. Key skills for growth include resilience, flexibility, agility, resource management, operations, quality control, programming, and technological literacy. Meeting these evolving demands will necessitate substantial efforts in workforce upskilling and reskilling. Employers estimate that, out of every 100 workers, 59 will require training by 2030. Among them, 29 can be upskilled in their current roles, and 19 can be retrained and redeployed within their organisations. However, 11 workers risk falling behind, as they are unlikely to receive the necessary reskilling, leaving their employment prospects increasingly vulnerable (World Economic Forum, 2025).

Organisations are implementing various efforts to reskill and upskill their workforce to meet job requirements. For instance, the global Skills and Education Accelerators unite leaders from governments, businesses, and other key stakeholders to drive transformative initiatives within their nations. The Skills Accelerators encourage public-private collaboration to drive systemic change and address national skills gaps. These accelerators create opportunities to amplify impact and progress by uniting a multi-stakeholder community dedicated to transformative change. Similarly, the Education Accelerators bring together a diverse community of change-makers to revolutionise learning for children and youth, reimagining an inclusive education system centered on the skills essential for success in future labor markets. Currently, participating countries in this network include Bangladesh, Brazil, Turkey, Pakistan, Vietnam, and Qatar. The programme's impact is driven by partner-led initiatives targeting internal workforces and external communities alongside strategic country-level skills and education programmes. For example, Brazil's Skills Accelerator has enrolled 3.4 million individuals in training programmes since 2022, underscoring the programme's significant reach and effectiveness (World Economic Forum, 2025).

In Malaysia, the government has made significant efforts to tackle the skill mismatch through various initiatives led by the Pertubuhan Keselamatan Sosial (PERKESO). The Social Security Organisation (PERKESO) was established under the Ministry of Human Resources and enforces the Employees' Social Security Act 1969 and related regulations. The social security protection model is based on joint responsibility, resource pooling, risk sharing, and income replacement. Strategic collaborations with ministries and agencies, such as the Ministry of Rural Development, Youth and Sports, and the Ministry of Higher Education, aim to enhance job matching. PERKESO's Employment Insurance System provides career counseling, skills profiling, resume writing, mock interviews, and training to improve marketability. Next, the JaminKerja Employment Incentive Programme offers financial incentives aimed at encouraging employers to hire female workers who have been unemployed for over six months, including single mothers and housewives who are not actively employed. As of 24 January 2023, 10,306 women have secured employment (PERKESO, 2023). Regular career fairs are organised to target youth, new graduates, school leavers, and active job seekers, assisting 181,106

youths, including 94,426 young women, in securing employment between January 2022 and March 2023. Furthermore, HRD Corp's Digital Skills Training programme, introduced in December 2022, equips vulnerable groups, particularly women, with digital skills, enabling 3,001 women to pursue job opportunities by March 2023 (Selangor Journal, 2024).

Despite various efforts by the Malaysian government, skill mismatches persist as a significant issue in the Malaysian job market. According to the Labour Force Statistics released by the Department of Statistics Malaysia (2024), skill-related underemployment remained at approximately 37% in the third quarter of 2024. Compared to the third quarter of 2023, underemployed workers increased from 1,922.7 thousand to 1,949.3 thousand. Hence, this study aims to explore employers' challenges in addressing skill mismatches in the job market and propose actionable solutions. This study contributes to the existing body of knowledge by comprehensively analysing skill mismatches, explicitly focusing on fresh graduates and the challenges employers face in the Malaysian job market. By identifying the root causes of skill mismatches from employers' perspectives, this study offers valuable insights into the interplay between educational outcomes and labor market demands. Findings from this study are expected to generate practical recommendations for policymakers, educators, and industry leaders to address skill mismatches effectively.

2 LITERATURE REVIEW

Skill gaps, a critical issue in the labor market, arise when workers' skills do not align with job demands. This phenomenon can manifest in several forms, including overeducation, undereducation, and skill shortages, each carrying significant implications for individual workers, employers, and economies. The Human Capital Theory offers a foundational perspective on skill mismatches from a supply-side viewpoint. This theory suggests that workers' wages are determined by their productivity, which depends on accumulated human capital, including education, training, and experience. The model assumes that workers are rewarded based on their productivity, implying that higher human capital leads to better job matches and higher wages (Becker, 1980; Ortiz & Kucel, 2008). However, overeducation can occur when educational attainment exceeds the labor market's demand for skilled workers. In such cases, highly educated individuals may accept lower-skilled roles due to limited opportunities, while employers benefit from hiring overqualified workers at reduced costs (Linsley, 2005; Zainizam Zakariya, 2014a).

While the human capital theory identifies the relationship between education, productivity, and wages, it assumes that mismatches are temporary, and market mechanisms will eventually restore equilibrium. However, empirical evidence indicates that skill mismatches often persist due to complex structural and systemic factors. These mismatches arise from individual characteristics and broader economic, technological, and institutional dynamics that disrupt the balance between skill supply and demand. To better understand the persistence of skill mismatches, it is essential to explore various contributing factors, from the adaptability of education and training systems to demographic shifts and labor market trends.

A primary driver of skill mismatches is the inability of education and training systems to keep pace with rapid labor market changes. Technological advancements, organisational innovations, and globalisation have transformed skill requirements, creating gaps between what workers are taught and employers need (European Economic and Social Committee, 2018). For example, new jobs often require advanced digital, problem-solving, and collaborative skills, which traditional education systems may not adequately emphasise (Desjardins & Rubenson, 2011). Labor mobility also plays a crucial role in skill mismatches. Low mobility across sectors, challenges in recognising educational qualifications, cultural factors, and information asymmetries hinder the efficient allocation of workers to jobs that match their skills (European Economic and Social Committee, 2018). Additionally, business cycle conditions impact skill demand in the short and medium term, with sector shifts creating asymmetric occupational shocks that are costly and time-consuming to address

(Hershbein & Kahn, 2016). Demographic shifts, such as an aging population, exacerbate skill mismatches, particularly in advanced economies like Europe. Older workers may face skills obsolescence due to outdated education or declining physical and cognitive abilities.

Meanwhile, younger workers often encounter overeducation during the school-to-work transition, as they lack the experience needed to fully utilise their qualifications in the labor market (CEDEFOP, 2018). Wage-setting mechanisms also influence skill mismatches. Firms operating in rapidly changing markets often prefer to hire workers with higher qualifications, anticipating their adaptability to future demands (Roland & Thijs, 2017). This preference and wage compression for highly educated workers lead to substitution effects where overqualified workers displace less-educated individuals in low-skill roles (Zainizam Zakariya, 2014). Technological progress and globalisation further polarise job structures, reducing demand for middle-skill jobs while increasing demand for high-skill roles. This trend, combined with slow worker reallocation across sectors, intensifies skill shortages and mismatches (Giorgio & Patricia, 2019). Employers may attempt to bridge these gaps through on-the-job training or by adjusting job requirements, but such measures often fall short in the short term due to the high costs and complexity of reskilling initiatives (Hershbein & Kahn, 2016).

3 METHOD

The study utilised purposive sampling to recruit participants, specifically targeting employers actively engaged in recruitment activities. Thirty employers participated in the study. The respondents were anonymised and coded R01 to R30 to ensure confidentiality and facilitate analysis. A summary of the respondents' profiles is presented in Table 1.

Table 1 Descriptive data of the respondents

Code	**Gender**	**Positions**
R01	Female	Assistant Manager
R02	Male	Regional Manager
R03	Male	Operation Manager
R04	Female	Manager
R05	Female	Assistant Sales Manager
R06	Female	Human Resources Manager
R07	Female	Human Resources/ Recruiter
R08	Female	Senior Manager (People Manager)
R09	Female	Manager (Human Resources)
R10	Male	Manager
R11	Female	Manager
R12	Male	Manager
R13	Male	Senior Human Resources Officer
R14	Female	Manager
R15	Female	Head (Organisational Design & Workforce Strategy)
R16	Female	Head (Training Development & Engagement)
R17	Male	Head (Training)
R18	Female	Talent Manager
R19	Female	Head (Talent & Management)

R20	Male	Manager
R21	Male	Advisor
R22	Male	Director
R23	Male	Director
R24	Male	Manager
R25	Female	Senior Manager
R26	Female	Manager
R27	Male	Manager
R28	Female	Senior Talent Acquisition Consultant
R29	Male	Manager
R30	Male	Manager

A qualitative, descriptive, and exploratory research design was employed to explore employers' challenges in addressing skill mismatches in the job market and propose actionable solutions. This participant-centred approach and semi-structured interviews effectively gathered detailed insights and subjective opinions (Brown & Lloyd, 2001). The semi-structured format facilitated a flexible yet focused exploration of hiring trends, skill expectations, and the evolving demands of the labour market.

Pilot testing was conducted with five employers prior to the primary interviews. Feedback from these pilot interviews informed the refinement and enhancement of the interview questions to ensure clarity, relevance, and effectiveness. The finalised interview questions were shared with participants in advance to allow them to prepare, thereby fostering more productive and thoughtful discussions.

The principle of reflexivity was upheld throughout the interviews, creating an environment where respondents felt free to express their thoughts and ideas openly and without interference. Each interview lasted approximately one hour.

4 FINDINGS AND DISCUSSIONS

Organisations are increasingly investing in various training programmes to reskill and upskill their workforce, primarily targeting fresh graduates entering the job market. Literature evaluating the effectiveness of training programmes highlights several critical factors that contribute to successful outcomes. These factors include improvements in knowledge and skills, well-designed course content, practical training approaches, facilitator performance, appropriate training schedules, and conducive training environments (Mohammad & Aziz, 2021; Hajjar & Alkjanaizi, 2018). While these factors are essential for delivering practical training, this study focuses on the challenges employers face when implementing such programmes to bridge skill gaps. Findings reveal four primary challenges: resistance to change among fresh graduates, intergenerational differences, unclear job expectations during the hiring process, and organisations' limited access to training resources.

(i) Resistance to Change

Employee resistance to change remains one of organisations' most significant challenges, particularly when job requirements evolve. This resistance manifests when employees are reluctant to adapt to new roles, methods, or training programmes, which can significantly impede organisational transformation. In the context of this study, resistance to change refers specifically to employees' unwillingness to embrace shifting job requirements, ultimately hindering efforts to address skill mismatches. As noted by employers, resistance is especially prevalent among senior or long-tenured employees, who tend to be less inclined to embrace new tasks or adopt continuous

learning mindsets. For example, R12 highlights resistance as a critical issue, exacerbated by dissatisfaction with training schedules, while R17 points out that senior employees may view new responsibilities as outside their job scope. This resistance hinders the organisation's ability to upskill its workforce, leaving employees ill-prepared for a dynamic industry landscape. Furthermore, some employees resist participating in training programmes due to inconvenient schedules or office hours, further diminishing the effectiveness of skill development initiatives.

To address this challenge, managerial support and active employee involvement are crucial. Organisations can reduce resistance by empowering and involving employees in the change process. Literature suggests that education, communication, and collaborative planning can effectively minimise resistance (Amarantou et al., 2018). Through these approaches, organisations can foster an environment that promotes ownership of learning and development, encouraging a culture of continuous improvement.

(ii) Intergenerational Differences

Intergenerational differences in adaptability present another significant challenge in reducing skill mismatches and fostering workforce upskilling. Younger employees are typically more open to change, demonstrating enthusiasm for adopting new technologies and innovative practices. As R17 mentions, their proactive behaviour often drives their willingness to learn and adapt, positioning them as key contributors to bridging skill gaps. In contrast, older employees may resist new methods or technologies, viewing them as unnecessary or outside the scope of their established roles. This reluctance can hinder organisations from maintaining a competitive, updated workforce, especially in industries where technological advancements demand continuous learning.

Employers face the challenge of addressing this gap in adaptability and fostering proactive behaviour across all age groups. To mitigate skill mismatches, organisations must implement strategies encouraging employees of all ages to engage in continuous learning and development. Tailored training programmes, for example, can help older employees gradually develop proficiency in new technologies, demonstrating how these skills enhance their roles. Moreover, creating a culture of initiative and self-directed learning can empower employees to take ownership of their personal and professional growth, reducing resistance to change.

(iii) Unclear Job Expectations

Unclear job expectations significantly contribute to skill mismatches, as employees may struggle to understand their roles and responsibilities. This lack of clarity hinders employees' ability to acquire the skills necessary for effective performance. Research by Vorecol (2024) suggests that nearly 70% of employees experience uncertainty regarding their roles, which leads to disengagement, reduced productivity, and increased turnover rates. Inaccurate or outdated job descriptions further complicate this issue by creating unrealistic expectations and employee dissatisfaction.

Additionally, R14 and R16 highlight the problem of resume misrepresentation, where candidates exaggerate their skills, resulting in mismatches between actual competencies and job expectations. Bryan (2023) reports that 70% of workers admit to lying on their resumes, which can result in hiring individuals whose qualifications do not align with the job requirements. This discrepancy negatively impacts performance and productivity and can harm the organisation’s reputation.

To address these challenges, organisations must regularly update job descriptions to reflect evolving roles and industry demands. Clear and accurate job descriptions are essential for guiding recruitment and performance evaluations. Furthermore, organisations should enhance transparency during recruitment by incorporating skills assessments and reference checks to verify candidates' qualifications. By improving communication and aligning job expectations with employee capabilities, Organisations can reduce skill mismatches and improve employee satisfaction.ies.

(iv) Limited Access to Training Resources

Limited access to training resources presents another challenge that hampers the effective development of employee skills. As noted by R12, resource constraints, such as insufficient training venues and a lack of qualified trainers, hinder organisations from delivering comprehensive training programmes. This issue is especially pronounced in organisations with inadequate infrastructure to support large-scale training initiatives. R25 also emphasises the scarcity of practical training for technical skills, which is particularly challenging for fresh graduates who struggle to keep pace with the training.

Technological advancements exacerbate this issue, as new tools and platforms demand continuous skill updates. Recent studies indicate a growing divide between the theoretical knowledge gained in formal education and the practical skills required in the workplace (Naif et al., 2022). Fresh graduates frequently find it challenging to adapt to new technologies, highlighting the need for adaptive learning approaches that cater to diverse learning speeds.

Organisations should invest in scalable and flexible training solutions, such as online platforms and virtual training programmes to address these challenges. These resources can alleviate constraints related to training venues and instructor availability. Collaborating with educational institutions or external training providers can facilitate specialised programmes tailored to industry needs. A blended learning strategy that integrates theoretical knowledge with hands-on practice can better prepare employees for the evolving demands of the workplace. Mentorship programmes and peer learning opportunities can further assist fresh graduates in adjusting to new technologies at a manageable pace.

5 CONCLUSION

This study highlights the growing challenge of skill mismatches in Malaysia's workforce, particularly among fresh graduates. Technological advancements and shifting industry demand create gaps between the skills employers seek and those graduates possess. The findings reveal that key obstacles, such as resistance to change, generational differences in adaptability, unclear job expectations, and limited access to training resources, significantly contribute to these mismatches. These factors impede employees' ability to meet evolving job requirements and hinder organisations' efforts to foster a skilled, adaptable workforce.

To address these challenges, this study proposes several actionable strategies. First, organisations should invest in tailored training programmes that accommodate employees' diverse learning needs, particularly for older employees who may struggle with new technologies. Clear and precise job descriptions and transparent recruitment processes are essential for aligning employee skills with organisational needs. Furthermore, fostering a culture of continuous learning, supported by strong managerial involvement, is crucial to reducing resistance to change and encouraging proactive behaviour among employees of all generations. Organisations should also consider scalable and flexible training solutions, such as online platforms and mentorship programmes, to overcome resource constraints and ensure employees develop the skills necessary to thrive in an ever-changing work environment.

The study emphasises the importance of collaboration among employers, policymakers, and educational institutions to bridge the skill gaps and better align graduate competencies with labour market demands. A stronger emphasis on developing entrepreneurial mindsets, enhancing English proficiency, and integrating adaptive, technology-enabled training frameworks can help prepare graduates for the complexities of today's dynamic job market. By addressing these barriers and fostering a more adaptable workforce, Malaysia can enhance graduate employability, reduce skill mismatches, and contribute to a more resilient and competitive economy.

In terms of future research, studies could further explore the impact of specific training interventions on reducing skill mismatches, particularly those targeting older employees or industries experiencing rapid

technological changes. Additionally, longitudinal studies examining the long-term effects of generational differences in adaptability on career progression and organisational outcomes would provide valuable insights. Future research could also investigate the role of educational institutions in bridging the gap between academic learning and industry requirements, offering a deeper understanding of how curriculum reforms can better prepare graduates for the workforce. Expanding research on the effectiveness of hybrid and adaptive learning models in overcoming resource constraints could also offer innovative solutions for addressing skill gaps across various industries.

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The Mediating effect of Organizational Culture between Organizational Training and Employee Well-Being

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ABSTRACT
The attitude of the organization depends on the commitments of all employees in the organization, and the working environment is essential for employees to strive to their full potential. Thus, this present study aimed to examine the mediating effects of organizational culture between organizational training on employee Well-Being. A sample of 120 employees responded to the survey and were selected through a quota and stratified sampling. A questionnaire was adopted and adapted which examined the impact of training on employee performance in the organization. The inferential analysis method was used to achieve the objectives of the study. In addition, the test of direct and indirect effects in SPSS were utilized through the Sobel test for mediation procedures. The study concluded several findings, most importantly the statistically significant positive direct effect of organizational training on employee well-being among Tenaga Nasional Berhad (TNB) who are in the Human Resources Department and the Islamic Affairs Department respectively. Organizational training has a statistically significant effect on organizational culture. In addition, the study revealed that organizational culture partially mediates between organizational training and employee well-being. However, organizational training has an insignificant statistical indirect effect on employee well-being via organizational culture. This research results contributed by highlighting the significance of organizational training on employee well-being in raising awareness and improving employees Tenaga Nasional Berhad (TNB).

KEYWORDS: Organizational Training, On Job Training, Organizational Culture, Employee Well-Being

1 INTRODUCTION

The well-being of an employee is the key progress of all organizations, be it public or private. The physical, mental, and emotional well-being of an employee must give the utmost priority in the sector. The component of well-being may vary through the position of the sector from job satisfaction, work balance and stress levels, sometimes variables such as time lag, age, and job change. The model of circumplex was used in testing employee well-being effectiveness, the model confirmed that employees were generally high, however, it is not a fixed posture, instead it changes overtime due to the means (Jonge & Peeters,2025). The study also found that employee well-being stability is relatively low because the variance in the results show 50% (Manzanares et at, 2024: Makikangas et al.,2016). Research has shown that age and job change are major factors that influence the stability of young employees and job changers have displayed a larger impact on time changes in the well-being compared to the senior employees (Van Vianen et al., 2022). The means of job stayers on the job have shown a positive result across public and private

organizations. Findings also asserted that through a critical review that indicators of employee effectiveness are associated with employee well-being, the research suggested that burnout and job satisfaction can be a meaningful future study for measuring changes in employee's well-being (Van Vianen et al., 2022: Makikangas et al.,2016). Therefore, sustainability and improving employee well-being are significant matters in the international scientific and political discussion on the extension of occupational careers. The demanding period that a career may constitute in one's life is huge because work challenges employee well-being. It is essential to understand and develop awareness about employee well-being in different career stages to be able to suit the appropriate organizational training for better living working and productive working environments. Thus, organizational training is the process of gaining essential knowledge and skills to perform a task in an organization (Mogea, 2023). This process of organizational training is a tool of management for gaining competitive advantage and stabilizing organizational success. The essences of training increase the values and personal development of an organization, which in turn enhances employee's knowledge and skills and improves the organizational goals and management. Training should be effectively implemented to meet the assessment of an organization (Bilderback,2024). Organizations that take the approach of achieving better enterprise performance through training emphasize on making sure that employees are relevant and equipped with skills, information, and tools to perform well in facing a new challenge. Research has shown that organizational training leads to personal growth and transforms organizations' success and employee satisfaction (Yertas, 2024). Another study emphasizes that knowledge gained during the training optimizes and promotes widespread information dynamically in the organization (Wang et al., 2022). According to Panjaitan et bal., (2023) it is the full responsibility of an organization to provide an adequate resource and training for the employees to effectively perform their day-to-day activities to obtain a competitive advantage and seek self-growth.

2 OBJECTIVES OF THE STUDY

1. To examine the effect of organizational training on employee well-being among Tenaga Nasional Berhad (TNB) staff.
2. To determine the effect of organizational training on organizational culture among Tenaga Nasional Berhad (TNB) staff.
3. To examine the effect of organizational culture on employee well-being among Tenaga Nasional Berhad (TNB) staff.
4. To evaluate the mediating effect of organizational culture between organizational training on organizational culture among Tenaga Nasional Berhad (TNB) staff.

3 RESEARCH QUESTIONS

1. What is the effect of organizational training on employee well-being among Tenaga Nasional Berhad (TNB) staff?
2. What is the effect of organizational training on organizational culture among Tenaga Nasional Berhad (TNB) staff?
3. What is the effect of organizational culture on employee well-being among Tenaga Nasional Berhad (TNB) staff?
4. What is the mediating effect of organizational culture between organizational training on organizational culture among Tenaga Nasional Berhad (TNB) staff?

4 LITERATURE REVIEW

4.1 Employee Well-Being

Employee well-being is a critical component of the overall employee well-being, including the emotional well-being of employees. This dimension encompasses an individual's quality of his/her daily emotional experiences, as in the frequency and intensity of emotions such as joy, stress, sadness, anger, and affection. These frequencies directly impact their well-being at work and their overall performance in the organization. (Adeyemi, 2025). Research has documented that emotional well-being is interlinked with the emotional intelligence of a person. Those who possess higher emotional intelligence lead healthier, happier, and productive lives, which contributes to better job performance (Deb et al., 2023). In this context, spiritual well-being significantly contributes to emotional well-being by assisting employees in discovering meaning in their work, coping with stress, and enhancing social and spiritual connections within the workplace. A study by Jena (2022) and Belwalkar et al., (2018) thus confirms that investment in spiritual and emotional development is not only important for employees but also leads to improved organizational effectiveness. Therefore, incorporating training programs that support these two aspects in building a more successful and competitive workforce. Additionally, well-being supported by an element of spirituality in the workplace can help employees cope with complex emotional challenges. Iqbal et al., (2023) explain that spirituality is often considered a black box because it is difficult to translate into models or theories, yet it clearly plays an important role in improving the emotional balance and performance of employees. Employees who have higher levels of spirituality tend to show better resilience to stress, more easily control negative emotions such as anxiety and anger, as well as better at achieving the emotional stability that is necessary for work productivity. Koburtay et al., (2023) also supported the view that workplace spirituality enhances employee commitment and morale, hence creating a better working environment (Hisam & Sanyal, 2021). Incorporating spiritual values into an organizational training program will enable employees to develop a better understanding of life and work objectives (Blanchard & Thacker, 2023). Thus, their attachment to the organization and colleagues will be enhanced. This approach not only benefits individuals but also ensures alignment between employee well-being and the overall success of the organization (Jena,2022). In addition, the integration between well-being and spirituality in the workplace not only impacts individuals but also the overall organizational environment.

Koburtay et al., (2023) emphasizes that spirituality has a positive relationship with the emotional, psychological, social, and spiritual well-being of employees, all of which complement each other to ensure that employees can function optimally in the organization. When employees feel more emotionally and spiritually connected, they tend to exhibit higher levels of motivation, a deeper sense of meaning in their work, and an increased ability to adapt to change. Lee & Kim (2023) state that investing in employees' mental and emotional well-being leads to improved performance as well as a higher sense of job satisfaction. Therefore, training programs that emphasize spiritual values can be an effective tool in helping employees maintain emotional well-being, thus contributing to the long-term effectiveness of the organization.

The well-being of employees in the organization is one of the important dimensions of an employee's spiritual well-being, which directly impacts their quality of life at work. Strong emotional well-being allows employees to better manage emotions, increase productivity, build harmonious interpersonal relationships, as well as contribute to a positive work culture. Previous studies emphasized that employee well-being can be impacted by emotional and spiritual intelligence through improving motivation, emotional resilience, and supportive relationships in the workplace (Ibrahim et al.,2022). In addition, the integration of spiritual elements in training programs is seen to be able to reduce work stress, increase mental endurance, as well as strengthen employees' social capacity (Archer et al.,2024). Therefore, organizations are advised to pay serious attention to the development of employees' spirituality through the implementation of holistic training programs, so that employees' emotional and spiritual well-being can be achieved, thereby contributing to the overall excellence of the organization.

4.2 Organizational Training

The actors involved in organizing the training in the organization should understand the gravity of the establishment of training to access organizational training and different types of training provided to the employee and support for organizational training. The financial capacity of the organization is vital, human resources, organizational performance and employee well-being can be accomplished through careful financial support from the stakeholders (Garcia, 2025). Many studies have identified that organizational training is positively related to employee well-being and human resource outcomes (Lestari et al.,2024). However, the organizational training is weakly related to financial outcomes (Pena et al.,2024). Another result shows that organizational training is more related to organizational performance which deals with employee wellbeing, the mediated factors were employee attitudes and human capital (Fletcher et al., 2018). Organizational training and organizational support are statistically related to strategic human resource management rather than configurational perspective (Agirre Aramburu et al.,2024). Organizational training has made it possible for employee well-being to thrive within the context of developing employees in the workplace. This harvest has made it possible for employees to understand the different types of training will be effective for their well-being. Research has shown that training on the job is effective for employee well-being to strengthen and strive for organizational excellence (Singha & Singha, 2024). The sustainability of public and private organizations is gauged according to the employee well-being through productivity of collective performance. Research has also claimed that wisdom and organizational training can work together to expiate organizational performance which in turn will facilitate the well-being of employees (Deepalakshmi et al.,2024). Pelealu (2022) in his study believed that organizational behavior and training will play a significant role in improving the well-being of employees because the outcome of any organization relies deeply on the individuals' contributions.

4.3 On-The-Job Training

The systematic and organized are mostly required by the employees to familiarize them with the working environment as well as to gain experience and perform better. The organization may be requiring employees to acquire some certain knowledge on how to operate machinery, equipment and tools. The on-the-job training will be a source of information and confidentiality for employees to strive in their various endeavors to actively perform tasks adequately from the training (Osiesi et al.,2022). On job training enhances the confidence of employees to perform tasks effectively and efficiently. These promote employee or job seeker interest to carry out a job successfully (Nzimakwe & Utete, 2024). The on-job training improves employee productivity, time management and commitment to retain the individual when the training is successfully completed (Susanto et al., 2024). Furthermore, it reduces the cost of the organizational association because all new employees undergo some form of training, it is essential to differentiate the initial training and orientation regularly provided by the employer to qualify new hires from the additional training that is to be provided for the on-the-job training (Arnold et al.,2024). Research has shown however, that the emphasis on-job training automatically eliminates all jobs that require no more than a brief initial orientation period (Susanto et al., 2024). Therefore, jobs that pay by commission or piece of work are generally considered inappropriate for employees since the organization will be held responsible for the training fee (Gupta et al.,2022). Additionally, seasonal, temporary and part-time jobs should likewise be avoided because the desired outcome of on-the-job training is long-term retention into full-time employment that leads to self-sufficiency (Wen et al.,2023). The organization and employees should be

providing an enabling workplace that could benefit on-job training (Huang, 2019). The decision to assign a participant to on-job training should be based on consideration of the individual's employability skills, skill deficiencies, and interests (Ahmed et al., 2019). The responsibilities that accompany the use of public funds demand that expenditures for training activities be confined to situations where there is a documented need for training; mere subsidies for business or financial incentives to hire are avoided (Osiesi et al.,2022). Thus, the selection of trainees for on-job training should be carefully governed by a well-thought-out process. The skills already possessed by the participant must be considered along with the skills required to do the job (Calhauet al.,2024). On-job training covers a relatively broad range of functions that draw from several occupations that are generally considered as a unique occupation for organizational purposes.

4.3 Organizational Culture

Organizational culture is the power that structure every aspect of an organization through a system of assumptions, values, standards, and approaches, manifested through symbols which the members of an organization have obtained and assumed through mutual experience, and which help them determine the meaning of the world around them and the way they behave in it (Bamidele, 2022: Janicijevic, 2013). Organizational culture designed the organization on how employees work and collaborate with each other to achieve the organizational growth and goals (Grover, 2022). Thus, the culture beyond shared values or written policies but it's the collective behaviours, attitudes, and norms that define how people interact and align with a mutual purpose (Touseef et al., 2023). A strong culture fosters collaboration, drives innovation, and builds trust, influencing every perspective including decision making. Kyla Dewar (2025) emphasizes positive culture promotes moral and teamwork that attracts employees to create an environment where they feel valued and supported, leading to higher involvement of productivity. However, understanding the culture is essential in effective leadership and management which places the organization in a better place (Farrell, 2028). Research has shown that incorporating employee well-being and organisational culture are likely to boost employee interest and willingness strategy will enhance organizational performance (Dora et al.,2019). It is said that organizational culture is critical in shaping the educational organizations and private companies in developing employee well-being which also impacts employee job satisfaction (Alkhodary,2023). It is also important to understand the existing culture of an organisation when thinking of introducing changes. It is often difficult to specify what exactly drives a particular culture, but easier to observe. Conceivably, it can take years for new joiners to fully understand and absorb the culture, or this may happen rapidly depending on the extent to which the organisation has a successful and smoother achievement, especially a senior level officer could modify the existing culture (Einhorn et al.,2024). Therefore, dedicating his whole effort on bushing organization to the top while strategies that are in line with it will be easier to put into effect and more likely to succeed (Kotter et al.,2025). Hence, in practice it should also be recognized that while an organization may have an 'umbrella' culture broadly defining how things should be done and what is acceptable – subsidiary cultures can emerge based on work roles or other allegiances (Einhorn et al.,2024). To gain an understanding of the culture of an organization, its written and unwritten rules should be examined alongside the relationships, values and behaviors displayed by its people (Lam et al.,2021). This checklist begins by outlining some well-known approaches proposed by management theorists to classify organizational cultures.

5 RESEARCH METHODOLOGY

The study uses survey methods consisting of the staff of Tenaga Nasional Berhad (TNB) in Bangi Selangor. The sample of this population was selected using a quota sampling and stratified sampling based on departments which consist of 120 staff. The demographic information of the respondents consists of three categories namely, gender, educational background, department and year of employment.
The questionnaire that was used in this study was adopted and adapted from Lwanga (2018) which examined the impact of organizational training on employee performance in the organization mediated by

organizational culture. The data collected among Tenaga Nasional Berhad (TNB) staff were analyzed through mediated by organizational culture. The questionnaire adopted a Likert scale of 1 to 5. The reliability of the study is 0.92, indicating that the questionnaire is suitable for analysis with such reliability strength.

Table 1 shows the proportion of males and females of 120 who responded to the research questionnaire, male has 56.7% and female has 43.3%, the survey gender structure showed a higher proportion of men than women, which is in line with the nature of the job description. From the frequencies of departments, the sample showed that the human resource contained 26.7%, Islamic affairs 8.3%, engineering 16.7%, and others 48.3% which had the most respondents respectively. In terms of the educational level, the respondents were from certificate, which is presented by 22.5%, diploma represented by 30.0%, degree represented by 35.0%, master's degree represented by 10.8, and PhD is represented by 1.7. Thus, from the frequencies of years of employment of the respondents 18.3% are of 1-5 years of experience, 8.3% are having 6-10 years of employment, 29.2% of the respondents are of 11-20 years of employment, and 44.2% are of 21 and above years of employment.

Table: 1 Demographic Variables

Construct	Category	Frequency	Percentage
Gender	Male	68	56.7
	Female	52	43.3
Department	Human Resource	32	26.7
	Islamic Affairs	10	8.3
	Engineering	20	16.7
	Others	58	48.3
Educational Level	Certificate	27	22.5
	Diploma	36	30.0
	Degree	42	35.0
	Master	13	10.8
	PhD	2	1.7
Years of Employment	1-5 Years	22	18.3
	6-10 Years	10	8.3
	11-20 Years	35	29.2
	21 and above	53	44.2

6 HYPOTHESES

H_a There is a statistically significant relationship between organizational training and employee well-being.
H_a There is a statistically significant relationship between organizational training and Organizational Culture.
H_a There is a statistically significant relationship between organizational culture and employee well-being.
H_a There is a statistically significant mediating effect of organizational culture between relationships of organizational training and employee well-being.

7 HYPOTHESIS SUMMARY

This study incorporates four hypotheses, summarized and presented in Table: 2 These hypotheses were formulated to address the research objectives and to examine the relationship between the key variables in the study.

Table: 2 Hypotheses Summary

Hypothesis	**B**	**Beta**	**t**	**Sig.**	**Decision**
H1	.590	.068	8.690	.000	Supported
H2	.715	.726	9.892	.000	Supported
H3	.242	.278	2.847	.006	Supported
H4	.487	.553	5.662	.000	Supported

Table: 3 displays the SPSS regression outputs. These tables demonstrate the unstandardized and standardized regression coefficient, standard errors, the t and p value the 95%confidence interval for each analysis. Table 1 shows that the independent variable (Organizational Training) is significantly predictor of the dependent variable (Employee Well-Being) ($t = 8.69$, $p < .01$). in other words, organizational training (unstandardized coefficient = .590 is a statistically significant.

Table: 3 Regression Analysis of Organizational Training on Employee Well-Being

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.485	.268		5.537	.000
Organizational Training	.590	.068	.680	8.690	.000

Table: 4 shows that the independent variable (Organizational Training) is significantly predictor of the mediating variable (Organizational Culture) ($t = 9.89$, $p < .01$). in other words, organizational training (unstandardized coefficient = .715) is a statistically significant.

Table: 3 Regression Analysis of Organizational Training on Organizational Culture

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.853	.285		2.988	.004
Organizational Training	.715	.072	.726	9.892	.000

Table: 5 shows that while controlling for the independent variable (Organizational Training), the mediating variable (Organizational Culture) is significantly predictor dependent variable (Employee Well-Being) ($t = 5.662$, $p < .001$). That is organizational culture (unstandardized coefficient = .487) is a statistically significant.

Table 5 :Regression Analysis of Organizational Training and Organizational Culture on Employee Well-Being.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.853	.285		2.988	.004
Organizational Training	.242	.085	.278	2.847	.006
Organizational Culture	.487	.086	.553	5.662	.000

8 SOBEL TEST

To utilize Sobel test, these steps:

Determine both "a and b" unstandardized regression coefficients and their standard errors (Sa and Sb respectively) These values are found in the tables 2 and 3, respectively, and are summarized in figure 1.

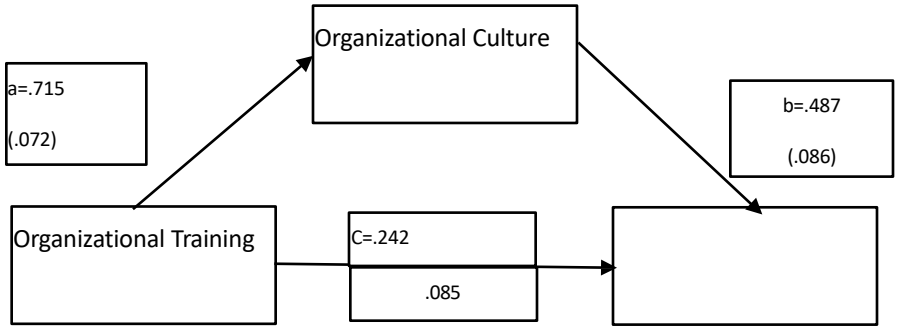


Figure1: Unstandardized Regression Coefficient and Standard Errors

Input:			Test statistic:	Std. Error:	*p*-value:
a	.715	Sobel test:	9.78466824	0.0355868	0
b	.487	Aroian test:	9.78322166	0.03559206	0
s_a	.072	Goodman test:	9.78611547	0.03558153	0
s_b	.0085	Reset all	Calculate		

Screen 1: Computer Calculator for Mediation

Screen 1: displays the results of the Sobel test as well as two additional tests: Aroian and Goodman test s. The latter two tests use slightly modified formulas of the Sobel test to compute the Z score (MacKinnon, Warsi and Dwyer 1995).

9 RESULTS AND DISCUSSION

The Sobel test was utilized to examine the mediating effect of organizational culture between organizational training and employee well-being. The first results of simple linear regression show that organizational training was a statically significant predictor of employee well-being (b = .59, beta = .68, t = 8.69, p <.01).

Next when the mediator, organizational culture, was entered into the regression analysis, organizational training was also a significant predictor of employee well-being (b = .71, t = 9.87, p < .01). On the other hand, the mediator, organizational culture, emerged as a significant predictor of employee well-being (b =.48, t = 5.66, <.01). To further investigate the mediator, Sobel test was utilized to examine if organizational culture significantly mediated the relationship between organizational training and employee well-being.

The results confirmed that organizational culture significantly mediates between organizational trai ning and employee well-being ($Z = 9.78$, $p < .001$). In line with the hypotheses of this study, many literatures have supported the idea of organizational training and employee well-being. A study conducted by Slutsky et al., (2019) asserted that organizational training and employee well-being have positive a outcome on training employees for a half-day with a great decrease in work–life conflict, fostering increased perceptions of job productivity, a positive relationship to work among employees and positive correlation to job satisfaction. Johnson et al., (2020) also confirmed in their investigation that to improve mental health among employees there must be organizational training, this is because employees' performance should be given priority due to the influence on individuals, team and organizational were identified as significant factors. Although this research is not directly related to organizational training and employee well-being, among the variables addressed were training and psychological well-being. The findings concluded that the positive effects of training on employee psychological well-being is a drive that improves employees' well-being and relationships among employees (Agarwal et al., 2020). Another study by Schubin et al., (2023) supported that workplace training programs are promising in promoting and facilitating employee mental health and working capabilities. There are few studies among many other studies that suggest that there is a potential positive relationship between organizational training and employee well-being.

10 CONCLUSIONS

The objective of the present study is to examine the role of mediating the effect of organizational culture between organizational training and employee well-being. The direct and indirect impacts of organizational training on employee well-being were examined. To test the proposed hypotheses, the Sobel test was utilized to examine the mediating effects analysis was conducted with a sample of 120 full-time employees in Malaysia. The results of this study showed a significant direct effect of organizational training on organizational culture which in turn had a significant influence on employee well-being. Organizational training had only a partial indirect effect on organizational culture among employees. These results bring out the importance of mediating roles of organizational culture on employee well-being.

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The Effect of Learning Methods on Academic Assessment Mediated by Quality Culture

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ABSTRACT
The importance of learning has been a major catalyst of any higher institution of learning due to the emergence of fast and rapid development of recent technologies. The role of teaching and learning are essential to develop a competent learner to face global challenges through an academic assessment. This study aims to examine the effect of learning methods on academic assessment mediated by quality culture in the educational arena. A quantitative research approach was used to identify the direct and indirect effects of the relationship between the variables. A questionnaire was adopted and adapted from previous studies to achieve the objectives of the research. A stratified random sampling was utilized for a total of 125 students who responded to the survey questionnaire. Thus, to test for the suggested hypotheses, based on the four hypotheses three hypotheses have direct relationship, which have significant effects. Besides, the results show that quality culture partially mediates the relationship between those learning methods and academic assessment. Therefore, the study concluded that academic assessment is a vital variable for academic improvement towards students' learning methods in higher institutions of learning.
KEYWORDS: Learning methods, learning environment quality culture, academic assessment

1 INTRODUCTION

Educational institutions are urged to investigate the new mode of assessment in higher education due to the adverse effects of technology and artificial intelligence machines in the learning environment. It is advisable to foresee some of how assessment will be more meaningful to access the capabilities of studies. This is because assessment of student assessment both individually and as a group is a vital aspect of the education process and has been a component of education. Therefore, academic assessment is the process of observing and measuring learning because the rationale of evaluating student learning achievement levels is to improve student learning by monitoring students' procurement of awareness and progress in mastering the curriculum (Mohan, 2023). The two angles that assessment has taken in the arena of education are formative assessment and summative assessment. The formative assessment is non-evaluative, designed to monitor student progress, and guide education decisions; meanwhile the summative type is looking into how subjects are designed to evaluate, used to assign grades or determine if some programmed criteria have been met according to the evaluation criteria (Sagarika et al.,2021). Thus, it is essential to bear in mind that assessments are meant to specify and verify problems to make suitable decisions. Some researchers have identified the purpose of student assessment as follows by identifying student strengths and weaknesses, monitoring student progress, assessing prior student knowledge, constructive approaches, educational

technologies, and diverse assessment methods (Zou et al.,2024). Therefore, constructive feedback and assessment are found to be a tool for improving student learning and performance.

2 OBJECTIVES OF THE STUDY

1. To examine the effect of learning environment on academic assessment among undergraduates.

2. To determine the effect of learning environment on quality culture among undergraduates.

3. To examine the effect of quality culture on academic assessment among undergraduates.

4. To evaluate the mediating effect of quality culture between learning environment and academic assessment among undergraduates.

3 RESEARCH QUESTIONS

1. What is the effect of learning environment on academic assessment among undergraduates?
2. What is the effect of learning environment on quality culture among undergraduates?
3. What is the effect of quality culture on academic assessment among undergraduates?
4. What is the mediating effect of quality culture between learning environment and academic assessment among undergraduates?

4 LITERATURE REVIEW

4.1 Academic assessment

Academic assessment determines the level of understanding of a student's academic activities and achievement through the series of classroom activities. Therefore, to understand the student activities by assessing the formative and summative requirements in the classroom. Academic assessment can be defined as the process of measuring and evaluating students' academic performance, progress and performance (Baines et ai.,2025). It allows teachers to identify students' strengths and weaknesses. Students tend to perform optimally during the assessment as it forecasts their ability to proceed in the academic line. Petherick et al., (2021) claimed some possible strategies used to examine the assessment are not consistent with the individual behavior in the academic arena. The information and instruction given might affect students' performance. Several methods are required to obtain a comprehensive understanding of the nature of the assessment issue (McIntosh et al.,2024). The process of assessment needs to cut across the range of direct and indirect approaches to capture a complete viewpoint of the academic skill glitches that the student is experiencing (Dietrich & McWatt, 2025). A brief review of direct assessment methods built on observation, curriculum-based assessment, normative or criterion-referenced standardized tests, are to be administered permanently (DePascale, 2025). A portfolio review is necessary, rating scales and interviews with both lecturers and students. This method improved academic assessment fairly, its widely used method in academic assessment according to (DePascale, 2025). Therefore, academic assessment is essential for fostering an ethos of continuous improvement within educational institutions. It provides valuable insights into the effectiveness of teaching strategies and the relevance of curricula, in that way of transforming decision-making processes (Clinciu, 2023). However, evaluation and assessment play a vital role in determining the educational scenery. By measuring learning outcomes, informing instructional practices, ensuring accountability, and supporting student development, these processes contribute significantly to the quality of education. Most institutions strive to meet the diverse needs of their students and adapt to the challenges of the contemporary world.

4.2 Learning methods

Learning methods have a significant role to play in educational institutions. Learning style provides appropriate understanding to the students by implementing some criteria such as right material, conducive learning environment and motivation to improve their cognitive thinking (Meng, 2023).Furthermore, learners feel interested in the depth of their purpose of their learning, it developed their confidence and self-esteem that transformed the organization to reach its goals in a short period of time. The learning style tempts to clarify most areas of ambiguity and work procedure to employees to work accordingly. Marquardt & Kearsley (2024).) asserts that learning benefits both organization and students in various ways it transmits impossible challenges to achievement in the workplace at large. In addition, learning is an individual's gradual progress. Similar educational and background experience, personality traits, levels of motivation and numerous other variables affect the way of learning. Individuals think and reason differently, so each person has a different learning style that refers to the general way he/she prefers to have information presented (Dietrich & McWatt, 2025). Learning styles allow the organization and employees to solve critical issues, process, learn and remember new information in their own way. However, students should have his/her learning preference of learning method such as, instructors can often have preferred teaching styles. Therefore, some teaching styles include lectures, conferences, demonstrations, workshops and discussions. It is important for students to discover their instructors' teaching method to adjust their learning method, both in class and the learning space have the maximized choice of learning when they understand their preferred learning style and select study strategies that capitalize on learning preferences and personal strengths (Erwin, 2024). Therefore, some institutions of higher learning should utilize one learning style exclusively, and there is usually a significant overlap in learning methods. Presently there are many learning style assessments and inventories that can be used to help educational institutions determine their predominant learning style and strengths in their abilities (Song & Cai,2024). Thus, educational institutions must be ready to close the gap between lecturers and students to have a very conducive environment for all parties.

4.3 Learning Environment

The concept of a learning environment is an essential element in education. The learning environment should be convenient enough to provide learners and adequate support to learn and understand the knowledge and information being given. This is the opportunity to succeed and better thoughtful collaboration and encouragement to improve learning procedure and learning environment should provide safe and conducive space (Song & Cai, 2024). Rashov (2024) found that students feel more engaged and motivated in a convenient facility of learning environment. They have positive involvement by being active participants exploring the relevance of what they were learning as a key to excel in their academics. Research reports that an environment that is motivated to deliver knowledge and information is often touched that this motivation was powered by the reactions of students that creates a positive recurring pattern in which one team feeds into the motivation and engagement levels of the other (Daniel et al.,2024). However, this can also delay the learning environment if there's a lack of engagement and motivation in one group of students could bring down the demotivation of the hard work of the other. For instance, students pay more attention to their phones than to a lecture or faculty lecturing for the entire class period.

Faroji et al., (2024) strongly agreed that nurturing a positive learning atmosphere fosters quality outcome. Students and lecturers are extrinsically and intrinsically motivated and energized to maximize their potential, often likely to initiate learning progress. Equally, the classrooms should have acceptable equipment to enhance learning as well as students should be familiar with the discipline environment and its consequences. Therefore, within the university surroundings, students must be passionately prepared to learn and express themselves (Putra & Kudri, 2024). In this regard, constant and regular motivation in the classroom can foster students to become resilient, independent learners. Thus, they should be fearless of tasks nonetheless see the task as an advantage to growth and development of their understanding (Putra & Kudri, 2024). This is when there is a positive environment, students are better able to properly express their needs, feelings, goals, ideals, ambitions and objectives to diversify academic progress.

4.4 Quality Culture

Quality culture plays a significant role in nurturing a space where the students study due to the surroundings of the institutions (Raju, 2024). All educational learning needs to provide a unique culture for learning to achieve an institutional goal. Therefore, with a good quality culture being administered, it is possible to achieve great academic excellence. This is because quality culture will prevail over the learning capacity of higher institutions students. The driving strength of quality culture in the learning space is essential to promote a healthy atmosphere for learners (Dziminska et al.,2018). Thus, quality culture indicates decent morality, values, common beliefs and mutual understanding to enhance the operational efficiency in the educational institutions. Wuletu et al., (2024) suggested that it is essential to promote quality culture in the educational arena to enable students to continuously improve their educational achievement. In addition, quality culture ensures students productivity to meet the educational demand of original learning goal achievement. Research has shown that quality culture encourages a student approach to identify and address potential quality issues early in the development of all learning levels Arcaro (2024). It promotes the mindset of students for continuous improvement, resulting in higher-quality graduates in the institution (Arcaro, 2024). There will also be a good form of satisfaction with student engagement by the institution. The institution should empower students who are satisfied and ready to contribute to the improvement of quality in academics. This quality culture nurtures a sense of ownership, pride, and engagement in their studies (Pedro et al,.2025). Hence, a quality culture, students are more likely to be satisfied, motivated, and committed to delivering their best, leading to higher productivity in various achievements. A strong quality culture encourages excellence, and continuous improvement throughout an institution (Pedro et al,.2025). It aligns with the processes of developing students towards delivering a supportive goal shared along with several benefit performance to improve overall institution progress. Albaroudi, & Iqbal (2024). claimed a significant positive effect of quality culture in institutional performance through consistency and persistence to orientate students.

5 RESEARCH METHODOLOGY

This applied a stratified random sampling technique to choose the sample from the population of the study. Stratified random sampling is defined as a process of stratification or segregation which is usually followed by randomly selecting the subjects from each stratum (Sekaran & Bougie, 2016). A total of 135 questionnaires were distributed to 4th year students. Distribution and collection of the questionnaire were done manually, and the survey time was 2024.After valid surveys were excluded, 125 valid surveys were collected. The response rate was an acceptable 92.5%. The questionnaire was adopted and adapted from Estaji & Ghiasvand (2021) which examined the assessment perceptions and practices in the academic domain, this was used to assess the academic assessment among students in the university. The data collected among students were analyzed through mediation by quality culture. The questionnaire adopted a Likert scale of 1 to 5 which has been used by several studies. The reliability of the study is 0.96, indicating that the questionnaire is suitable for analysis with such reliability strength.

Table 1 shows the proportion of males and females 125 (26.4) and (73.6); the survey gender structure showed a higher proportion of female students than male students. This indicates that in the program of Arabic language and Islamic Literature 4th year students the female students are more than male students. respondent who responded to the survey via questionnaire. From the frequencies of the age groups of the sample 64.0% of them are in the age group of 21-23 years old and 36.0% of total respondents are between 24-26 years old. In terms of the program in the faculty, 100% of the 4th year students in the faculty.

Table: 1 Demographic Variables

Construct	Category	Frequency	Percentage
Gender	Male	33	26.4
	Female	92	73.6
Age	21-23	80	64.0
	24-26	45	36.0
Program	Bachelor of Arabic language and Islamic Literature with Honors	125	100.0

6 HYPOTHESES

H_a The is a statistically significant relationship between learning environment and academic assessment among undergraduates.

H_a There is a statistically significant relationship between learning environment and quality culture among undergraduates.

H_a The is a statistically significant relationship between culture and academic assessment among undergraduates.

H_a The is a statistically significant mediating effect of quality culture between learning environment and academic assessment among undergraduates.

7 HYPOTHESIS SUMMARY

This study incorporates four hypotheses, summarized and presented in Table 2 These hypotheses were formulated to address the research objectives and to examine the relationship between the key variables in the study.

Table: 2 Hypotheses Summary

Hypothesis	B	Beta	t	Sig.	Decision
H1	.182	.303	3.522	.001	Supported
H2	. 877	.979	53.125	.000	Supported
H3	. -.039	-.064	-3.331	.001	Supported
H4	.898	1.003	52.743	.000	Supported

Table 3 displays the SPSS regression outputs. These tables demonstrate the unstandardized and standardized regression coefficient, standard errors, the t and p value the 95%confidence interval for each analysis. Table 2 shows that the independent variable (Learning Methods) is significantly predictive of the dependent variable (Academic Assessment) ($t = 3.52$, $p < .01$). In other words, learning methods (unstandardized coefficient = .182 is statistically significant.

Table 2 :Regression Analysis of Learning Methods on Academic Assessment

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	2.398	.174		13.743	.000
Learning Methods	.182	.052	.303	3.522	.001

Table 3 shows that the independent variable (Learning Methods) is a significant predictor of the mediating variable (Quality Culture) (t = 53.12, p <.00). In other words, learning methods (unstandardized coefficient = . 877) is statistically significant.

Table 3 :Regression Analysis of Learning Methods on Quality Culture

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.144	.056		2.583	.011
Learning Methods	.877	.017	.979	53.125	.000

Table 4 shows that while controlling for the independent variable (Learning Methods), the mediating variable (Quality Culture) is significantly predictor dependent variable (Academic Assessment) (t = -3.331, p <.001). Therefore, the quality culture (unstandardized coefficient = .898) is a statistically significant.

Table: 4 Regression Analysis of Learning Methods and Quality Culture on Academic Assessment

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.853	.285		2.988	.011
Learning Methods	-.039	.011	-.064	-3.331	.001
Quality Culture	.898	.017	1.003	52.743	.000

8 SOBEL TEST

To utilize Sobel test, these steps:

Determine both “a and b” unstandardized regression coefficients and their standard errors (Sa and Sb respectively) These values are found in the tables 2 and 3, respectively, and are summarized in figure 1.

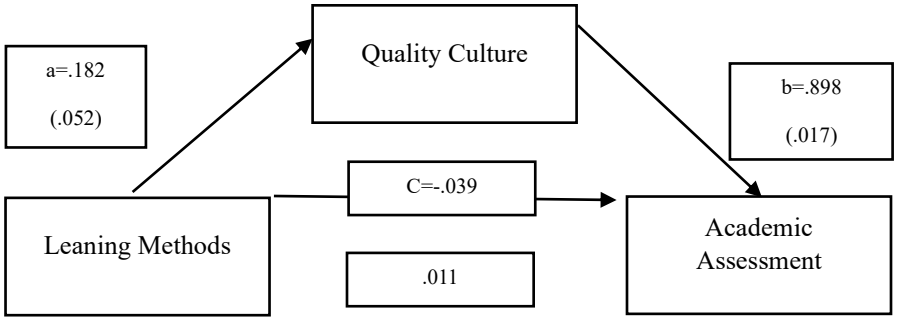


Figure1: Unstandardized Regression Coefficient and Standard Errors

Input:			Test statistic:	Std. Error:	*p*-value:
a	.182	Sobel test:	3.49234241	0.04679839	0.0004788
b	.898	Aroian test:	3.49171952	0.04680674	0.00047992
s_a	.052	Goodman test:	3.49296563	0.04679004	0.00047769
s_b	.017	Reset all	Calculate		

Screen 1: Computer Calculator for Mediation

Screen 1: displays the results of the Sobel test as well as two additional tests: Aroian and Goodman test s. The latter two tests use slightly modified formulas of the Sobel test to compute the Z score (MacKinnon, Warsi and Dwyer 1995).

9 RESULTS AND DISCUSSION

The Sobel test was utilized to examine the mediating effect of learning methods between quality culture and academic assessment. The first result of simple linear regression shows that learning methods were a statically significant predictor of academic assessment (b = .18, beta = .30, t = 3.52, p <.01). Next when the mediator, quality culture, was entered into the regression analysis, learning methods were also a significant predictor of academic assessment (b = .87, t = 53.12, p < .00). On the other hand, the mediator, quality culture, emerged as a significant predictor of academic assessment (b = .89, t = 52.74, <.00). To further investigate the mediator, Sobel test was utilized to examine if organizational culture significantly mediated the relationship between learning methods and academic assessment. The results confirmed that quality culture significantly mediates between learning methods and employee academic assessment (Z =3.49, p <.000). There is no doubt that the university strives to ensure quality education across the nation, meeting the bigger aims of the country. According to experimental theory students display learning preferences which result in having different marks in their assessment. Maya et al., (2021) conducted research and found that some variables are main factors that help in student assessment such as multiple choice, open-ended questions, short answer, creation-elaboration and an elaboration question on the relationship between theory and practice. The study also found that personal and educational variables defined the learning styles in the study. Furthermore, abstract conceptualization was also correlated with medium-high performance in all assessment methods and this variable projected constant high performance, autonomous of the assessment method. Sanchez-Cabrero et al., (2021) concluded that online assessment has increased grades by 10% with the same validity and reliability of learning outcomes. Ismail et al., (2022) asserted that summative and formal assessment should be adopted by higher institutions for learning methods and teaching learning diversity.

10 Limitations and suggestions for future studies

This study has several limitations that warrant consideration. Firstly, the population under study was 4-year students in one faculty due to time constraints. The researcher was unable to collect data from all students in the program. This could limit the generalizability of findings. The research also investigates teaching methods and assessment in general, not specifically demanding a summative and formative assessment. Therefore, future research should prioritize longitudinal designs to explore the correlation between summative and formative in identifying learning methods that will be applicable to all students. The study also may involve other programs and faculties to see how the findings will look differently.

11 CONCLUSION

The aim of the present research is to examine the role of mediating the effect of quality culture between learning methods and academic assessment among higher institution students. The direct and indirect impacts of learning methods on academic assessment were examined. To test the proposed hypotheses, the Sobel test was utilized to examine the mediating effects analysis conducted with a sample of 125 students. The results of this study showed a significant direct effect of learning methods on quality culture which in turn had a significant influence on academic assessment. Learning methods had only a partial indirect effect on quality culture among higher institution students. These results bring out the importance of mediating roles of quality culture on student academic assessment.

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The Mediating effect of off-the-job training between Quality Culture and Employee Job Performance

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ABSTRACT
The growth of an organization is based on the quality that is possessed through a defined and reliable quality culture which will enhance employee job performance. This is because quality culture will promote excellence, employee focus and continuous improvement in the organization. This study examines the mediating effects of off job training between quality culture and employee job performance. A sample of 90 employees responded to the survey and were selected through stratified sampling. Ramos-Villagrasa, et al. (2019) and Saeedi (2017). was adopted and adapted to achieve the purpose of the study. In addition, to test the direct and indirect effects Baron & Kenny, (1986) and Preacher & Hayes (2008) in SPSS were utilized through the Sobel Test for mediation procedures. The findings of this study revealed that there is a statistically significant direct effect between quality culture and employee job performance. Off-the-job training has a statistically significant effect on employee job performance. Thus, the indirect effect of off-the job training has partially mediated between quality culture and employee job performance. Finally, study results show that the off-the-job training is significantly meditating on the variables in this research.

KEYWORDS: Job Performance, Quality Culture, Off Job Training, Leadership Training, Employee Behaviour.

1 INTRODUCTION

There is a higher demand in the organizational arena for quality culture demand which relates to interactions of employees within the organization. These organizations are filled with different employees who are ready to participate and contribute positively to the success of the organization. (Mumtaz et al.,2024). Therefore, there is a need to interact with employees to understand grievances and communicate with the right channels to overcome these issues. Among what has been proposed previously was training in general which consists of on-the-job training, off-the-job training, quality training, diversity training, soft skills training and leadership training (Pastore & Pompili, 2020). Another research proposed that for employees to perform in the workplace there should be two means of communication between the employer and employees, this will pave the way for common understanding that will last for years in the future (Sopandi et al.,2024). Many researchers have discovered that for any industry or organization to be efficient and efficient there should be an achievement of employees' performance (Liaquat et al.,2024). Another research mentioned that employee quality life has a significant impact on employees' engagement, job satisfaction and employees job performance. Moving from the concept of good life provided by the organization can promote the outcome of the organization (Wang et al.,2019). This study examined the

work culture, motivation, and quality of work life on the relationship between employee's job performance and job performance. The results indicated that work culture has a negative impact on the effect of employee job performance (Natasya & Awaluddin, 2021). Furthermore, the results indicated that motivation and work culture have a positive outcome on employee job performance. Understanding the nature of research on the importance of employee job performance to strive for the organization in a better position by considering the strength and the weakness.

2 OBJECTIVES OF THE STUDY

1. To examine the effect of quality culture on employee job performance among Tenaga Nasional Berhad (TNB) administrative staff.
2. To determine the effect of quality culture on off job training among Tenaga Nasional Berhad (TNB) administrative staff.
3. To examine the effect of off job training on employee job performance among Tenaga Nasional Berhad (TNB) administrative staff.
4. To evaluate the mediating effect of off-the- job training between quality culture and employee job performance among Tenaga Nasional Berhad (TNB) administrative staff.

3 RESEARCH QUESTIONS

1. What is the effect of quality culture on employee job performance among Tenaga Nasional Berhad (TNB) administrative staff?
2. What is the effect of quality culture on off job training among Tenaga Nasional Berhad (TNB) administrative staff?
3. What is the effect of off job training on employee job performance among Tenaga Nasional Berhad (TNB) administrative staff?
4. What is the mediating effect of off job training between quality culture and employee job performance among Tenaga Nasional Berhad (TNB) administrative staff?

4 LITERATURE REVIEW

4.1 Employee Job Performance

The evaluation of employee performance has been in the organizational system for quite some time due to the need for any organization to strive to achieve the maximum threshold set by the management. This is because the organization is designed to foresee the potential of each individual organizational contribution. The performance of individuals against the organization also determines whether the organization meets its goals (Aguilera et al.,2024). Studies have shown that employee performance appraisal and reward has shown positive outcomes on individual performance in the workplace (Pepple & Ambilichu, 2024). Measuring the performance of employees has been an issue due to the lack of the same capabilities of employees and conflicting organizational goals (Keltu, 2024). The promotion and reward system among employees has sparked some controversies in the activities and have been key performance indicators set in the organization (Marrucci et al.,2024). Although some researchers have found that quality culture may be a source of empowerment for employees through a good understanding of organizational goals and objectives (Arhin & Cobblah, 2024). Research has shown that employees' performance has the potential to develop and is the main element of organizational development (Darmawan,2024). Marpaung (2024) research emphasizes that employees' job performance is a real reflection of quality organization through a rich sustainable quality culture.

4.2 Quality Culture

It is the responsibility of any individual in the workplace to understand what the needs of that organization are. There are various opinions on how a good organization can proceed and provide continuous assistance for its employees through a caring working relationship between co-workers. There are some procedures that need to be in place before any quality culture could occur. The quality culture is seen as a benchmark for the progress of the organization. Therefore, quality culture, organizational culture,

organizational engagement, organizational management are some key factors for the creation of employee job performance through the results of some previous literature (Twaissi et al.,2025). Research has shown the positive relationship between quality culture and employee job performance in different companies and organizations (Kumar et al,.2024). This has given a positive impression that quality culture will still be relevant in the organizations through which all organizations are working hard for the betterment of the employees. Kim & Jung (2022). research concluded that quality culture in the workplace serves as a positive impact on employee job performance, leading to increased efficiency, competence, and quality of work. Furthermore, the research asserts that quality culture elements include the following factors such as fostering a growth mentality, encouraging strength in the face of challenges, and promoting psychosomatic protection.

4.3 Off-The-Job Training

Much research has been conducted on training and employee job performance with the recent development of artificial intelligence presence in the organizational arena. The importance of training still exists because organizations need human resources to activate the goals set by these organizations (Negt & Haunschild,2025). Research has been consistent in line with the performance of the organization, and off job training has become a major training among training beneficiaries for employees to re-activate their various dedications to the improvement of their work style (Junca & Pinto, 2024). Arta et al., (2022) research has shown that off-job training has a positive significant impact on employee competence and employee performance. Organizational effectiveness has received some setbacks due to situation management overseeing the functions of off-job training.

5 RESEARCH METHODOLOGY

The study uses survey methods consisting of administrative staff of Tenaga Nasional Berhad (TNB) in Bangi Selangor. The sample of this population was selected using a quota sampling and stratified sampling based on departments which consist of 90 administrative staff. A questionnaire which was used in this research was adopted and adapted from some previous studies which examined the effects of quality culture on employee job performance, mediated by off-the-job training. The data collected among Tenaga Nasional Berhad (TNB) admin staff were analyzed through the Sobel Test mediation analysis. The questionnaire adopted a Likert scale of 1 to 5. The reliability of the study is 0.91, indicating that the questionnaire is suitable for analysis with such reliability strength.

6 HYPOTHESES

H_a There is a statistically significant relationship between quality culture on employee job performance.
H_a There is a statistically significant relationship between quality culture on off job training.
H_a There is a statistically significant relationship between off job training on employee job performance.
H_a There is a statistically significant mediating effect of off-the-job training between quality culture and employee job performance.

7 HYPOTHESIS SUMMARY

This study incorporates four hypotheses, summarized and presented in Table 1. These hypotheses were formulated to address the research objectives and to examine the relationship between the key variables in the study.

Table: 1 Hypotheses Summary

Hypothesis	B	Beta	t	Sig.	Decision
H1	.726	.859	15.773	.000	Supported
H2	.715	.700	9.208	.000	Supported
H3	. 136	.744	9.960	.000	Supported
H4	.629	.164	2.198	.031	Supported

Table 2. displays the SPSS regression outputs. These tables demonstrate the unstandardized and standardized regression coefficient, standard errors, the t and p value the 95%confidence interval for each analysis. Table 2 shows that the independent variable (Quality culture) is significantly predictor of the dependent variable (employee job performance) (t = 15.77, p <.00). in other words, Quality culture (unstandardized coefficient = .726 is a statistically significant.

Table: 2 Regression Analysis of Quality culture on Employee Job Performance.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.115	.170		6.564	.000
Quality culture	.726	.046	.859	15.773	.000

Table 3 shows that the independent variable (Quality culture) is significantly predictor of the mediating variable (Off-the-job training) (t = 9.20, p <.00). in other words, quality culture (unstandardized coefficient = .715) is a statistically significant.

Table: 3 Regression Analysis of Quality culture on off-the-job training

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.890	.287		2.988	.003
Quality culture	.715	.078	.700	9.208	.000

Table 4 shows that while controlling for the independent variable (Quality culture), the mediating variable (Off-the- job training) is significantly predictor dependent variable (Employee job performance) (t = 9.960, p <.00). That is organizational culture (unstandardized coefficient = .136) is a statistically significant.

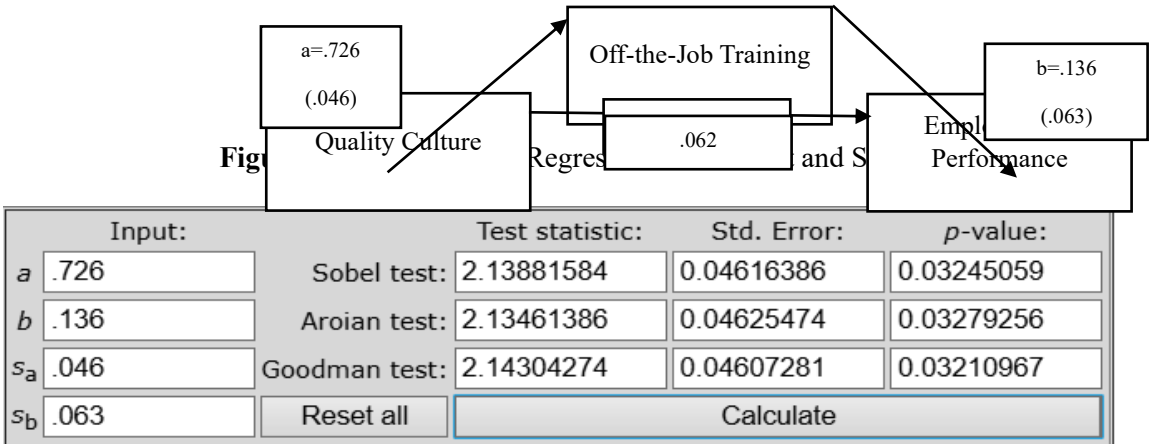
Table 4 : Regression Analysis of Quality culture and Off-the- job training on Employee job performance.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.994	.175		5.677	.000
Quality culture	.629	.062	.164	2.198	.031
off-the- job training	.136	.063	.744	9.960	.000

8 SOBEL TEST

To utilize Sobel test, these steps:

Determine both "a and b" unstandardized regression coefficients and their standard errors (Sa and Sb respectively) These values are found in the tables 2 and 3, respectively, and are summarized in figure 1.



Screen 1: Computer Calculator for Mediation

Screen 1: displays the results of the Sobel test as well as two additional tests: Aroian and Goodman test s. The latter two tests use slightly modified formulas of the Sobel test to compute the Z score (MacKinnon, Warsi and Dwyer 1995).

9 RESULTS

Sobel test was utilized to examine the mediating effect of quality culture between off-the job training and employee job performance. The first results of simple linear regression show that quality culture was a statically significant predictor of employee job performance (b = .72, beta = .85, t = 15.77, p <.00). Next when the mediator, off-the job training , was entered into the regression analysis, quality culture was also a significant predictor of employee job performance (b = .13, t = 9.96, p < .00). On the other hand, the mediator, off-the job training, emerged as a significant predictor of employee job performance (b = .56, t = 8.83, <.00). To further investigate the mediator, Sobel test was utilized to examine if off-the job training significantly mediated the relationship between quality culture and employee job performance. The results confirmed that off-the job training significantly mediates quality culture and employee job performance (Z =2.13, p <.004).

10 Limitations and suggestions for future studies

The study has concluded several limitations that warranted serious consideration. Firstly, the respondents are some two departments only which do not include departments due to the distance barriers. The researcher did not carry out an observation or competence-based assessment on the level of employee job performance. The criteria to measure employee job performance need more instruments which will be suitable for qualitative perceptions towards employee job performance. Therefore, further studies should be conducted on different instrumentations and methodology to collect and analyze data.

11 CONCLUSIONS

The purpose of the present research is to evaluate the role of mediating the effect of off-the job training between quality culture on employee job performance. The direct and indirect impacts of quality culture on employee job performance were examined. To test the proposed hypotheses, the Sobel test was utilized to examine the mediating effects analysis which was conducted with a sample of 238 full-time

administrative staff. The results of this study showed a significant direct effect on quality culture on off-the-job training which in turn had a significant influence on employee job performance. Quality culture had only a partial indirect effect on employee job performance among employees. These results bring out the importance of mediating roles of off-the job training on employee job performance.

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The Effect of Upward Communication on On-The-Job Training Mediated by Employee Well-Being

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ABSTRACT
Training has become a continuous strategic intervention for most developing organizations through the implementation of the SWOT analysis. On-the-job training deals with the training of employees during their working period in the organization, which entails learning more skills to increase productivity. It is seen as an integral part of the human resource development practices due to the advancement and complexity of the workplace. This study examines the mediating effect of employee well-being between upward communication and on-the-job training. The survey sampled a total of 238 employees using a stratified random sampling technique. A questionnaire was adopted and adapted from previous studies to achieve the objectives of the research. Data analysis was conducted using Sobel Test to test the mediation analysis. The findings of the study revealed that both upward communication and employee well-being have shown significant positive association with on-the-job training. Employee well-being produced a partial mediation effect of on-the-job training. This highlights a crucial link between upward communication and on-the-job training. This study indicates the critical impact of upward communication and employee well-being to enhance effectiveness of on-the-job training in the organization.

KEYWORDS: On-the-job training, Upward Communication, Communication, , Employee Well-Being.

1 INTRODUCTION

The importance of on-job training in any proactive organization is the optimum priority to evaluating all activities within and outside the organization. This is the reason continuous observation among staff should be given attention to oversee the need for good communication to enable organizational goals to be achieved. In a perspective, communication is the benchmark for any organization either public or private to flourish and excel among others (Hart & Rodgers, 2024). There are many concerns about how on-the-job training can be effective and efficient among employees, some research has shown that for on-the-job training to be considered effective and efficient the organizational management must listen to the employees (Al-Zoubi et at.,2025). It is assumed that one way communication cannot sustain any organization that wants to strive for the best in this competitive era of technology. Understanding the nature and importance of upward communication which involves the lower level of employees sharing their views with top management, is crucial (Saeed et al.,2024). This is because some researchers have identified that communication from the lower-level employees is not attended due to the bureaucracy in the organization (Wightman et al.,2024). It is essential to note that the pillars of any organization rely on the achievement of the lower-level employees. Furthermore, research has shown that among the successful organizations upward communication has played a significant role in achieving the goal (Mubashra & Saleemi, 2025).

Therefore, the top management should think beyond improvement and implementation among employees. However, to further their inquest for more sustainable working environments to allow employees to thrive all their capacities during the sustainability of their job and organization (Mkhize & Mutambara, 2024). Any reasonable working environment will allow employees to communicate directly or indirectly with the top management to see issues on ground.

2 OBJECTIVES OF THE STUDY

a) To examine the effect of upward communication on on-the-job training.
b) To determine the effect of upward communication on employee well-being.
c) To examine the effect of employee well-being on on-the-job training.
d) To evaluate the mediating effect of employee well-being between upward communication on on-the-job training.

3 RESEARCH QUESTIONS

a) What is the effect of upward communication on on-the-job training?
b) What is the effect of upward communication on employee well-being?
c) What is the effect of employee well-being on on-the-job training?
d) What is the mediating effect of employee well-being between upward communication on on-the-job training?

4 LITERATURE REVIEW

4.1 On-The-Job Training

Generally, training with doubt has immediately improved the situation of many employees in achieving the primary and secondary goals of the organization. The investment in human resources is essential during working periods of employment, this as a return has benefited many organizations via the success of all employees. Research has declared that for women to be mobile in the workplace there should be on-the-job training that will enhance their mobility in the organization (Nzimakwe & Utete, 2024: White & Knight, 2018). On the job training refers to the activities carried out by the individuals in their working place to develop work related knowledge and skills that are required for employees to perform a specific task within the workplace (Jin-qi et al.,2018). Research identified that employees must learn new skills to improve their outcomes via the assistance of the organization (Nzimakwe & Utete, 2024). Furthermore, on the job training uses the tools or the existing workplace tools such as machine, documents, equipment, knowledge and skills necessary for an employee to learn effectively to excel in performing his or her job. Piwowar-Sulej, & Bąk-Grabowska (2024) Research has shown that these skills are acquired during the working period in their various organizations.

4.2 Upward Communication

Trust and credibility should be between the top management and the lower-level employees, this has given rise to good and direct communication through the organizational process. The process of upward communication is vital to the progress of the organization which promotes a well-balanced working environment (McKee, 2024). To build trust and credulity in the organization there must be strong upward communication between the top management and lower-level employees (Kandel & Timilsina,2024). This communication speaks about the ultimate success or failure of the organization. Furthermore, upward communication must be established to make ways for a successful outcome. (Shipton et al.,2024) declared that the voice of the lower level of employees was not given adequate attention because it is believed that their impact is good but not in terms of taking serious decisions in the workplace. Huang et al., (2024) asserted the need for upward and on-the-job training is essential to promote harmony and understanding

among employees. In another development research has found that employees will feel frustrated, disconnected and unhappy from top management if their thoughts and opinions are not valued (Williamson, 2025). Research explored upward communication via in-depth interviews; case studies in a hundred and seven semi structured interviews across four organizations across Scotland on upward communication investigated ingratiation theory and impression top management dynamics could influence making sense of approaches and on-the-job training. It was found that upward communication can be shaped by processes such as management and leadership styles and the power of dynamism (Royo et al.,2024 & Tourish, 2007). The study of McKee (2024) emphasizes that even with unclear drawbacks like unclear channels and fear of reprisals, upward communication can also promote trust, lessen frustration and identify matters early in the organization. They proposed in the study that regular feedback sessions, reporting systems and on-the-job training can be a way forward.

4.3 Employee Well-Being

The organizational competition has become one of the trending topics that employers and employees have found interesting. This is coupled with the definition of employee well-being, a complex and multidimensional concept which is hard to define and measure in the context of human behavior (Jaswal et al.,2024). This is a result of the improvement that was found in the crises among employees and the management. A critical literature view was done to evaluate the reason behind employee well-being is crucial in upward communication and on-the-job training. The well-being of employees has become more interesting, integrating cognitive and well as effective elements because in the context of organizational goals, the definition is vague and needs further explanation (Islam & Amin, 2022). This kind of well-being is applied to the condition of the workplace; it should be important not to be confused with the general well-being and condition of the employees physically and mentally. Therefore, the definition of employee well-being as the condition of the employee's physical and mental health, including both life and workplace experiences (Marescaux et al., 2019). Another definition believed that work related wellbeing is the general quality of job that the employee experiences. A holistic approach was introduced it was claimed that employee well-being has three main key dimensions namely: the psychological, the physical, and the social one (Singh & Gautam, 2023). This could be linked with upward communication and on-the-job training with the social component of employee well-being, which is relevant to the quality subjective experiences of interpersonal relationships that employees experience inside the organization. It refers to communication vertically and horizontal, as well as the way they respond to organizational needs (Stranzl et al.,2024). Another research conducted by Jaskeviciute et al., (2021) sees that employee well-being could be viewed as in terms of cooperation and reciprocity, that is consistent with trust and support at the organizational level.

5 THEORETICAL FRAMEWORKS

This study adopted the regular training theoretical framework which depicts the relationship between the variables which consist of accuracy, speed and responsiveness and improvement and flexibility. This theory is based on effective training in the organization with good quality services (Parasuraman et al., 1985). The accuracy of the training means the degree of correctness. It also implies the condition or quality of being true, correct and exact. Responsiveness is the readiness or willingness of employees to provide service, timeliness of service from the training that he or she has gone through during work experience. Improvement and Flexibility is the ability to adapt easily by an employee to different scenarios to make whatever internal changes are necessary to respond effectively to the changing working environment. Improvement is to be able to reshape the existing processes to accomplish significant improvement in service provision through the training acquired and helps to generate promising results in operational efficiency to the organization (Adam & Al-Masrey, 2020).

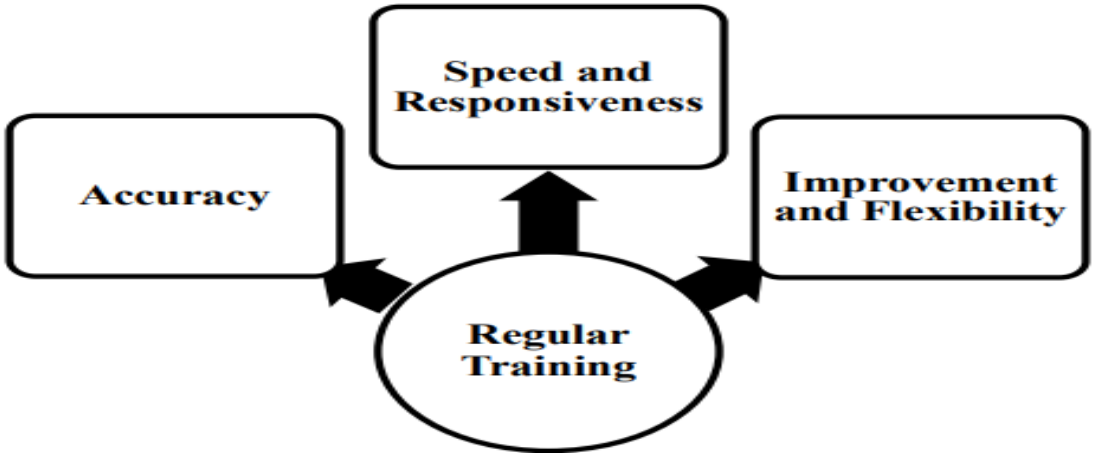


Figure 1: A Theoretical Framework for the Effect of Training

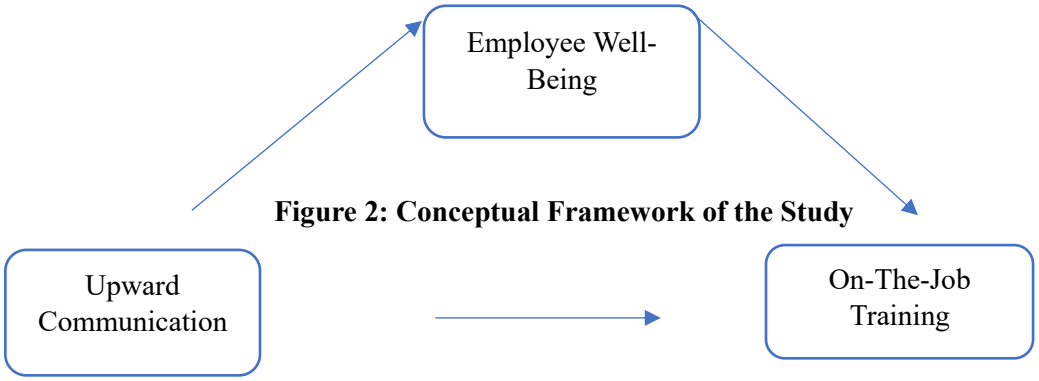


Figure 2: Conceptual Framework of the Study

6 HYPOTHESES

H_a The is a statistically significant relationship between upward communication on on-the-job training.
H_a There is a statistically significant relationship between upward communication on employee well-being.
H_a The is a statistically significant relationship between employee well-being and on-the-job training.
H_a The is a statistically significant mediating effect of employee well-being between upward communication and on-the-job training.

7 RESEARCH METHODOLOGY

The Sobel test is a statistical method used to assess the significance of mediating effect, whether a mediating variable carries the influence of an independent variable to the dependent variable (Abu-Bader & Jones, 2021). The survey sampled a total of 238 among Tenaga Nasional Berhad (TNB) in Malaysia, using a stratified random sampling technique. A questionnaire was adopted and adapted from previous studies to achieve the aims direct and indirect hypotheses of the study. The demographic information of the respondents consists of gender, staff and work experience. The reliability of the study is 0.96, indicating that the questionnaire is suitable for analysis with such reliability strength.

Table 1 shows the proportion of males and females of 238 who responded to the study survey questionnaire, male has 55.5% and female has 44.5%, the survey gender structure showed a higher proportion of men than women, which is in line with the nature of the job description. From the frequencies of staff, the sample showed that the admin contained 28.9%, and none-admin 71.0% which had the most respondents respectively. In terms of the work experience, 22.7% of the respondents are

of 1-5 work experience, 9.2.3% have 6-10 work experience, 24.8% of the respondents are of 11-20 work experience, and 43.3% are of 21 and above have work of experience.

Table: 1 Demographic Information

Construct	Category	Frequency	Percentage
Gender	Male	132	55.5
	Female	106	44.5
Staff	Admin	69	28.9
	None- Admin	167	71.0
Work Experience	1-5 Years	54	22.7
	6-10 Years	22	9.2
	11-20 Years	59	24.8
	21 and above	103	43.3

8 HYPOTHESIS SUMMARY

This study incorporates four hypotheses, summarized and presented in Table 2. These hypotheses were formulated to address the research objectives and to examine the relationship between the key variables in the study.

Table: 2 Hypotheses Summary

Hypothesis	B	Beta	t	Sig.	Decision
H1	.612	.644	7.893	.000	Supported
H2	.665	.755	10.802	.000	Supported
H3	.675	.799	11.272	.000	Supported
H4	.083	.093	1.315	.192	Rejected

Table 3 displays the SPSS regression outputs. These tables demonstrate the unstandardized and standardized regression coefficient, standard errors, the t and p value the 95%confidence interval for each analysis. Table 2 shows that the independent variable (upward communication) is significantly predictive of the dependent variable (on-the-job training) (t = 7.89, p <.00). In other words, learning methods (unstandardized coefficient = .612 is statistically significant.

Table: 2 Table 3: Regression analysis of upward communication on on-the-job training

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.410	.286		4.928	.000
upward communication	.612	.078	.644	7.893	.000

Table 4 shows that the independent variable (Upward communication) is a significant predictor of the mediating variable (employee well-being) (t = 10.80, p <.00). In other words, learning methods (unstandardized coefficient = . 665) is statistically significant.

Table: 4 Regression Analysis of upward communication on employee well-being

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.364	.227		6.001	.000
Upward communication	.665	.062	.755	10.802	.000

Table 5 shows that while controlling for the independent variable (upward communication), the mediating variable (employee well-being) is not significantly predictor dependent variable (on-the-job training) (t = 1.315, p >.000). Therefore, the quality culture (unstandardized coefficient = .083) it is not statistically significant.

Table: 5 Regression Analysis of upward communication and employee well-being on on-the-job training

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	.998	.191		5.223	.000
Upward communication	.675	.060	.799	11.272	.000
Employee well-being	.083	.063	.093	1.315	.192

9 SOBEL TEST

To utilize Sobel test, these steps:

Determine both “a and b” unstandardized regression coefficients and their standard errors (Sa and Sb respectively) These values are found in the tables 2 and 3, respectively, and are summarized in figure 1.

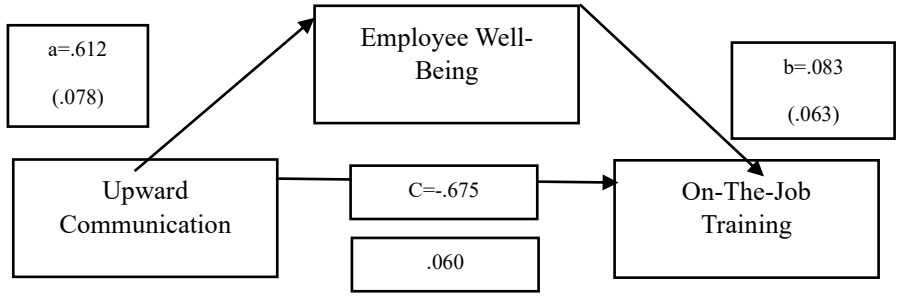
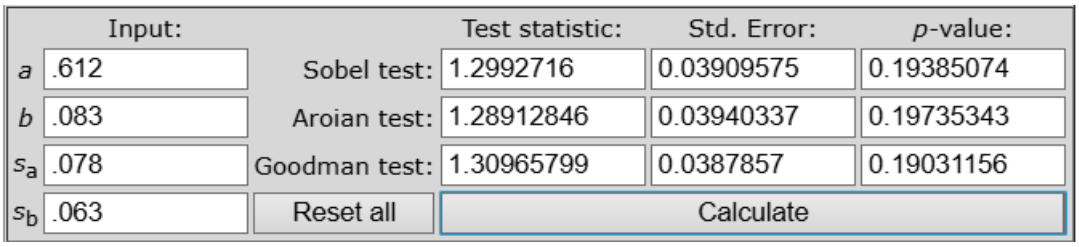


Figure1: Unstandardized Regression Coefficient and Standard Errors



Input:			Test statistic:	Std. Error:	*p*-value:
a	.612	Sobel test:	1.2992716	0.03909575	0.19385074
b	.083	Aroian test:	1.28912846	0.03940337	0.19735343
s_a	.078	Goodman test:	1.30965799	0.0387857	0.19031156
s_b	.063	Reset all	Calculate		

Screen 1: Computer Calculator for Mediation

Screen 1: displays the results of the Sobel test as well as two additional tests: Aroian and Goodman test s. The latter two tests use slightly modified formulas of the Sobel test to compute the Z score (MacKinnon, Warsi and Dwyer 1995).

10 RESULTS

The Sobel test was utilized to examine the mediating effect of employee well-being between upward communication and on-the-job training. The first result of simple linear regression shows that upward communication was a statically significant predictor of on-the-job training (b = .61, beta = .64, t = 7.89, p <.00). Next when the mediator, employee well-being, was entered into the regression analysis, on on-the-job training it was found to be statistically significant (b = .78, beta=.65 t = 11.27, p < .00). However, hand, the mediator, employee well-being, emerged as not a significant predictor of on-the-job training (b = .083 t = 1.315, p > .19). To further investigate the mediator, Sobel test was utilized to examine if employee well-being significantly mediated the relationship between upward communication and on-the-job training. The results confirmed that employee well-being is not significantly mediated between upward communication and on-the-job training. (Z =1.29, p >.000).

11 CONCLUSIONS

The aim of the present research is to examine the role of mediating the effect of employee well-being between upward communication and on-the-job training among employees in the organizational arena. The direct and indirect impacts of upward communication on on-the-job training were examined. To test the proposed hypotheses, the Sobel test was utilized to examine the mediating effects analysis conducted with a sample of 238 employees. The results of this study showed a significant direct effect of upward communication on employee well-being which in turn had a significant influence on on-the-job training. Upward communication had only a full indirect effect on on-the-job training among employees. These results bring out the importance of mediating roles of employee well-being on-the-job training.

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Humblebragging in Education: Exploring how Personality, social media, and School Culture Shape Teacher Communication and Reputations in school

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ABSTRACT

Humblebragging, a form of self-promotion disguised as modesty, has become prevalent in social media and professional settings, with educational environments being no exception. In schools, where relationships between teachers, students, parents, and colleagues are crucial, humblebragging can influence communication dynamics. This study explores how teachers' personality traits, school culture, and social factors like peer interactions and social media contribute to humblebragging behaviors and their impact on teachers' professional relationships and reputations. The research objectives include identifying the personality traits associated with humblebragging, exploring the influence of school culture, examining the effect of humblebragging on relationships, understanding the role of peer interactions and social media, and assessing its impact on reputation, considering both online and offline contexts. A survey was conducted with 456 teachers, using the Big Five Personality Inventory and a custom humblebragging scale, followed by correlation and regression analyses. Results revealed strong correlations between extraversion and humblebragging, and a negative correlation with agreeableness. School culture had no significant effect on humblebragging, while peer interactions showed a small negative impact, and social media use was a significant predictor. Humblebragging positively affected reputation in offline contexts but negatively in online contexts. The study highlights that extraversion and social media use are key drivers of humblebragging behaviors, and context plays a significant role in shaping its impact on reputation. This research contributes to understanding teacher communication dynamics, offering insights for fostering healthier relationships and improving professional reputations in both digital and face-to-face environments.

KEYWORDS: Humblebragging, Teacher Communication, Personality Traits, Social Media, Professional Relationships & School Culture

1 INTRODUCTION

Humblebragging has emerged as a subtle form of self-promotion, where individuals boast about their accomplishments under the guise of humility. In the educational field, where professional relationships and social identities are fundamental, humblebragging may impact how teachers communicate with peers, students, and parents, both online and offline. Understanding the personality traits and social factors that influence humblebragging, as well as how it manifests in both virtual and face-to-face interactions, is critical for improving teacher communication and fostering healthier professional relationships. Humblebragging, while prevalent on social media, is also likely to occur in educational environments, where teachers may subtly showcase their achievements without appearing boastful. Understanding why and how teachers engage in humblebragging will shed light on broader communication patterns in schools, including their effects on teacher well-being, professional relationships, and social identity. This study aims to explore the relationship between teachers' personality traits, their use of humblebragging, and its consequences in school settings.

The psychological basis of bragging, particularly humblebragging, offers valuable insights into how this behaviour is used by teachers to navigate professional communication and reputation management. According to Murray's Psychogenic Needs, individuals engage in bragging to satisfy their need for affiliation and power (Burger, 2008). For teachers, humblebragging provides a way to present themselves positively, increasing their social standing within professional networks such as the school environment. This behaviour helps them enhance their influence over colleagues, students, and parents, thereby strengthening their social and professional relationships. Similarly, Maslow's Hierarchy of Needs suggests that self-presentation behaviours like boasting satisfy self-esteem and belongingness needs (Feldman, 2011). Teachers may use humblebragging to gain validation and recognition, boosting their self-worth and increasing their social desirability within their educational communities. Moreover, McClelland's Need Theory aligns with this by emphasizing that the fulfilment of power and affiliation needs through self-presentation behaviours like humblebragging reinforces an individual's social control and acceptance (Robbins & Judge, 2013). For teachers, this can mean continually reinforcing their professional reputation and influence, both within the school and in broader professional circles. Understanding these psychological motives enriches the research on humblebragging by highlighting its role as a strategic tool for teachers to fulfil deep-seated social and personal needs, ultimately influencing their relationships and reputation in educational settings.

1.1 Research Questions

a) Which personality traits are associated with humblebragging behaviours among teachers?
b) How does the school culture influence how often teachers engage in humblebragging?
c) How does humblebragging affect teachers' relationships with their colleagues, students, and parents?
d) How does peer interaction and social media affect teachers' reasons for humblebragging?
e) How does humblebragging affect teachers' reputations, considering their personality traits and the context (online vs. offline)?

1.2 Research Objectives

a) To identify the personality traits associated with humblebragging behaviours among teachers.
b) To explore the school culture influence how often teachers engage in humblebragging.
c) To examine the impact of humblebragging on teachers' relationships with colleagues, students, and parents.
d) To understand the role of peer interactions and social media affect teachers' reason for humblebragging.
e) To assess how humblebragging affects teachers' reputations, considering their personality traits and the context (online vs. offline).

2 LITERATURE REVIEW

2.1 Humble Bragging Among Teachers

Humble bragging, a self-presentation strategy where individuals mask self-promotion with modesty or complaints, has been extensively studied in various contexts, including social media and workplace environments. However, its specific prevalence, motivations, and impact within the teaching profession remain underexplored. This literature review synthesizes existing research on humble bragging and its relevance to educators, aiming to inform future studies on this phenomenon in educational settings.

Humblebragging, a term first invented by Harris Wittels in 2010, refers to a form of self-promotion where someone masks their boasting by pretending to be humble. This behaviour allows individuals to talk about their accomplishments without feeling guilty or ashamed. While humblebrags often come across as self-deprecating, there are exceptions. Essentially, humblebragging is a way of bragging about one's achievements while hiding the boast behind a disguise of humility or discontent to make it seem less arrogant.

In the teaching profession, humblebragging can be understood as a coping mechanism linked to the broader societal shift toward digital interactions and virtual identity management. As teachers increasingly use social media and other online platforms to share their achievements and professional milestones, the desire for validation becomes intertwined with maintaining a positive online persona (Erza & Hamzah, 2018). Like other professionals, teachers are motivated by biological and psychological factors that drive them to seek recognition for their hard work, as this can activate the brain's dopamine reward system and fulfill social needs for power and affiliation (Bazarova et al., 2012). However, in the digital era, where online identities carry significant weight in professional environments, teachers must carefully navigate the balance between showcasing their successes and maintaining humility to avoid being perceived as boastful (Walther, 2012). As overt bragging can be seen as unprofessional, teachers may resort to humblebragging—presenting their accomplishments in a disguised manner that allows them to seek praise while avoiding the negative stigma associated with boastfulness (Sezer et al., 2017). This behavior is particularly relevant in online communities where teachers interact with peers, administrators, and the public, as it enables them to protect their virtual identities and maintain a sense of belonging within professional circles (Statista, 2020). Humble bragging involves presenting oneself as modest while subtly boasting about achievements or status. Sezer et al. (2017) identified two primary forms: complaint-based humble bragging, where individuals mask boasting with complaints, and humility-based humble bragging, where boasting is disguised as modesty. Their research indicates that while these strategies are common, they are often perceived as insincere and less effective than straightforward self-promotion.

2.2 Personality Traits and Humblebragging Behaviours

The literature on personality traits and humblebragging behaviours in teachers highlights key findings. Extraversion positively correlates with humblebragging, suggesting that extraverted individuals are more likely to engage in self-promotion through subtle boasting. This aligns with research indicating that extraverts, driven by a need for social validation, may use humblebragging as a strategy to gain attention without appearing overly boastful (Sezer et al., 2017). On the other hand, agreeableness negatively correlates with humblebragging, indicating that individuals who prioritize harmony and positive relationships are less inclined to boast, even indirectly (Sezer et al., 2017). Conscientiousness and openness also show moderate positive correlations with humblebragging, suggesting that more conscientious individuals might use it to highlight their achievements subtly, while those who are open may employ humblebragging to express their ideas without overt boasting (Sezer et al., 2017; Walther, 2012).

According to Sezer, Gino, and Norton (2017), humblebragging is influenced by personality traits such as extraversion, agreeableness, and neuroticism. Extraverted individuals are more likely to engage in humblebragging, as they seek social acknowledgment and validation. On the other hand, agreeable individuals tend to avoid humblebragging due to their preference for harmonious relationships. These findings align with your research on how personality traits influence humblebragging among teacher social media and Humblebragging. Research by Matley (2018) highlights the significant role that social media plays in fostering humblebragging behaviours. Social media platforms like Instagram enable teachers to subtly boast about their achievements while maintaining a modest facade. This aligns with your objective

to explore how social media impacts humblebragging in the teaching profession, as it provides a space for teachers to engage in self-promotion without overt bragging.

Humblebragging, often seen as a strategy for self-presentation in social and professional settings, is primarily driven by the need for affiliation, self-esteem, and power, as highlighted by various psychological theories. Murray's Psychogenic Needs suggests that humblebragging serves to satisfy the need for affiliation and power by helping individuals present themselves in a positive light while increasing social interactions (Burger, 2008). Teachers, for example, may use humblebragging to grow their social circles within educational settings and enhance their professional influence (Sezer et al., 2018). According to Maslow's Hierarchy of Needs, humblebragging fulfils both the need for belonging and self-esteem, as teachers gain validation through subtle boasting while maintaining an image of modesty. This aligns with McClelland's Need Theory, where behaviours like humblebragging are reinforced by the desire for power and social control, creating a feedback loop of recognition and professional success (Robbins & Judge, 2013). The use of social media has amplified these behaviours, especially in educational contexts, where platforms like Instagram and Twitter serve as venues for teachers to humblebrag and cultivate a desirable digital persona (Trivedi & Srinivas, 2019).

However, as research shows, humblebragging is often ineffective or even damaging if perceived as inauthentic. Models for detecting humblebragging in text highlight the complexities of this behaviour, which involves detail in bragging masked by modesty or complaints (Naganna et al., 2024). Humblebragging is especially prevalent in digital environments, where it can be easier for teachers to navigate social dynamics by concealing self-promotion behind humour or humility (Sezer et al., 2018). Despite its widespread use in professional and educational settings, studies suggest that humblebragging may be misinterpreted, especially when evaluated by others who fail to detect the nuance of the behaviour (Sezer et al., 2017). This underscores the challenge of maintaining authentic relationships in both online and offline contexts, where teachers' reputations may be influenced by how their humblebragging is received by peers and students.

Further research suggests that while humblebragging is prevalent across various professional fields, it can often be perceived as insincere, diminishing its effectiveness compared to direct self-promotion (Sezer et al., 2017). In the educational context, teachers may use humblebragging as a coping mechanism to balance the desire for recognition with maintaining a professional image. As social media plays a larger role in professional communication, platforms like Instagram provide opportunities for teachers to engage in humblebragging while managing their online identities (Bazarova et al., 2012; Walther, 2012). Thus, personality traits like extraversion and openness, alongside the increasing influence of social media, are significant factors shaping humblebragging behaviours among teachers.

2.3 School Culture and Social Influence on Humblebragging

In examining how school culture and social influence shape humblebragging behaviours among teachers, existing literature indicates that both workplace dynamics and peer pressure are crucial factors. School culture, especially in competitive environments, can drive teachers to engage in self-presentation strategies like humblebragging to gain social recognition without appearing overtly boastful. Competitive school cultures may foster more humblebragging behaviours as teachers seek to signal their accomplishments while adhering to the norm of humility in their professional interactions (Sezer et al., 2017). Conversely, collaborative school cultures, where cooperation and mutual support are emphasized, may reduce the likelihood of humblebragging, as teachers are less driven by personal competition and more by collective achievements (Bazarova et al., 2012).

Research suggests that peer pressure and the dynamics of workplace relationships significantly influence self-presentation behaviours in educational settings. Teachers might engage in humblebragging to fit into social circles or to align with the expectations set by colleagues and administrators (Walther, 2012). However, findings from this study indicate that school culture itself did not significantly impact humblebragging behaviours, suggesting that factors such as personality traits and external social media pressures might be stronger determinants of this self-promotion strategy (Sezer et al., 2017). Thus, while school culture could theoretically shape self-presentation behaviours, peer interactions and social media play more prominent roles in influencing humblebragging behaviours in teachers, with social media proving to be a particularly strong driver in this context (Erza & Hamzah, 2018).

2.4 Impact of Humblebragging on Professional Relationships

In professional settings, humble bragging can influence interpersonal dynamics and perceptions. Studies have shown that such behaviours can lead to negative impressions, as audiences may view them as disingenuous. For instance, a study analysing self-praise in the form of humble brags on Twitter found that these were less effective than straightforward bragging and often backfired due to perceived insincerity. Social media platforms, particularly Instagram, have become an integral part of modern communication, allowing users worldwide to interact, exchange information, and share content, regardless of geographical distances. The rise of social networks has sparked significant interest among researchers, as these platforms present new communication dynamics and audience structures (Bazarova et al., 2012). Instagram, with over one billion users and a strong millennial user base, offers users opportunities for self-presentation and strategic self-marketing (Statista, 2020). These platforms allow for both verbal and nonverbal communication, making them key subjects of study for understanding language and social behaviours in mediated environments (Walther, 2012). As social networks continue to evolve, their influence on social interaction and communication strategies remains a critical area for further investigation (Erza & Hamzah, 2018).

In the educational context, humblebragging among teachers can be understood as a form of self-promotion where individuals subtly boast about their achievements while disguising their bragging with humility, self-deprecation, or even negative comments. This behaviour helps teachers balance their need for recognition and social connection while maintaining a professional and modest image in front of colleagues and students. Teachers engage in humblebragging to protect their virtual identities, especially in the age of social media, where maintaining an online persona is essential. The effectiveness of humblebragging relies on finding the right balance between self-promotion and humility, as it can be met with resistance or scepticism from peers. As this area of research is still developing, future studies could explore the personality traits and social factors influencing humblebragging among teachers, as well as its occurrence in face-to-face interactions within schools. Understanding humblebragging in the educational context is crucial for exploring the evolving trends in teacher communication, the impact on professional relationships, and how it shapes teachers' social identities in both digital and physical environments.

Yan et al. (2024) explore how humblebragging impacts viewer behaviour in terms of social desirability, gossip, and social distancing. These effects are particularly relevant in educational environments, where relationships with colleagues, students, and parents can directly influence professional success. Teachers' humblebragging behaviours, especially those that emphasize personal accomplishments, can improve their social capital if they are seen as positive and inspiring. However, if these behaviours are perceived as self-centred or insincere, they may harm professional relationships, leading to alienation or diminished trust among peers and stakeholders. This aligns with findings in the literature suggesting that humblebragging may backfire, particularly when the audience perceives the self-presentation as manipulative rather than genuine (Sezer, Gino, & Norton, 2017).

2.5 Role of Peer Interactions and social media in Humblebragging

The literature on the role of peer interactions and social media in shaping humblebragging behaviours among teachers points to several key findings. Peer interactions, both in-person and virtual, significantly influence self-presentation behaviours, including humblebragging, within professional networks like teacher communities. Teachers often engage in humblebragging to maintain social status and validation within these networks. Peer pressure can encourage or discourage humblebragging depending on the social dynamics of the environment. In collaborative settings, where cooperation is valued over competition, humblebragging may be less common, as teachers are motivated by collective success rather than individual recognition (Bazarova et al., 2012; Sezer et al., 2017).

The role of social media in modern self-presentation, including humblebragging, is also a crucial factor. Social media platforms, particularly Instagram, provide teachers with a space to subtly promote their achievements while maintaining an image of humility. These platforms facilitate the creation of a professional persona that can influence both the self-image and how others perceive teachers (Walther, 2012). Research indicates that humblebragging behaviours in online contexts can be more prevalent due to the desire for social validation in public forums. However, this form of self-presentation often backfires if

perceived as insincere or excessive (Sezer et al., 2017). Social media platforms have become key spaces for teachers to navigate their professional identity while balancing personal humility with public acknowledgment (Erza & Hamzah, 2018). Studies on peer interactions indicate that while humblebragging can be linked to a desire for social affiliation, it can also damage relationships with colleagues. According to Sezer et al. (2017), people tend to view humblebragging as insincere, which can lead to negative perceptions and strained professional relationships.

The rise of social media has amplified humblebragging behaviours, especially among professionals, including teachers. Yan et al. (2024) note that social media platforms serve as tools for individuals to engage in humblebragging, as they allow for curated self-presentation while maintaining a semblance of modesty. Teachers often use platforms like Instagram, Twitter, and LinkedIn to share achievements or milestones in a way that minimizes overt boasting. These platforms provide opportunities to shape a professional persona that highlights achievements while fostering engagement and validation from their audience (Bazarova et al., 2012). However, as research has shown, excessive humblebragging on these platforms can lead to negative perceptions and reputation damage, particularly when the self-promotion appears insincere or excessive (Sezer et al., 2017).

2.6 Humblebragging and Reputation: Online vs. Offline Contexts

In examining how humblebragging affects teachers' reputations in online vs. offline contexts, literature reveals significant differences in how these behaviours are perceived depending on the medium. Offline humblebragging tends to enhance reputation, as face-to-face interactions allow for more personal connections and non-verbal cues, which may make the boasting appear more authentic and less self-serving. In contrast, online humblebragging is often viewed as insincere and self-promoting, especially in public digital spaces where audiences may feel distanced from the individual. This dynamic is compounded by the challenges of managing a digital identity, where the line between self-promotion and modesty is often blurred. Studies indicate that humblebragging behaviours in online settings may diminish a teacher's reputation due to perceptions of inauthenticity or self-centeredness, especially on platforms like Instagram or Twitter, where users actively curate their online personas (Erza & Hamzah, 2018; Walther, 2012). Social media, with its broad reach and public nature, allows teachers to boast subtly about their achievements while appearing humble, but this often backfires, particularly when audiences perceive the behaviour as boastful under the guise of humility (Sezer et al., 2017). Furthermore, personality traits such as neuroticism have been linked to increased humblebragging tendencies, which can positively affect reputation in offline settings but may create a negative perception online (Bazarova et al., 2012). Thus, the context, whether online or offline stated significantly moderates the impact of humblebragging on reputation, with offline settings being more conducive to reputation enhancement, while online behaviours tend to harm it.

Humblebragging has been shown to have differing impacts on reputation depending on the context (online vs. offline). Sezer et al. (2017) found that humblebragging in online environments often leads to negative perceptions of the individual, while in offline contexts, it can be perceived more positively due to the more authentic interactions that occur face-to-face.

3 METHODOLOGY:

3.1 Survey Design:

Develop a comprehensive survey that includes:

a) Personality Assessment: Use standardized personality inventories (the Big Five Personality Inventory) to assess traits such as narcissism, extraversion, and humility.
b) Humblebragging Scale: Develop a custom scale or adapt existing scales to measure humblebragging behaviours, including frequency, context (online vs. offline), and perceived motivation.
c) Social Factors: Include questions about the school culture, peer interactions, and teachers' social media presence.
d) Impact on Professional Relationships: Use Likert-scale questions to gauge the perceived impact of humblebragging on relationships with colleagues, students, and parents.

3.2 Sample:

a) Target a diverse sample of teachers from multiple school districts to ensure representation across various demographics and educational contexts.
b) Aim for a minimum sample size of 500 teachers to ensure statistical validity and the ability to perform subgroup analyses.

3.3 Data Collection:

a) Administer the survey online using platforms like Google Forms to ensure anonymity and encourage honest responses.

3.4 Data Analysis:

a) Use descriptive statistics to summarize the frequency and nature of humblebragging behaviours.
b) Perform correlation analysis to explore relationships between personality traits, social factors, and humblebragging.

4 SIGNIFICANCE OF THE STUDY:

This study will contribute to the understanding of communication behaviours in educational settings, providing insights into how teachers navigate self-promotion and humility in their professional lives. By exploring the dynamics of humblebragging, this research can inform strategies for fostering healthier communication practices, improving teacher-staff relationships, and enhancing school culture. Additionally, understanding the role of personality and social influences in humblebragging can help educators develop more authentic and effective communication strategies.

5 ANALYSIS

5.1 To identify the personality traits associated with humblebragging behaviours among teachers.

Correlations

		HUMBLEBRAGGING	TRAITEXTRAVERSION	TRAITSAGREE	TRAITSCONSCIENTIOUS	TRAITSNEOROTICISM	TRAITSOPENNESS
HUMBLEBRAGGING	Pearson Correlation	1	.650**	-.634**	.458**	-.137**	.254**
	Sig. (2-tailed)		<.001	<.001	<.001	.003	<.001
	N	456	456	456	456	456	456
TRAITEXTRAVERSION	Pearson Correlation	.650**	1	-.090	-.266**	-.102*	-.018
	Sig. (2-tailed)	<.001		.055	<.001	.029	.706
	N	456	456	456	456	456	456
TRAITSAGREE	Pearson Correlation	-.634**	-.090	1	-.539**	.163**	-.394**
	Sig. (2-tailed)	<.001	.055		<.001	<.001	<.001
	N	456	456	456	456	456	456
TRAITSCONSCIENTIOUS	Pearson Correlation	.458**	-.266**	-.539**	1	.428**	.651**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001	<.001
	N	456	456	456	456	456	456
TRAITSNEOROTICISM	Pearson Correlation	-.137**	-.102*	.163**	.428**	1	.778**
	Sig. (2-tailed)	.003	.029	<.001	<.001		<.001
	N	456	456	456	456	456	456
TRAITSOPENNESS	Pearson Correlation	.254**	-.018	-.394**	.651**	.778**	1
	Sig. (2-tailed)	<.001	.706	<.001	<.001	<.001	
	N	456	456	456	456	456	456

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The data shows various correlations between humblebragging and personality traits. There is a strong positive correlation between humblebragging and extraversion (0.650, $p < 0.01$), suggesting that more extraverted individuals tend to engage in humblebragging behaviours. On the other hand, agreeableness has a strong negative correlation with humblebragging (-0.634, $p < 0.01$), indicating that individuals who are more agreeable are less likely to humblebrag. Conscientiousness also shows a moderate positive correlation with humblebragging (0.458, $p < 0.01$), meaning that more conscientious individuals tend to engage in humblebragging to a certain extent. However, neuroticism has a weak negative correlation (-0.137, $p < 0.01$) with humblebragging, implying that individuals who are more neurotic are less likely to engage in

humblebragging. Additionally, openness shows a moderate positive correlation (0.254, $p < 0.01$) with humblebragging, indicating that people who are open tend to humblebrag more.

Overall, extraversion is the most significant predictor of humblebragging, while agreeableness is strongly negatively associated with this behaviour. Conscientiousness and openness also play a role, though to a lesser extent. These findings highlight the complex relationships between personality traits and humblebragging behaviours, with extraversion being a key factor in humblebragging tendencies.

5.2 To explore the school culture influence how often teachers engage in humblebragging.

Table 2 Summary statistics, correlations and result from the regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.011	.000	-.002	.67179

Note: *Predictors: (Constant), SCHOOLCULTURE*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	.023	1	.023	.051	.822
Residual	204.892	454	.451		
Total	204.915	455			

Note: *dependent variable: humblebragging*
predictors: (constant), schoolculture

Predictor	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
Constant	2.074	.229		9.067	< .001
SCHOOLCULTURE	.013	.057	.011	.225	.822

Note: *dependent variable: humblebragging*
predictors: (constant), schoolculture

Table 2 shows the analysis of the relationship between school culture and humblebragging among teachers reveals that school culture does not significantly influence humblebragging behaviours. The R^2 value of 0.000 indicates that school culture explains none of the variance in humblebragging. The adjusted R^2 value is also negative, suggesting that the model does not account for variability in humblebragging, which implies a poor fit. The ANOVA results show the F-value of 0.051 with a significance level of 0.822, further confirming that the relationship between school culture and humblebragging is not statistically significant. The regression coefficient for school culture is very small (0.013), indicating a negligible effect on humblebragging, and the standardized beta coefficient is close to zero (0.011), which emphasizes the lack of a meaningful impact. Therefore, the results suggest that school culture does not significantly affect humblebragging behaviours, and other factors may be more influential in determining teachers' humblebragging tendencies.

5.3 To examine the impact of humblebragging on teachers' relationships with colleagues.

Table 3 Summary statistics, correlations and result from multiple regression analysis for teacher relationships with colleagues.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.164	.027	.025	.66268

Note: *Predictors: (Constant), PEERINTERACTION*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	5.542	1	5.542	12.619	< .001
Residual	199.373	454	.439		
Total	204.915	455			

Note: *dependent variable: humblebragging*
predictors: (constant), peerinteraction

Predictor	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
Constant	2.944	.233		12.650	< .001
PEERINTERACTION	-.222	.063	-.164	-3.552	< .001

Note: *dependent variable: humblebragging*
predictors: (constant), peerinteraction

The results from the multiple regression analysis show in table 3 indicated that peer interactions have a statistically significant, but relatively small, impact on humblebragging. The R^2 value of 0.027 indicates that only about 2.7% of the variance in humblebragging is explained by peer interactions, suggesting that other factors are likely more influential. The ANOVA test reveals the F-statistic of 12.619 with a significance value of < 0.001, indicating that the regression model is statistically significant and that peer interactions do have some effect on humblebragging. However, the effect is moderate. The unstandardized coefficient for peer interaction is -0.222, meaning that for each one-unit increase in peer interaction, humblebragging tends to decrease by 0.222 units. The standardized beta coefficient of -0.164 further confirms a weak negative relationship between peer interactions and humblebragging. Additionally, the t-value for peer interaction is -3.552 with a p-value of < 0.001, confirming that this relationship is statistically significant. Peer interactions are found to significantly influence humblebragging, the effect is small, and the low R^2 value suggests that other variables likely contribute more to explaining humblebragging behaviours.

5.4 To understand the role of peer interactions and social media affect teachers' reason for humblebragging.

Table 4 Summary statistics, correlations and result from multiple regression analysis for peer interactions and social media affect

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.571	.326	.323	.55209

Note: *predictors: (constant), socialmedia, peerinteraction*

Predictor	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
Constant	.800	.246		3.252	.001
PEERINTERACTION	-.070	.053	-.052	-1.318	.188
SOCIALMEDIA	.532	.038	.558	14.181	< .001

Note: *Dependent Variable: humblebragging*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	66.840	2	33.420	109.645	< .001
Residual	138.075	453	.305		
Total	204.915	455			

Note: *dependent variable: humblebragging*
predictors: (constant), socialmedia, peerinteraction

Table 4 indicated the results from the multiple regression analysis for both peer interactions and social media use have an impact on humblebragging behaviours among teachers, but the effects differ in significance. The R^2 value of 0.326 suggests that approximately 32.6% of the variance in humblebragging is explained by these two predictors combined, which is a moderate proportion, indicating that other factors also play a role in humblebragging behaviours. The ANOVA results, with an F-statistic of 109.645 and a significance value of < 0.001, confirm that the model is statistically significant, meaning that the relationship between peer interactions, social media use, and humblebragging is not due to chance.

Looking at the coefficients, the constant is 0.800, indicating the baseline level of humblebragging when both peer interactions and social media use are zero. The unstandardized coefficient for peer interaction is -0.070, suggesting that as peer interaction increases, humblebragging tends to decrease slightly. However, the t-value for peer interaction is -1.318, with a p-value of 0.188, which is not statistically significant, indicating that peer interaction does not significantly affect humblebragging in this model. On the other hand, social media use has an unstandardized coefficient of 0.532, meaning that an increase in social media use is associated with a significant increase in humblebragging. The t-value for social media is 14.181, with a p-value of < 0.001, making it a statistically significant predictor of humblebragging.

In conclusion, while both peer interactions and social media use are included in the model, social media use emerges as the stronger and more significant predictor of humblebragging behaviours, with a positive relationship indicating that more social media engagement is linked to more humblebragging. In contrast, peer interactions show only a weak and statistically insignificant negative relationship with humblebragging. Therefore, social media use plays a more crucial role in influencing humblebragging among teachers compared to peer interactions.

5.5 To assess how humblebragging affects teachers' reputations, considering their personality traits and the context (online vs. offline).

Table 5 Summary statistics, correlations and result from multiple regression analysis for humblebragging affect teachers' reputations, personality traits and the context

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1.000	1.000	1.000	.00000

Note: *predictors: (constant), contextoffline, traitsconscientious, traitextraversion, traitagree, traitsneuroticism, contextonline, traitsopenness*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	112.860	7	16.123		
Residual	.000	448	.000		
Total	112.860	455			

Note: *dependent variable: impactsocial*
predictors: (constant), contextoffline, traitsconscientious, traitextraversion, traitagree, traitsneuroticism, contextonline, traitsopenness

Predictor	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
Constant	.744	.000		37778051.203	<.001
Traitextraversion	-.504	.000	-.706	-4069790736.2	<.001
Traitagree	.303	.000	.305	127452819.52	<.001
Traitsconscientious	-.568	.000	-.530	-274085838.2	<.001
Traitsneuroticism	.509	.000	.786	294830044.95	<.001
Traitsopenness	.209	.000	.267	854708083.599	<.001
Contextonline	-.118	.000	-.229	-99691509.750	<.001
Contextoffline	1.044	.000	1.924	848115636.79	<.001

Note: *Dependent Variable: IMPACTSOCIAL*

Table 5 indicated the regression analysis on how humblebragging, personality traits, and context (online vs. offline) influence teachers' reputations. The Model Summary shows a perfect fit with an R^2

value of 1.000, indicating that the model explains 100% of the variance in the dependent variable (IMPACTSOCIAL, a proxy for reputation). This suggests that the predictors for context, personality traits (such as extraversion, agreeableness, conscientiousness, neuroticism, and openness), and their interactions, completely account for the variations in teachers' reputations. The ANOVA table further confirms the model's significance, with a perfect fit indicated by a residual sum of squares of 0.000, which means no unexplained variance remains.

The Coefficients Table indicates how each predictor affects teachers' reputations. The constant of 0.744 represents the baseline reputation impact when all predictors are zero. Among the personality traits, trait extraversion shows a negative relationship with reputation impact (B = -0.504, Beta = -0.706), suggesting that higher extraversion slightly reduces the impact on reputation. Conversely, trait agreeableness has a positive impact (B = 0.303, Beta = 0.305), meaning that more agreeable individuals tend to have a higher reputation impact. Trait conscientiousness shows a negative effect (B = -0.568, Beta = -0.530), indicating that higher conscientiousness is associated with a lower reputation impact. Trait neuroticism has a significant positive impact (B = 0.509, Beta = 0.786), suggesting that individuals higher in neuroticism tend to have a stronger reputation impact. Trait openness also positively influences reputation (B = 0.209, Beta = 0.267), meaning more open individuals tend to have a better reputation impact.

The context variables show differing effects on reputation: online context has a small negative impact (B = -0.118, Beta = -0.229), suggesting that humblebragging or related behaviours in an online context slightly decrease reputation. However, offline context has a strong positive effect (B = 1.044, Beta = 1.924), indicating that offline humblebragging is much more likely to enhance reputation. The analysis highlights that both personality traits and the context (online vs. offline) significantly affect how humblebragging influences teachers' reputations. Specifically, offline contexts have a much stronger positive effect, while online contexts tend to have a negative effect. Among personality traits, neuroticism has the most significant positive impact, while traits like extraversion and conscientiousness show a negative relationship with reputation. The R^2 value of 1.000 implies that the included predictors fully explain the variations in teachers' reputations in this model.

6 DISCUSSION

This study aimed to explore the complex dynamics of humblebragging behaviors among teachers, particularly in relation to their personality traits, school culture, peer interactions, social media use, and context (online vs. offline). The findings from the various analyses offer valuable insights into the underlying factors that drive humblebragging and how these behaviours influence teachers' relationships and reputations.

6.1 Personality Traits and Humblebragging

The investigation into the personality traits ostensibly associated with humblebragging behaviours among educators revealed a more complex interplay of characteristics that affect an individual's predisposition toward flashes of this type of self-promotion. On the thwart, extraversion with its rich gamut of sociability, assertiveness, and occasional inclination toward stimulation exhibited a significant positive correlation with humblebragging, thus revealing that teacher extraverts have a higher proclivity for the use of this strategy (Skaalvik & Skaalvik, 2014). This is perhaps explained by extraverts' need to be at the centre of attention for social gratification: humblebragging acts as their social glue to faintly broadcast merits and seek appreciation by peers and students (Mihaela, 2014). On the contrary, agreeableness-the trait denoting empathy, cooperativeness, and an orientation toward maintaining a harmonious relationship-has been negatively correlated with humblebragging, which suggests that the more agreeable teachers are, the less rest they hold to engage themselves in this behaviour (Qin et al., 2019). The reverse relationship would stem from agreeable persons being more concern about nurturing positive interpersonal relations and less inclined to engage in activities that would be construed as being self-centred, bragging, or hypocritical (Exline & Hill, 2012).

Moreover, conscientiousness, describing one who is hardworking, well-organized with a high sense of responsibility, was moderately positively correlated with humblebragging; that is, conscientious teachers may somewhat engage in humblebragging to communicate about their accomplishments or points of view

(Roloff et al., 2020). Likewise, openness to experience, a variable that entails curiosity, intellectualism, and readiness to embrace novelty, was found to be moderately positively correlated with humblebragging. Hence, teachers with this trait may occasionally resort to humblebragging to present their accomplishments or points of view more covertly (Qian et al., 2018). To talk further about the interface between various elements of personality and humblebragging contributes greatly toward explaining the psychological basis beneath this difficult concept, illuminating some of the motives and predilections leading teachers toward subtle forms of self-promotion (Shaukat et al., 2023). Self-promotion seeks to present a positive image by focusing on strengths and praise-worthy accomplishments (Hartog et al., 2018).

Humblebragging behaviours and personality traits each affect communication strategies in the work setting with a very subtle resonance. The prominent extravert's drive for attention and validation may take a humblebragging form, securing social acknowledgment to unwanted association with apparent arrogance or pride. Agreeable people will put harmonious relationship-prone care at first; therefore, humblebragging would represent a rather self-serving behaviour and incompatible with interpersonal dynamics. The moderate positive correlations between conscientiousness, openness, and humblebragging imply that those with these personality traits might opt for humblebragging tactics to somehow boast about their accomplishments or share their sentiments, but not too openly, in a way that still preserves some social acceptance. Whereas someone can state with a straight face that they have compassion without coming off as ridiculous, humility is considered somewhat differently (Hughes, 2022). The link of humblebragging with personality traits in teachers may be in terms of the need for achievement since pride promotes motivation, effort, and knowledge exploration (Vogl et al., 2019).

Concurrent in existence with humble while yet being narcissistic further complicates the paradox of the polar dimensions of narcissism and humility, often regarded as crucial traits in leadership studies (Ströbl et al., 2018). It is worth noting that considering situational contingencies such as organizational culture and social context may shed light on the expression of humblebragging behaviors. Future research is therefore encouraged to investigate the potential moderating effects of contextual aspects, including the subtle details of organizational culture and the social dynamics' complexities prominent within educational institutions, to fix with some degree of precision the effect on personality-related correlates and predisposition toward humblebragging.

6.2 School Culture's Influence on Humblebragging

The second objectives were to consider whether the culture of the school influences teachers' tendency to engage in humblebragging. The analysis clearly showed that school culture did not exert a strong effect on humblebragging behaviour. This strongly suggests that while school culture might influence general behaviour among teachers, it does not directly influence its use in humblebragging. Instead, other personal factors such as personality and outside influences such as social media may have a stronger effect on whether teachers humblebrag. Perhaps one would expect to see more humblebragging in a highly competitive or socially charged atmosphere, but this was in fact not supported by the present findings. This points either to the behaviour being motivated internally or being channelled through extrinsic factors that lie outside the immediate school environment. Future research could consider different measures of school culture or investigate the mechanisms through which certain aspects of culture interact with personal characteristics to affect humblebragging behaviours. School culture is conceptualized as a constellation of shared values, beliefs, norms, and practices and is regarded as the social and academic environment that permeates through the educational institution.

Future lines of investigation may probe into the details of leadership styles and their possible repercussions on teachers' motivation through longitudinal studies crawling over substantial time spans. To better understand leadership effectiveness in differing settings, the study should compare analyses looking at diverse educational settings, like rural or urban schools, or even public or private schools.

Another interesting avenue for future research would examine the moderating effects of age, gender, and teaching experience on the relationship between school culture and humblebragging. By focusing on these demographic variables, a more nuanced picture of how the teaching profession is divided could emerge, with some groups of teachers viewing and reacting to the school environment quite differently from others. Such understanding will inform interventions in school culture that foster more positive working environments (Wuletu et al., 2024). Since self-sufficiency and engagement affect the

teachers' motivation and efficacy and values championed by teachers somehow build school culture and social norms (Javorčíková et al., 2021), the creation of a supportive school culture will become imperative.

6.3 Impact of Humblebragging on Relationships

In terms of humblebragging concerning the relationship with peer teachers, the correlation analysis hinted at a weak negative correlation between humblebragging and peer interactions, indicating that humblebragging may harm relationships with colleagues, perhaps being so perceived because of perceived insincerity or egocentricity. Teachers that humblebrag may appear less relatable and approachable to their colleagues and so may be socially distanced from or foster strained relations. Studies have confirmed that self-promotion can have adverse effects on social evaluations of individuals, especially when it is seen as being excessive or manipulative. However, it is important to mention that the correlation was weak, which means this effect may not be the case with all individuals and may have other factors involved in it, such as interrelation dynamics of the constituency, individual personalities, and the frequency and context of humblebragging.

Thus, there are several avenues for further research that would allow a comprehensive delineation of the nuanced effect of various leadership styles, including that of the headmaster, on both teachers' professional behaviour and their interaction within school. There is, moreover, a dynamic necessity to render the research discussions within the field of educational leadership clearer and more engaging, whereby researchers should move beyond merely reporting research findings to convincing a wide variety of stakeholders, including educators and practitioners. By gaining a more in-depth understanding of contextual variables affecting leadership efficacy, educational bodies can work toward the creation of contexts wherein the professional development, well-being, and success of teachers and learners alike may occasion.

This study has implications for educational administrators and policymakers in promoting a nurturing and collaborative school environment jointly. Knowing personality traits that have been associated with humblebragging can, therefore, help administrators in designing appropriate training schemes that aim at co-creating self-awareness and communication skills with teachers (Pozo-Rico et al., 2023). Such interventions would help in imparting knowledge among teachers to recognize behaviour that might be perceived as self-serving and then give strategies to speak more openly and relate in expressing their achievements.

6.4 Role of Peer Interactions and social media

The fourth objective focused on understanding the role of peer interactions and social media in affecting teachers' reasons for humblebragging. The results showed that social media use was a significant predictor of humblebragging, with a positive correlation. This finding suggests that social media platforms provide a fertile ground for humblebragging behaviours, likely due to the desire for social validation and the public nature of these platforms. Social media allows teachers to subtly boast about their accomplishments while maintaining a facade of humility, which could be particularly appealing in the highly competitive and image-driven online environment. In contrast, peer interactions showed a weaker, non-significant effect on humblebragging. This might indicate that while in-person peer interactions do play a role in social dynamics, they do not have as strong an influence on humblebragging behaviours as social media does.

Enabling students to engage with others and especially those that come from different backgrounds is vital. Teaching establishments ought to appreciate the significance of teamwork, free-flowing exchange of ideas, and constructive appraisal. Thus, limitations of humblebragging and ways of fostering health relationships between teachers can be appreciated. Establishments looking to equip teachers with the ability of shedding egocentric behaviours and focusing on cooperation and comprehension can help in the creation of spaces that make people mix and to have stabler interpersonal relations. This sissy model of expectations would pervade the rhetoric that guides teacher communities' interactions beyond what is reasonable. Attitudes from research that is only about status may provide interesting insights into educational women's lives and pre-existing educational structures, as the avoidance model recreates the assumptions of the problems that produce the very status the manner is attempting to bypass.

6.5 Impact of Humblebragging on Reputation: Personality Traits and Context

The final objective assessed how humblebragging affects teachers' reputations, considering personality traits and the context (online vs. offline). The results revealed that offline contexts had a significantly positive effect on reputation, suggesting that humblebragging behaviours, when observed in face-to-face interactions, are perceived more positively and can even enhance teachers' reputations. This could be because offline humblebragging may come across as more genuine and relatable, as it occurs in personal or professional settings where context and non-verbal cues play a role in shaping perceptions. In contrast, humblebragging in online contexts had a negative effect on reputation. This finding underscores the difference in perception between online and offline behaviours. Online humblebragging may be seen as more self-serving and inauthentic, which could harm a teacher's reputation in the eyes of students, colleagues, and parents. Additionally, neuroticism was found to have a strong positive effect on reputation, indicating that individuals with higher levels of neuroticism may be more likely to engage in humblebragging to cope with insecurities or to seek validation, which could inadvertently enhance their social standing, despite the negative connotations of humblebragging.

When engaging sincerely with professional development schemes, teachers improve their trade, help encourage a more supportive, collaborative work culture in an organization where development experiences facilitate the joint understanding and consolidated communal efficacy and enhance their intrinsic motivation and satisfaction in their work in general. As the study went quite a bit into the different ways in which positive reinforcement might affect accountability, the results show that positive reinforcement in a form such as praise, acknowledgment, or other rewards would boost the sense of accountability in students for which they will be likely to feel encouraged to put more effort into their tasks in that they idea of commendation and rewards will make it possible. It contributes intangibly towards the creation of a sense of meaning or purpose in a teacher and actionable responsibility, which would include both improvement and devotion to the educational mission to understand engagement. By affecting teachers in their discussion of students' relational, rhetorical, and emotional needs and wants, effective communication contributes to student engagement (Xie & Derakhshan, 2021).

Table 6 Summary of Results for All Objectives

Objective	Analysis Conducted	Key Results
Objective 1: Personality traits associated with humblebragging	Correlation and regression analyses	Extraversion positively correlates with humblebragging. Agreeableness negatively correlates with humblebragging. Conscientiousness and openness have a moderate positive relationship.
Objective 2: Impact of school culture on humblebragging	Descriptive statistics and regression	School culture had no statistically significant effect on humblebragging, suggesting that other factors like personality or social media use play a stronger role.
Objective 3: Impact of humblebragging on relationships (colleagues, students, parents)	Multiple regression analysis	Peer interactions showed a weak negative correlation with humblebragging, suggesting that humblebragging negatively affect relationships with colleagues. However, the exact impact on relationships with students and parents wasn't assessed in depth in this analysis.
Objective 4: Role of peer interactions and social media in humblebragging	Multiple regression analysis with peer interactions and social media as predictors	Social media use was a significant predictor of humblebragging, with a positive relationship. Peer interactions had a weak, non-significant effect on humblebragging, indicating social media

		plays a larger role in influencing humblebragging behaviours.
Objective 5: Humblebragging's impact on reputation (personality traits and context)	Multiple regression analysis with context (online vs. offline), personality traits, and humblebragging as predictors	Offline context positively impacts reputation significantly. Online context has a negative impact on reputation. Neuroticism had a strong positive relationship with reputation. Extraversion and conscientiousness showed negative relationships with reputation.

Table 6 consolidates the findings for each objective, providing a clear view of how humblebragging and its influencing factors impact teachers' professional dynamics and social reputation. The study uncovered key information around the existing phenomenon of humblebragging among teachers: extraversion positively correlated with humblebragging, agreeableness showed a negative correlation, conscientiousness and openness displayed moderate positive relationships with humblebragging behaviours. Conversely, school culture was not considered a factor influencing humblebragging and thus, it was suggested that personality traits and perhaps social media use may have stronger effects on humblebragging. Peer interaction, conversely, negatively correlated with humblebragging, which might imply that humblebraggers potentially damage professional relationships with their peers; however, these contexts were not fully explored about relationships with students and parents. Social media use, on the contrary, strongly predicted humblebragging behaviours, while interaction between peers did very little. Reputation-wise, offline humblebragging tended to help much more in enhancing perceptions of reputation, while online humblebragging would probably do the opposite. Neuroticism strongly and positively impacted reputation, while extraversion and conscientiousness worked against positive reputation perception.

7 CONCLUSION

As a conclusion, this study highlights the complex interactions between humblebragging, personality traits, context, and social dynamics. While humblebragging is a nuanced behaviour influenced by extraversion and social media use, its effects on reputation are highly context dependent. Offline humblebragging is more likely to enhance reputation, whereas online humblebragging can be negative. Teachers with higher neuroticism may be more prone to humblebragging, which in turn may affect how their reputation is shaped. Overall, the findings suggest that while personality traits play a significant role in determining whether a teacher engages in humblebragging, the context in which humblebragging occurs especially whether it is online or offline has a significant impact on how it affects reputation of the teachers.

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Comparative Analysis of Scientific Calculators and Excel Spreadsheets in Facilitating Statistical Learning in Introductory Course

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ABSTRACT

This study investigates the differences in efficiency and accuracy between the use of scientific calculators and Excel spreadsheets in solving statistical problems among KPTM Batu Pahat students. A total of 130 students enrolled in the introductory statistics course participated in the study. All participants were trained using scientific calculators and Excel spreadsheets to solve statistical problems. After completing the training on both methods, participants were randomly assigned to one of two groups: one group used scientific calculators, while the other group utilized Excel to solve the same set of statistical problems. Students' performance, including the time taken to solve the problems and the accuracy of the solutions, was recorded. The study employed descriptive statistics, including measures of central tendency (mean, median, mode) and measures of dispersion (variance, standard deviation, range) to analyze the distribution and variability of the time. The non-parametric Mann-Whitney U test was conducted to determine the statistical significance of differences in mean times, as the data does not meet the assumption of normality and a Chi-square test of independence was used to examine the association between the tool used (calculator or Excel) and the accuracy of responses (correct or wrong). Although descriptive trends indicate a minor advantage in accuracy for the Excel group, statistical analysis revealed no significant differences between the two groups across either measure. These results imply that, with sufficient training and instructional support, both scientific calculators and Excel spreadsheets provide similar cognitive effectiveness for solving basic statistical tasks.

KEYWORDS: statistical learning tools, scientific calculator, Excel spreadsheet, technology in education, educational tools comparison

1 INTRODUCTION

The teaching and learning of statistics in higher education has evolved considerably in recent years, primarily due to the growing importance of data literacy and the increasing integration of educational technologies. As data-driven decision-making becomes central across disciplines such as business, economics, healthcare, and the social sciences, proficiency in statistical reasoning is no longer optional but essential. However, despite its value, introductory statistics remains a challenging subject for many students. Learners frequently report difficulties in understanding abstract concepts, applying computational procedures, and maintaining motivation throughout the course (Sutter et al., 2024). These barriers have urged scholars and educators to explore new pedagogical strategies that leverage digital tools to enhance student engagement and improve performance outcomes.

Two of the most common simple tools used to support statistics learning at diploma level are scientific calculators and spreadsheet software such as Microsoft Excel. Scientific calculators have long been embedded in mathematics instruction due to their portability, cost-effectiveness, and practical use. These devices allow students to perform essential statistical operations such as calculating measures of central tendency, dispersion, and correlation using built-in functions in calculators without manual computation. Their user-friendly interface and efficiency in executing single-line calculations make them an accessible option for both instructors and students, particularly in exam settings (Roman, 2018). However, calculators are limited in their ability to handle large datasets, conduct simulations, or facilitate exploratory data analysis, skills that are becoming increasingly important in today's data-centric academic and professional environments (LaCour et al., 2019; Matthew & Sunday, 2014).

On the other hand, spreadsheet software like Microsoft Excel which is owned by Microsoft Corporation has emerged as a powerful educational tool for supporting the development of data literacy. Microsoft first released Excel for the Macintosh in 1985 and for Windows in 1987, and it has become widely used nowadays. Excel enables users to automate statistical computations, manipulate datasets, and generate visualizations such as histograms, scatterplots, and trend lines, all within a single platform. The interactive and graphical nature of spreadsheets provides a more holistic learning environment where students can engage with data dynamically and immediately see the effects of their analyses (Dol et al., 2024). Research has shown that integrating Excel into classroom instruction enhances student performance and fosters deeper understanding of statistical concepts, especially when paired with guided activities and real-world datasets (Kazika & Malambo, 2025). Nonetheless, Excel also presents challenges: its complex interface may overwhelm students with limited digital literacy, and errors in formula construction can lead to misinterpretations if not carefully monitored (Udeogalanya, 2022).

Although both calculators and spreadsheets are widely used, few empirical studies directly compare their effects on student learning outcomes in statistics education. Much of the existing literature focuses either on qualitative aspects such as student preferences or on case studies assessing one tool in isolation (van Borkulo et al., 2023). As a result, there remains a critical gap in the quantitative evidence base concerning how these tools impact key performance indicators such as accuracy and efficiency. This gap is especially important given the global shift toward blended and technology-enhanced learning environments, where instructors must make informed decisions about which tools to adopt, train, and evaluate.

To examine this issue, the current study adopts a quantitative experimental design comparing the effectiveness of scientific calculators and Excel spreadsheets in solving basic statistical problems. The study specifically measures two performance outcomes: (1) efficiency, defined as the time taken to complete statistical tasks, and (2) accuracy, assessed based on the correctness of students' responses. The sample includes semester two diploma-level students enrolled in introductory statistics courses in Kolej Poly-Tech MARA Batu Pahat in November 2024 session. All participants are trained in both tools to ensure baseline familiarity and eliminate technological bias.

This study is grounded in Cognitive Load Theory (CLT), which posits that instructional strategies should reduce extraneous cognitive load so that learners can allocate cognitive resources to essential tasks (de Jong, 2010; Sweller, 2020). Technological tools that automate repetitive calculations or facilitate visualization may help reduce unnecessary mental effort, improving both efficiency and comprehension. From this perspective, Excel may offer a cognitive advantage by streamlining tasks and supporting dual-channel learning through visual feedback. However, CLT also warns against overloading learners with

complex interfaces, which means that poorly scaffolded use of Excel could backfire if students are not adequately trained.

In addition, this study is informed by constructivist learning theory, which highlights the value of learner interaction, exploration, and reflection in constructing knowledge. Spreadsheet tools support a constructivist approach by allowing students to manipulate data, test hypotheses, and generate visual representations that promote deeper insight into statistical patterns (Bada & Olusegun, 2015). Conversely, calculators emphasize procedural fluency but limit opportunities for exploratory analysis, raising questions about their utility in fostering conceptual understanding.

In synthesizing these theoretical perspectives with current pedagogical needs, this study aims to contribute to the field of statistics education by providing evidence-based recommendations on tool selection. It seeks to inform instructors, curriculum developers, and policymakers on the optimal integration of educational technologies in statistics courses, particularly within the context of higher education. By focusing on measurable learning outcomes and grounding the research in established educational theory, this paper aspires to fill a notable gap in the literature and advance the conversation on effective, technology-enhanced teaching practices in statistics.

2 METHOD

2.1 Research Design

This study employed a between subject experimental design to examine whether the type of computational tool (scientific calculator or Excel spreadsheet) affects student performance in solving introductory level statistical problems. The independent variable was the type of tool used, while the dependent variables were efficiency, measured as time taken to solve the correlation problems, and accuracy, measured as the correctness of student responses. This design was chosen to facilitate a controlled comparison between two instructional tools under real-world educational conditions.

2.2 Participants

A total of 130 students from semester two of Diploma in Human Resource Management program in Kolej Poly-Tech MARA Batu Pahat enrolled in an introductory statistics course in November 2024 session participated in the study. All participants were trained using a scientific calculator and Excel spreadsheet to solve statistical problems on the topic of Regression and Correlation. After completing standardized training on both methods, participants were randomly assigned to one of two groups: one group utilized calculators (73 students), while the other employed Excel spreadsheets (57 students) to solve identical statistical problems. Group sizes differed due to random assignment and tools availability at the time of testing.

2.3 Materials and Procedures

All participants received structured training on both tools, calculator and Excel. The training was conducted in a controlled classroom environment and consisted of 1 hour and 30 minutes training session. Instructional guides and demonstrations were provided in class, followed by brief practice exercises. After completing the training, participants were randomly assigned to one of two experimental groups. Both groups were administered an identical set of statistical problems on the topic of Regression and Correlation designed to assess competencies in data entry and calculation of correlation coefficient. The tasks were developed in alignment with the course learning outcomes.

During the test session, students were given 30 minutes to solve the assigned tasks on an online platform named e-Learning Management Utility (eLMU) used in Kolej Poly-Tech Mara. No collaboration was allowed, and all students were supervised by the course instructor. Efficiency was measured as the total time (in seconds) taken to complete the entire set of problems, which was automatically recorded by the system. Accuracy was coded as binary in which each correct answer was awarded a score of 5, and incorrect answers were scored as 0.

2.4 Data Analysis

A descriptive statistical analysis was carried out to summarize and compare the time taken by students to complete the test in both calculator and Excel groups. This analysis provided an initial understanding of the data, highlighting overall patterns in task completion time and supporting subsequent inferential analyses. Important measures of central tendency; mean, median, and mod were calculated to represent the central location of the distribution of the time taken to solve the task for each group. These measures allowed for the identification of general trends and helped characterize the average time spent by students within each group.

In addition to central tendency, measures of dispersion were computed, including variance, standard deviation, and range. These indicators were used to evaluate the spread or variability in completion times. While central tendency measures described the average duration, dispersion measures highlighted the degree of consistency or variation of task completion among students. For example, a high standard deviation or wide range would indicate significant variation in how long students took to finish, whereas a low standard deviation would suggest more uniform completion times. The use of descriptive statistics in this study develops a comprehensive understanding of time efficiency in both groups.

Data were analyzed using IBM SPSS Statistics version 20. Prior to conducting inferential tests, the data were screened for normality using the Shapiro-Wilk test. Based on this test, the value of $p \leq 0.05$ means that normality is violated. Results indicated a violation of the normality assumption for the time variable in both the calculator group ($W = .942$, $p = .002$) and the Excel group ($W = .930$, $p = .003$), suggesting the necessities to use a non-parametric test.

To compare efficiency (time taken) between the two groups, a Mann-Whitney U test was conducted, as the data were non-normally distributed and the group sizes were unequal. The Mann-Whitney U test is a non-parametric statistical method used to compare two independent groups without the assumption of normally distributed data or large sample sizes (Nachar, 2008). In this study, the test was applied to examine whether there was a statistically significant difference in the time taken to complete the tasks between students using calculators and those using Excel. Given the possibility that the data may not follow a normal distribution, the Mann-Whitney U test was considered appropriate for analyzing group differences. Unlike parametric tests that compare means under the assumption of normality, this test evaluates whether the distributions of the two groups differ significantly by comparing their medians. Using the Mann-Whitney U test enabled the researchers to assess potential differences in time efficiency based on the tool employed; calculator or Excel.

Furthermore, the analysis included a calculation of the percentage of correct and wrong answers. This binary categorization enabled a comparative analysis of accuracy between the two groups. For accuracy, given the categorical nature of the dependent variable (correct vs. incorrect), a Chi-square test of independence was used to assess whether there was a statistically significant association between the type of tool used and the accuracy of student responses. The Chi-square test is a statistical test used to determine whether there is a significant relationship between two categorical variables. Following the Chi-square test, Cramér's V was calculated to see how strong is that relationship. Cramér's V was calculated as a measure of effect size for the Chi-square analysis, following standard statistical conventions (Field, 2018). All statistical tests were conducted at an alpha level of 0.05.

3 RESULTS

This section presents the results of the statistical analyses conducted to evaluate differences in efficiency (time taken) and accuracy (correctness of responses) between the calculator and Excel groups. All analyses were conducted using IBM SPSS Statistics Version 20.

3.1 Efficiency: Time Taken to Complete Tasks

Based on the descriptive statistics results in Table 1, it revealed that the mean time for the calculator group was 415.81 seconds with a standard deviation of 151.51, while the Excel group reported a mean time of 419.47 seconds with a standard deviation of 145.27. The difference in average times between the two groups is minimal, and both groups also exhibited relatively high standard deviations, indicating a wide

range of individual performance times within each group. Furthermore, the minimum time recorded for the calculator group was 182 seconds less than that of the Excel group, at 210 seconds. In contrast, the maximum time taken in the calculator group was 940 seconds, which is higher than the maximum time recorded in the Excel group, at 746 seconds.

Table 1 Descriptive Statistics

	METHOD			Statistic	Std. Error
	CALCULATOR	Mean		415.808	17.7332
		95% Confidence Interval for Mean	Lower Bound	380.458	
			Upper Bound	451.159	
		5% Trimmed Mean		406.795	
		Median		383.000	
		Variance		22955.935	
		Std. Deviation		151.5122	
		Minimum		182.0	
		Maximum		940.0	
		Range		758.0	
		Interquartile Range		212.5	
		Skewness		.943	.281
		Kurtosis		1.008	.555
	EXCEL	Mean		419.474	19.2410
		95% Confidence Interval for Mean	Lower Bound	380.929	
			Upper Bound	458.018	
		5% Trimmed Mean		412.904	
		Median		378.000	
		Variance		21102.361	
		Std. Deviation		145.2665	
		Minimum		210.0	
		Maximum		746.0	
		Range		536.0	
		Interquartile Range		198.5	
		Skewness		.735	.316
		Kurtosis		-.317	.623

Prior to hypothesis testing, the normality of the time data was assessed using the Shapiro-Wilk test. Results of the normality test in Table 2 indicated that the assumption of normality was violated in both the calculator group ($W = 0.942$, $p = 0.002$) and the Excel group ($W = 0.930$, $p = 0.003$). Therefore, a Mann-Whitney U test, a non-parametric alternative to the independent samples t-test, was employed to compare the median time taken to solve the statistical test between the two groups.

Table 2 Test of Normality

	METHOD	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
TIME	CALCULATOR	.109	73	.031	.942	73	.002
	EXCEL	.125	57	.026	.930	57	.003

Table 3 Mann-Whitney U Test

Test Statistics[a]

	TIME
Mann-Whitney U	2041.000
Wilcoxon W	4742.000
Z	-.185
Asymp. Sig. (2-tailed)	.853

a. Grouping Variable: METHOD

A Mann-Whitney U test was conducted to determine whether there were differences in the time taken to solve statistical problems between students who used scientific calculators and those who used Excel spreadsheets. Results in Table 3 indicated that the difference in time between the two groups was not statistically significant, U = 2041.00, z = -0.185, p = 0.853. This result suggests that the type of tool used (calculator or Excel) did not significantly influence the efficiency or impact the time students needed to solve the tasks.

3.2 Accuracy: Correctness of Responses

To examine whether the type of tool used was associated with student performance in terms of answer accuracy, a Chi-square test of independence was conducted. The bar chart in Figure 1 illustrates a comparison of accuracy between students who used scientific calculators and those who used Excel spreadsheets to solve statistical problems.

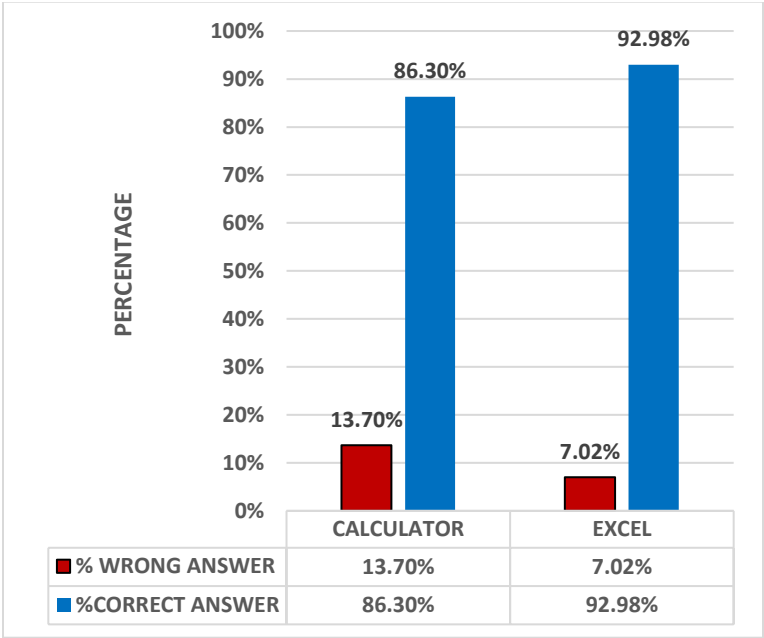


Figure 1: Percentage of Answer Accuray in Calculator and Excel Groups

Among the students who used calculators, 86.30% provided correct answers while 13.70% submitted incorrect responses. In contrast, the group that used Excel achieved a higher accuracy rate, with 92.98% correct answers and only 7.02% incorrect. This visual trend suggests that students using Excel performed better in terms of accuracy than those using calculators. Although the Excel group demonstrated a higher proportion of correct responses, the Chi-square analysis as shown in Table 4 indicated that the association between tool type and performance accuracy was not statistically significant with $\chi^2(1, N = 130) = 1.49$, $p = 0.223$.

Table 4 Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	**1.487**	1	**.223**		
Continuity Correction	.873	1	.350		
Likelihood Ratio	1.545	1	.214		
Fisher's Exact Test				.265	.176
Linear-by-Linear Association	1.475	1	.225		
N of Valid Cases	130				

Table 5 Cramer's V Statistical Measures

		Value	Approx. Sig.
Nominal by	Phi	.107	.223
Nominal	Cramer's V	**.107**	**.223**
N of Valid Cases		130	

The effect size, measured by Cramér's V in Table 5, was approximately 0.11, indicating a small effect (Field, 2018). These findings suggest that while there is a trend toward higher accuracy with Excel, the association between the tool used and the correctness of answers is not strong enough to be considered statistically significant.

3.3 Summary

The results of both the Mann-Whitney U test and Chi-square test suggest that there were no significant differences in student performance either in terms of time efficiency or accuracy based on whether students used scientific calculators or Excel spreadsheets. These findings imply that both tools offer comparable outcomes when applied to basic statistical problem solving at the diploma level.

4 DISCUSSIONS

This study aims to examine whether the type of computational tool; scientific calculator or Excel spreadsheet significantly affects students' efficiency and accuracy in solving introductory statistical problems. Guided by Cognitive Load Theory and constructivist perspectives on technology-enhanced learning, we hypothesized that Excel, with its automated functions and dynamic visual capabilities, might lead to higher performance compared to calculators. However, the results revealed no statistically significant differences between the two groups in terms of either time efficiency or answer accuracy, suggesting that both tools are equally effective in supporting students' performance in basic statistical tasks.

The finding that the calculator and Excel groups performed similarly in terms of efficiency contradicts a common assumption that spreadsheet software necessarily facilitates faster task completion. While Excel does offer automation and template-based problem-solving, it also requires navigating menus, inputting formulas, and managing interfaces that may offset these advantages particularly among users who are not fully proficient. This aligns with prior research indicating that while spreadsheets enhance

functionality, they may impose an initial cognitive overhead that affects task fluency, especially among novice users (Darejeh et al., 2021; Gallardo & Valenzuela González, 2015). From a Cognitive Load Theory perspective, Sweller (2019), both tools appear to provide a manageable cognitive environment for students when properly introduced through training, resulting in comparable cognitive demands and completion times.

In terms of accuracy, the Excel group exhibited a modestly higher percentage of correct responses (92.98%) compared to the calculator group (86.30%), yet the difference was not statistically significant. This pattern may suggest that Excel's error-reducing features such as automatic recalculation and visibility of formulae offer a slight edge in avoiding computation mistakes, even though the margin of benefit was not large enough to yield significance in this sample. These findings resonate with those of Kazika & Malambo, (2025), who noted that Excel-supported instruction can marginally enhance statistical reasoning and reduce arithmetic errors, especially when used alongside guided instruction. However, consistent with Dania et al. (2019), this study also suggests that using spreadsheets like Excel may not have shown a clear advantage because people are still learning how to use them properly. The tools in Excel can be powerful, but if users don't fully understand how to use them or make mistakes, it can cancel out any time-saving benefits. This learning curve and the chance of using the features incorrectly likely reduced the positive effects we might have expected to see in this study.

Theoretically, these results contribute to the ongoing discussion about the pedagogical role of educational technology in statistics instruction. The absence of significant differences suggests that either tool can be pedagogically viable, depending on the learning environment, available resources, and instructional goals. Calculators continue to offer value in settings where digital literacy or hardware access is limited. Conversely, spreadsheets may offer richer learning opportunities in courses that emphasize data visualization and exploratory analysis. From a constructivist perspective Kronthaler (2023), Excel's affordances could be more beneficial in higher-order tasks that require data manipulation, hypothesis testing, or multivariate analysis areas not explored in the current study but worthy of future investigation.

These findings carry important implications for instructors and curriculum designers. First, they offer reassurance that selecting either tool (calculator or spreadsheet) does not inherently advantage or disadvantage students in terms of performance on foundational statistical tasks. This is particularly useful for educators navigating constraints such as technological access, exam settings, or institutional policy. Second, the results support the integration of structured training sessions on the chosen tool, as familiarity may be a key mediator of performance outcomes, regardless of the tool's inherent complexity or capabilities.

However, several limitations of the present study should be acknowledged. The study was conducted within a single institution and limited to basic statistical tasks typically covered in an introductory course. As such, the generalizability of the findings may be constrained across different contexts, such as advanced courses, diverse academic disciplines, or international settings. Additionally, while the study measured efficiency and accuracy, it did not assess students' conceptual understanding, confidence, or long-term retention, all critical components of statistical literacy. Finally, the reliance on performance-based measures alone limits insights into how students engage with or perceive each tool, an area that could be further explored through mixed-methods research.

Looking forward, future studies could expand the scope by incorporating more complex statistical applications, such as hypothesis testing, or analysis of variance (ANOVA) to determine whether tool-related differences emerge under increased cognitive or computational demand. Researchers might also consider examining the impact of hybrid approaches, where both calculators and spreadsheets are used in complementary ways throughout a course. Moreover, assessing student motivation, cognitive strategies, and digital self-efficacy could offer deeper insights into how technology supports or hinders statistical learning.

In summary, this study contributes to a growing body of evidence suggesting that both scientific calculators and Excel spreadsheets can serve as effective tools in statistics education. While each tool has distinct advantages and limitations, their impact on student performance in basic statistical tasks appears to be statistically equivalent when appropriate training and support are provided. These results encourage educators to focus less on the tool itself and more on how it is integrated into instruction, emphasizing pedagogy, accessibility, and alignment with learning outcomes.

5 CONCLUSIONS

This study investigated the comparative effectiveness of scientific calculators and Excel spreadsheets in supporting diploma level students' performance in solving introductory-level statistical problems. Through an experiment involving 130 participants, the study assessed two key outcomes: efficiency, measured by time taken to complete tasks, and accuracy, measured by correctness of responses. Despite descriptive trends suggesting a slight advantage for the Excel group in terms of accuracy, statistical analyses revealed no significant differences between the two groups on either metric.

These findings suggest that, when adequate training and instructional support are provided, both scientific calculators and Excel spreadsheets offer comparable cognitive benefits for basic statistical tasks. Grounded in Cognitive Load Theory and constructivist learning principles, the study highlights that the effectiveness of educational tools is contingent not solely on their technical capabilities but also on how they are integrated into instructional contexts. While calculators remain a viable option for straightforward computation, Excel's potential may be more fully realized in complex, exploratory, or data-intensive statistical applications.

Practically, the results support flexibility in tool selection for instructors, especially in diverse educational environments where access to digital infrastructure may vary. Both tools appear suitable for promoting foundational statistical competencies, and the choice of tool can be tailored to pedagogical goals, resource availability, and learner preferences without compromising educational quality.

Future research should explore the use of these tools in more advanced statistical domains and across broader institutional settings. It would also be helpful to follow students over a longer period to see how well they understand the material, how much they remember, and how they feel about learning with technology. Additionally, incorporating mixed-method approaches could give a deeper understanding of how different tools influence students' learning experiences and engagement.

In conclusion, this study contributes empirical evidence to the growing discourse on technology in statistics education. It underscores that pedagogical strategy, rather than the tool alone, plays a pivotal role in shaping learning outcomes; an insight that remains critical as educators navigate increasingly digital and data-driven learning environments.

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A Systematic Comparative Study of Mandarin as a Foreign Language (MFL) Courses in Malaysian Universities and Hanyu Shuiping Kaoshi (HSK) Programs in Malaysia: An Empirical Analysis

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ABSTRACT

This study compares the curriculum, pedagogical approaches, and outcomes of Mandarin as a Foreign Language (MFL) course offered in Malaysian public universities with HSK language courses conducted in Malaysia. While university MFL courses emphasize holistic language acquisition within an academic framework, HSK programs focus on standardized exam proficiency aligned with the Chinese proficiency test. By analysing syllabus, teaching materials, assessment methods, and learner outcomes, this research identifies the strengths and uniqueness of both systems. Findings reveal that university MFL programs provide clear proficiency metrics and general language skills but often neglect industry-relevant communication skills. Conversely, HSK courses excel in fostering communicative competence and cultural understanding but lack standardized benchmarks for proficiency progression. The study highlights a critical gap: the disconnect between academic language training and industry-recognized certification (MFL), which limits graduates' competitiveness in multilingual workplaces. To bridge this gap, the study proposes integrating HSK's structured proficiency framework into university curricula while retaining strengths in communicative and cultural pedagogy. These findings suggest a collaborative design of hybrid programs, teacher training for exam-oriented instruction, and alignment with the China Standards for International Chinese Language Education (2021). This integrated approach would elevate the global competitiveness of Malaysia's Mandarin education system by equipping learners with three critical competencies: internationally recognized certification, practical communicative fluency, and industry-specific language skills.

KEYWORDS: Mandarin Language, Local Universities, Foreign Language, HSK (*Hanyu Shuiping Kaoshi*) and Malaysia

1 INTRODUCTION

In today's interconnected world, technological advancements facilitate seamless communication across international borders, making multilingualism an increasingly essential skill (Dollar, 2023). Recognizing this, Malaysia has actively promoted multilingual education, encouraging university students to learn foreign languages particularly Mandarin (Lee, 2022). This growing interest can be attributed to China's remarkable economic growth, technological innovation, political influence, and expansive market potential, all of which have positioned Mandarin as a strategically valuable language in international business and diplomacy (Shambaugh, 2023).

To enhance local university graduates' competitiveness in the global corporate world and develop their Mandarin proficiency, Malaysian universities have incorporated Mandarin as a foreign language course (Tan et al., 2023). Externally, the Hanyu Shuiping Kaoshi (HSK) operates as an independent organization offering Mandarin education to the general public. While both systems share the common objective of promoting Mandarin mastery, they differ significantly in approach: universities employ an academic framework with degree-aligned curricula, comprehensive skill development (reading, writing, speaking), and continuous assessment, while HSK concentrates on standardized test preparation, exam-focused training, and China's official proficiency certification (Abdul Rahman & Chen, 2023). Furthermore, university courses mainly cater to enrolled students for academic credit, whereas HSK serves professionals and lifelong learners pursuing internationally recognized credentials. These distinct systems: one embedded in higher education, the other specializing in proficiency certification; create complementary pathways addressing diverse needs, from academic advancement to professional development and personal enrichment (Hanban, 2022). In other words, both systems possess unique strengths and make valuable contributions to Malaysia's multilingual landscape. However, research has identified several challenges. University programs, while academically rigorous, often produce graduates with limited conversational fluency despite strong theoretical knowledge or excellent of academic achievement (Tan, 2022: Wong & Abdullah, 2023). Conversely, HSK's China-centric curriculum may not fully accommodate Malaysia's distinct cultural context and linguistic environment (Wong & Chen, 2023). These gaps suggest opportunities for curriculum adaptation potentially integrating more practical communication components into university courses while localizing HSK content to better reflect Malaysian sociocultural realities. These shortcomings create a critical theory-practice divide: university students master grammar but struggle with business communication, while HSK learners excel in testing but lack cultural understanding (Lee et al., 2023). To bridge these gaps, Malaysia needs an integrated approach that combines the academic rigor of university programs with HSK's standardized assessment, while adapting content to local contexts and emphasizing practical communication skills for real-world business scenarios.

Therefore, this study aims to systematically compare Malaysia Mandarin as a Foreign Language (MFL) program with the Hanyu Shuiping Kaoshi (HSK) certification system across few critical dimensions. The findings can be considered foundational for developing an integrated Mandarin education framework that combines the academic rigor of university programs with HSK's standardized proficiency benchmarks, while addressing current gaps in practical communication skills and local cultural adaptation - ultimately proposing evidence-based recommendations to enhance Malaysia's Mandarin education ecosystem for greater alignment with both global standards and domestic workforce needs.

2. THE DEVELOPMENT OF THE MANDARIN AS A FOREIGN LANGUAGE (MFL) IN MALAYSIA

The history of Mandarin as a foreign language (MFL) in Malaysia reflects both the country's multicultural heritage and China's growing global influence. Initially limited to Chinese vernacular schools serving the ethnic Chinese community during the British colonial period, Mandarin education gradually expanded beyond its traditional demographic after Malaysia's independence, transforming into an important skill for intercultural communication and economic advancement (Hoe et al., 2011).

To ensure graduates would maintain language competitiveness, the Malaysian government introduced Mandarin as a foreign language (TMSL) at university level. This initiative began in 1963 when

the University of Malaya pioneered Mandarin classes for non-native speakers, establishing the foundation for structured Mandarin education in Malaysia's higher education system (Lee & Wong, 2015; Tan & Teoh, 2018). Over subsequent decades, growing demand fuelled by Malaysia's multicultural environment and expanding economic ties with Greater China led to the establishment of Mandarin programs across all 20 public universities by September 2011 (Fan, 2011).

The expansion of Mandarin as a foreign language (MFL) in Malaysia gained further momentum in the 21st century, driven by globalization and China's emergence as an economic superpower. Recognizing its strategic value, Malaysian universities began tailoring their Mandarin programs to meet diverse needs from business communication and tourism to academic research and diplomatic relations (Hoe & Tan, 2007). Confucius Institutes, established in collaboration with China's Ministry of Education, played a pivotal role by providing standardized curricula, teacher training, and internationally recognized proficiency exams like the HSK (Hanyu Shuiping Kaoshi). These efforts significantly elevated the quality and credibility of Mandarin education in the country (Tan & Zhang, 2018).

Mandarin's importance was further underscored by Malaysia's deepening economic ties with China, particularly under initiatives like the Belt and Road Initiative (BRI) (Chen & Abdullah, 2021). As Chinese investments in Malaysia surged, proficiency in Mandarin became a highly sought-after skill in industries such as trade, manufacturing, finance, and hospitality. Many Malaysian corporations, including multinational firms and SMEs, began prioritizing Mandarin-speaking employees to facilitate smoother business transactions and strengthen partnerships with Chinese counterparts (Cheng, 2008). Moreover, the Malaysian government actively promoted Mandarin learning through policies encouraging bilingualism and multiculturalism. Programs like the Malaysia-China Friendship Association and student exchange initiatives fostered cultural understanding while enhancing language skills (Ho, 2020). The rise of digital learning platforms, such as online courses and language apps, further democratized access to Mandarin education, enabling working professionals and students to learn at their own pace.

Today, Mandarin is not just a foreign language but a vital tool for socioeconomic mobility and global competitiveness in Malaysia. Its integration into education, business, and diplomacy highlights its enduring relevance, positioning Malaysia as a key player in fostering Mandarin proficiency within Southeast Asia. Moving forward, continued collaboration between educational institutions, industry stakeholders, and the government will be crucial to standardizing and advancing Mandarin education for future generations (Hoe et al., 2011).

3 COMPARISONS BETWEEN MFL AND HSK SYSTEMS

This study systematically compares Mandarin as a Foreign Language (MFL) programs in Malaysian universities with the Hanyu Shuiping Kaoshi (HSK) certification system across five key dimensions: (1) pedagogical approaches (theory-based instruction vs. standardized testing preparation), (2) cultural relevance (adaptation to Malaysia's multicultural context), (3) learning outcomes (theoretical knowledge vs. practical communication skills), (4) workforce preparedness (alignment with Malaysia-China business needs), and (5) integration potential (synergies between academic and certification frameworks).

3.1 PEDAGOGICAL APPROACHES

The pedagogical approaches of Mandarin as a Foreign Language (MFL) course in Malaysian universities and the Hanyu Shuiping Kaoshi (HSK) certification system present fundamentally different paradigms in language education. Malaysian universities implement MFL programs through a comprehensive academic framework, typically structured across 14-week semesters with balanced attention to all four language skills: listening, speaking, reading, and writing (certain of universities merely focus on Hanyu pinyin) (Tan & Hoe, 2007). These programs employ communicative language teaching (CLT) methodologies, combining theoretical grammar instruction with practical tutorials and cultural immersion

activities, as evidenced by some local Universiti's MFL syllabus. Assessment follows continuous evaluation models incorporating written exams, oral presentations, and coursework portfolios, aligned with the Common European Framework of Reference for Languages (CEFR) standards (Hoe, 2014)

In stark contrast, HSK programs adopt a laser-focused examination preparation model, with most private language centers offering intensive courses (60-80 sessions) structured around HSK test blueprints. The Malaysian Hanban Institute's HSK preparation program exemplifies this approach, dedicating the majority of instructional time to reading comprehension drills and listening exercises that utilize past exam recordings, while allocating significantly less attention to speaking and writing components (Hanban, 2022) These latter elements are typically addressed through formulaic response patterns rather than fostering creative language use. The pedagogical framework is overwhelmingly exam-driven, emphasizing vocabulary memorization through systematic techniques, strategic test-taking approaches, and frequent mock examinations that mirror actual testing conditions. This creates a learning environment where mastery of examination formats takes precedence over organic language acquisition, with instructional content carefully calibrated to match the specific requirements and scoring rubrics of the HSK proficiency levels. The program's structure reflects a pragmatic orientation toward measurable outcomes, prioritizing efficient test performance over broader linguistic or cultural competencies. This focus results in a distinctive educational experience where students become adept at navigating the examination system but may develop skills that are narrowly tailored to test-specific contexts rather than versatile real-world application (Hanban,2022)

Furthermore, the pedagogical approaches of these two systems foster distinct learning outcomes with complementary strengths. University MFL programs cultivate metacognitive skills through hands-on projects and research assignments, while HSK instruction focuses squarely on immediate performance outcomes measured through standardized test scores (Teh, & Ng, 2022). This fundamental difference extends to technological integration university programs typically employ blended learning platforms including language laboratories for interactive practice, whereas HSK centers rely heavily on AI-powered test simulation software (Abdullah & Wong, 2021). These divergent approaches produce markedly different graduate profiles. On one hand, MFL students develop strong academic foundations but may struggle with spontaneous communication in real-world settings. On the other hand, HSK graduates demonstrate exam proficiency yet face difficulties adapting their language skills to Malaysia's unique sociocultural contexts, particularly in informal or culturally nuanced situations (Yap, 2011).This contrast highlights how each system, while effective within its specific parameters, creates specialists in different aspects of language competency, one in academic mastery and the other in test performance, it suggesting potential benefits from strategic integration of these approaches.

3.2 CULTURAL RELEVANCE

The cultural relevance of Mandarin education in Malaysia reveals a striking contrast between university MFL programs and HSK certification systems, particularly in their adaptation to Malaysia's multicultural context Yap, 2011)MFL programs consciously localize their content through Malaysia-specific cultural modules that compare Chinese-Malaysian practices with mainland Chinese traditions, incorporate localized case studies of daily communication, and examine the historical, culture and lifestyle development of Chinese communities in Malaysia, while also addressing linguistic realities like code-switching between Mandarin and Malay/English and analyzing distinctive features of Malaysian Mandarin vocabulary (Ooi & Tan,2023). For instance, some of the University conducted "Malaysian" MFL curriculum include dedicated "Mandarin in Malaysian Contexts" modules that explore language use in local media, cross-cultural daily negotiations, and community interactions, using authentic materials from Malaysian Chinese newspapers and recordings of local Mandarin dialects.

In stark contrast, HSK programs maintain a rigid China-centric cultural framework, with standardized teaching materials developed by China's Hanban that predominantly feature mainland Chinese

social contexts, business etiquette, and cultural references, often rendering them culturally dissonant for Malaysian learners (Hanban, 2022)Based on the HSK textbooks and exam materials uniformly present Beijing-standard Mandarin without accommodation for local linguistic variations, and cultural content focuses exclusively on mainland Chinese festivals, social norms, and historical narratives, leaving Malaysian learners unprepared for nuanced local Mandarin usage in professional or social settings. This cultural mismatch becomes particularly evident when HSK-certified professionals encounter actual workplace scenarios requiring understanding of Malaysian Chinese business protocols or ability to navigate the country's unique linguistic landscape where Mandarin blends with other local languages, whereas MFL graduates typically demonstrate greater cultural agility in these situations, though they may lack the standardized test scores valued by certain employers (Tan, & Hoe,2007). The resulting paradox forces Malaysian learners to choose between programs offering cultural relevance but limited certification recognition (MFL) versus those providing prestigious certification but inadequate cultural preparation (HSK), highlighting the need for curriculum reform that could bridge this divide by combining HSK's rigorous assessment standards with MFL's localized cultural content to better serve Malaysia's multilingual workforce needs in an era of growing China-ASEAN economic integration.

3.3 LEARNING OUTCOMES

The learning outcomes of Malaysia's Mandarin as a Foreign Language (MFL) programs and Hanyu Shuiping Kaoshi (HSK) certification reveal fundamentally different competencies shaped by their distinct pedagogical approaches. University MFL graduates typically develop comprehensive language skills with strong foundations in academic writing, hand on assignment and intercultural understanding but often demonstrate limited fluency in spontaneous conversational contexts and practical workplace communication (Yap, 2011) In contrast, HSK-certified learners show exceptional performance in standardized testing environments, mastering examination-specific vocabulary and grammatical structures, but frequently struggle to adapt their language skills to Malaysia's multilingual social and professional settings. This divergence becomes particularly evident in real-world applications (Hanban, 2022).

MFL graduates from institutions exhibit stronger capabilities in formal business correspondence and nuanced understanding of local Chinese-Malaysian cultural contexts (Hoe & Tam, 2007) while HSK certificate holders, especially at intermediate and advanced levels, demonstrate superior accuracy in structured language tasks but face difficulties with unscripted dialogue or comprehending regional linguistic variations. National graduate surveys consistently highlight this dichotomy, with HSK-certified professionals reporting confidence in examination settings but discomfort in actual business negotiations, whereas MFL graduates show the opposite pattern of slight better practical communication abilities but less familiarity with standardized testing formats (Hoe, 2014). These contrasting outcomes stem from core curricular differences, local University MFL programs emphasize gradual language acquisition through semester-long courses incorporating literary analysis, academic discourse, and cultural studies, while HSK preparation prioritizes intensive, short-term mastery of testable competencies through repetitive exercises and simulated examinations. The technological components further differentiate results: MFL's blended learning approaches cultivate digital collaboration skills, whereas HSK's AI-driven test practice develops proficiency in computerized assessment formats (Hanban,2022). In essence, this divergence reveals a fundamental tension between language proficiency as measured by standardized testing versus language competence developed through contextualized learning. While HSK certification provides an internationally recognized benchmark of linguistic accuracy, MFL programs offer culturally-grounded communicative fluency that aligns with Malaysia's unique sociolinguistic landscape.

3.4 WORKFORCE PREPAREDNESS

The distinction between MFL (Mandarin as a Foreign Language) courses and HSK (Hanyu Shuiping Kaoshi) preparation in Malaysia becomes particularly evident when examining workforce preparedness and educational quality, including lecturer expertise and learning conditions (Hoe, 2013). Commonly offered in Malaysian universities, MFL courses primarily introduce non-native speakers to basic Mandarin communication, cultural awareness, and everyday language use. However, the absence of a standardized proficiency framework across different universities results in inconsistent skill levels among graduates. While MFL provides foundational knowledge, its generalist approach often fails to adequately prepare students for professional environments requiring advanced Mandarin proficiency, such as international trade, diplomacy, or Chinese-Malaysian business sectors. By contrast, HSK - China's official standardized Mandarin proficiency test - follows a rigorous six-level system (HSK 1-6) that systematically develops listening, speaking, reading, and writing competencies. Particularly valued by multinational corporations and China-linked industries, HSK certification (especially levels 4-6) provides employers with guaranteed, internationally recognized proof of language ability (Hanban,2022). Professionals with HSK qualifications enjoy a competitive edge in careers requiring technical or formal Mandarin usage. The test's alignment with the Common European Framework of Reference for Languages (CEFR) further enhances its global credibility for academic and career advancement.

Significant differences also exist in lecturer quality and learning conditions. Malaysian MFL programs face challenges including inconsistent teaching standards, limited access to native-speaking instructors, and insufficient specialized teacher training. While public institutions often rely on non-native Mandarin teachers with varying fluency levels, private providers demonstrate mixed quality depending on available resources (Hoe,2013). In stark contrast, HSK preparation courses typically feature certified Mandarin instructors frequently native speakers affiliated with Confucius Institutes or accredited language centers. These educators receive specialized training in teaching Mandarin as a foreign language and employ methodologies precisely aligned with HSK requirements (Hanban,2022). HSK students additionally benefit from globally standardized textbooks, digital learning platforms, and comprehensive mock exams that ensure systematic progression. The infrastructure gap proves equally notable. Many MFL programs struggle with outdated materials, limited immersion opportunities, and minimal industry collaboration. Meanwhile, HSK courses commonly incorporate multimedia resources, language exchange programs, and partnerships with Chinese educational institutions to facilitate real-world language application. Some advanced HSK programs even provide internship connections with Chinese companies, substantially enhancing graduates' workforce readiness (Chen & Lim, 2022).

3.5 INTEGRATION POTENTIAL

The integration potential of MFL (Mandarin as a Foreign Language) courses and HSK (Hanyu Shuiping Kaoshi) in Malaysia reveals stark contrasts in how academic curricula align with standardized certification frameworks. MFL programs, typically offered by Malaysian universities as elective language courses, operate within institutional academic frameworks but lack formal synchronization with internationally recognized proficiency benchmarks (Hoe,2013) While these courses provide structured syllabus for basic to intermediate Mandarin learning, their learning outcomes often remain disconnected from external certification systems, resulting in a gap between classroom instruction and measurable language competency demanded by employers (Hanban,2022). This disconnection limits MFL's integration potential, as universities design courses based on internal academic requirements rather than global standards, leaving graduates without portable credentials that validate their proficiency in professional contexts. In contrast, HSK's standardized six-level framework (HSK 1-6) is explicitly designed to bridge academic learning with certification, offering a clear progression pathway that aligns with both educational and industry needs. The seamless integration potential of HSK stems from its direct correspondence with **the** Common European Framework of Reference for Languages (CEFR)**,** enabling

Malaysian institutions to map their Mandarin curricula to internationally accepted competency levels (Wong & Tan, 2021).

Moreover, HSK's integration extends beyond mere assessment; its preparation materials, teacher training programs, and digital resources are designed to complement formal education systems, allowing Malaysian universities to adopt or adapt HSK-aligned content into existing MFL modules (Hanban,2022). Conversely, MFL programs rarely offer such flexibility, as their localized focus and lack of standardization hinder compatibility with external certification frameworks. The absence of a unified Mandarin assessment system in Malaysian higher education further exacerbates this issue, as MFL courses vary widely in content and difficulty across institutions. HSK, by contrast, provides a universal metric that academic institutions, employers, and even government policies can recognize, creating opportunities for cross-sector collaboration such as dual certification programs or credit transfers for HSK achievers.

4 THE CHALLENGE OF MFL AND HSK SYSTEMS IN MALAYSIA.

The current implementation of Mandarin as a Foreign Language (MFL) course in Malaysia presents significant challenges within the country's Mandarin education system. While these university-based programs offer foundational Mandarin training, their lack of standardization and misalignment with globally recognized certification frameworks like HSK creates systemic inefficiencies. This disconnect poses substantial difficulties for students, educators, and policymakers attempting to establish a cohesive Mandarin education system that serves both academic and professional needs (Wong & Tan, 2020).

A primary concern is the growing mismatch between academic instruction and industry recognition. Although MFL courses provide valuable basic language acquisition, they frequently operate independently of established proficiency benchmarks. Malaysian universities typically design their curricula based on internal academic requirements rather than standardized competency levels, producing graduates who may have conversational skills but lack certified proof of their proficiency (Abdul Rahman & Chen, 2022). This situation creates problems when graduates enter a job market where employers particularly multinational corporations and China-linked businesses increasingly prioritize HSK certification as concrete evidence of language ability. As a result, MFL students often find themselves at a professional disadvantage despite their considerable investment in Mandarin education.

Compounding these issues is the inconsistent quality of teaching and resources across institutions. MFL programs demonstrate wide variations in curriculum depth, teaching methodologies, and instructor qualifications throughout Malaysia. Some universities depend on non-native Mandarin speakers or general language instructors without specialized training in Mandarin pedagogy, resulting in uneven educational outcomes (Hoe, 2013). This stands in stark contrast to HSK preparation courses, typically offered through Confucius Institutes or accredited language centers, where certified instructors often native speakers with specific training in teaching Mandarin as a foreign language deliver the curriculum. Such disparities highlight the ongoing challenge of providing equitable access to high-quality Mandarin education across the nation.

While the HSK (Hanyu Shuiping Kaoshi) certification offers a standardized measure of Mandarin proficiency, its implementation in Malaysia faces several challenges. First, the exam's China-centric content often overlooks local Malaysian linguistic and cultural contexts, creating a disconnect for learners who need Mandarin for domestic communication rather than mainland Chinese interactions (Yap, 2011). At the same time, accessibility and awareness remain significant barriers. Many students and professionals outside major urban centers lack information about HSK or face difficulties finding certified test centers. The costs of preparation materials and exam fees also deter potential candidates, particularly those from lower-income backgrounds.

Additionally, limited institutional support hinders widespread adoption. Unlike countries where HSK is integrated into national education systems, Malaysian universities and employers rarely mandate or recognize the certification, reducing its perceived value. This lack of formal recognition discourages long-term commitment from learners. Lastly, the rigid structure of HSK may not suit all learners' needs. Professionals seeking industry-specific Mandarin skills (e.g., business, engineering) find the generalist

approach less practical, while the emphasis on written proficiency disadvantages those prioritizing verbal communication (Lim & Zhang, 2023). For HSK to gain traction in Malaysia, greater localization, affordability, and alignment with local academic and professional frameworks are essential. Without these adjustments, its potential to enhance Malaysia's Mandarin education landscape remains limited.

5 CONCLUSIONS

The comparison between MFL and HSK in Malaysia reveals distinct advantages and limitations for each system. While MFL programs provide accessible, foundational Mandarin education within academic institutions, their lack of standardization and industry recognition limits their effectiveness in preparing students for professional demands. The absence of a unified certification framework means MFL graduates often struggle to prove their competency in competitive job markets, particularly where employers prioritize measurable proficiency. Conversely, HSK offers a globally recognized, standardized assessment that aligns with international benchmarks and industry needs. Its structured progression and certification system give learners a clear pathway to demonstrable fluency, making HSK graduates more competitive in China-linked sectors. However, HSK's limited integration with Malaysia's education system and its China-centric focus present barriers to widespread adoption. For Malaysia to maximize its Mandarin education outcomes, a hybrid approach that combines MFL's academic foundation with HSK's certification framework would be ideal. By aligning MFL curricula with HSK standards, Malaysian institutions could maintain academic flexibility while ensuring graduates obtain portable, industry-recognized credentials. Policymakers and educators should prioritize bridging this divide through curriculum harmonization, instructor training, and stronger institutional partnerships. Only through such integration can Malaysia develop a Mandarin education system that meets both local needs and global standards, preparing students for academic success and professional competitiveness in an increasingly China-connected world.

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The Use of Instagram as a Tool for Learning Academic English Among Diploma Students at a Private Institution in Ipoh

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ABSTRACT

This study examines the use of Instagram as a supplementary tool for learning Academic English among diploma students at a private higher education institution in Ipoh, Malaysia. This study investigates how Instagram, a prevalent social media platform, can improve language learning through informal digital engagement, in accordance with government's initiatives to integrate information and communication technology (ICT) into education. Thus, this study employed a quantitative exploratory methodology, and gathered data through structured questionnaires from 18 diploma students enrolled in an academic English course for diploma students. Subsequently, SPSS analysis indicated that Instagram favourably influences vocabulary acquisition and listening comprehension, especially via various kinds of content including reels, stories, and carousel posts. Moreover, students reported enhanced motivation and confidence while engaging with academic content in a familiar digital setting. Nonetheless, obstacles include distractions, colloquial language, and limitations in obtaining high-quality educational content were also identified. The study highlights Instagram's potential as a supplementary platform for academic language learning, provided its utilization is guided and coordinated by educators. Key recommendations include integrating educator-curated content, leveraging multimedia features for visual learning, and offering multilingual support. The findings provide practical insights for educators and policymakers aiming to enhance English language instruction through digital platforms in Malaysian tertiary education.

KEYWORDS: Instagram, Academic English, Social Media Learning, ICT in Education

1 INTRODUCTION

Malaysia's focus on digital integration in education opens doors for using social media in language acquisition. ICT is promoted by the Ministry of Education as pillar for getting students ready for digital involvement (Ministry of Education Malaysia, 2013). Programs like the Digital Educational Learning Initiative Malaysia (DELima) and the Malaysia Education Blueprint highlight how dedicated the nation is to encouraging digital competency among its citizens. These initiatives seek to equip students with tools to interact meaningfully with technology, therefore preparing them for a technologically linked future.

English, which is required for both academic and professional success, especially at university levels, demands creative learning approaches. Accessing scholarly materials, engaging in academic debate, and looking for a career in a globalised employment market all depend on one's ability in English. Thus, creative approaches for English instruction and learning are required to satisfy the changing needs of the students.

Popular among young people in Malaysia, Instagram could be a good forum for unofficial academic participation. With 31% of respondents choosing Instagram over other platforms, according to a Merdeka Centre poll, Instagram is the most popular social media site among young Malaysians (Merdeka Centre,

2023). This extensive use offers a chance to maximise Instagram's tools for academic engagement, therefore benefiting visual learning, interactive participation, real language use, and community development.

Examining diploma students' views and behaviours in this field helps this study to offer a targeted, small-scale viewpoint. It seeks to investigate how Instagram may be used to promote academic English learning, therefore offering information that might guide next digital learning projects and teaching plans.

Malaysia's emphasis on digital integration in education has created avenues for leveraging social media in language learning. The Ministry of Education promotes ICT as a cornerstone for preparing students for digital engagement (Ministry of Education Malaysia, 2013). Initiatives such as the Malaysia Education Blueprint and the Digital Educational Learning Initiative Malaysia (DELIMa) underscore the country's commitment to fostering digital proficiency among students. These efforts aim to prepare students for a digitally connected world, enhancing their ability to engage with technology in meaningful ways.

English, being essential for academic and professional success, especially at tertiary levels, demands innovative learning strategies. Proficiency in English is crucial for accessing scholarly resources, participating in academic discourse, and pursuing career opportunities in a globalized job market. Consequently, innovative strategies for teaching and learning English are necessary to meet the evolving needs of students.

This study contributes a focused, small-scale perspective by examining diploma students' perceptions and practices in this area. It aims to explore how Instagram can be effectively utilized to support the learning of Academic English, providing insights that could inform future educational strategies and digital learning initiatives.

1.1 RESEARCH OBJECTIVES

1. To investigate the ways in which diploma students at a private institution in Ipoh use Instagram to support their Academic English learning.
2. To evaluate students' perceptions of the effectiveness of Instagram in enhancing their Academic English proficiency.

1.2 RESEARCH QUESTIONS

1. In what ways do diploma students use Instagram as a supplementary tool for learning Academic English?
2. How do students perceive the usefulness of Instagram in improving their Academic English skills?

2 LITERATURE REVIEW

Academic English, characterised by formal writing, referencing, and discipline-specific terminology, remains understudied, while most research focuses on general English or vocabulary learning. Instagram can assist with Academic English through organised educator-led content (Savina, 2017; Zakaria et al., 2021; Maierová, 2021; Sarangapani & Hashim, 2022; Nambakhsh, 2024); however, it is not inherently academic.

Instagram, among other social media sites, is becoming more and more known for its educational value. The graphic and interactive character of Instagram helps with vocabulary acquisition, contextual communication, and exposure to real language use (Al-Ali, 2014). Research conducted in Malaysia validates Instagram's contribution to language acquisition assistance and increases student motivation (Savina, 2017; Yunus et al., 2019; Rahmat, 2020; Maierová, 2021; Sarangapani & Hashim, 2022).

Furthermore, Instagram's tools such as stories, IGTV, and live sessions—offer dynamic means for students to interact with materials and instantly practise language. Immersion learning opportunities that transcend conventional classroom environments can be produced using these instruments (Nambakhsh, 2024).

Furthermore, improving students' critical thinking and analytical abilities is the platform's capacity to support peer-to-peer interaction and cooperative learning. Through conversations and feedback loops, students can improve their presenting and academic writing abilities (Rahmat, 2020).

3 METHODOLOGY

The study uses a quantitative, exploratory design to investigate Instagram's role in Academic English learning among diploma students at a private institution in Ipoh. The sample comprises 18 students enrolled in English courses within their diploma programs.

A structured questionnaire was designed using frameworks by Manca (2020) and Al-Ali (2014), focusing on Instagram and Academic English. The questionnaire includes sections on demographics (age, gender, field of study, and English proficiency), Instagram usage (frequency, content types followed, and features used such as stories, reels, and posts), perceived usefulness (measured on a 5-point Likert scale, assessing Instagram's impact on vocabulary, writing, and academic understanding), and three open-ended questions to gather qualitative insights on students' experiences and perceptions.

A convenience sampling method was employed, with participants voluntarily completing the online questionnaire, ensuring anonymity. Descriptive statistics, including frequencies, means, and percentages, were generated using SPSS. Due to the exploratory nature of the study, inferential testing was not performed.

4 FINDINGS & DISCUSSION

4.1 SURVEY

Students reported moderate benefits from Instagram in Academic English learning. Listening skills were notably improved (M = 3.67, SD = 1.08), supporting Martínez-Domingo et al. (2025). Understanding real-life English usage was also positively rated (M = 3.56, SD = 1.25).

Instagram's role in vocabulary exposure scored M = 3.5 (SD = 1.15), especially through Reels, stories, and posts (Nasution, 2023). Frequent engagement with English-language content was reported (M = 3.44, SD = 1.42). Motivation compared to textbooks was mixed (M = 3.11, SD = 1.41), with distraction concerns (M = 3.11, SD = 1.08) (Gonulal, 2019).

Students expressed a modest increase in confidence (M = 3.06, SD = 1.35). Instagram was deemed a useful supplementary resource (M = 3.06, SD = 1.11). Interest in structured lessons via Instagram was moderately positive (M = 3.00, SD = 0.91). However, difficulty identifying reliable educational accounts was noted (M = 2.56, SD = 0.92).

4.2 OPEN ENDED QUESTIONS

Theme	Quote
Reels	"The short videos help me remember words better because I can see how they are used."
Posts	"I like the carousel posts that explain academic phrases—they are easy to understand."
Stories	"Sometimes I learn just by watching the stories with captions. It feels less stressful than reading textbooks."
Distractions	"I get distracted easily and end up scrolling through non-educational posts."
Connectivity	"High data usage limits access."
Informality	"A lot of the content is in slang or too casual for academic writing."
Complexity	"Some posts are too hard to understand without translation."

Thematic analysis of the data revealed several preferred content types and challenges associated with using Instagram for learning Academic English. Students found Instagram Reels effective for vocabulary and phrase acquisition, with one student remarking, "The short videos help me remember words better because I can see how they are used" (Mukolo et al., 2024).

Posts were deemed suitable for structured learning, as another student commented, "I like the carousel posts that explain academic phrases—they are easy to understand" (Maldonado-Estrada, 2020). Stories were valued for their visual engagement, with a participant sharing, "Sometimes I learn just by watching the stories with captions. It feels less stressful than reading textbooks" (UpGrow, 2024).

However, several challenges were identified. Students noted that the oversaturation of content on Instagram often led to distractions, with one student stating, "I get distracted easily and end up scrolling through non-educational posts" (WallHabit, 2024). High data usage was another issue, limiting access for some students (Voyeglobal, 2025). The informal nature of Instagram, characterized by slang and a casual tone, was not always conducive to formal English learning. A student explained, "A lot of the content is in slang or too casual for academic writing" (FluentSlang, 2023). Additionally, the complexity of advanced vocabulary and structures created barriers, as one respondent noted, "Some posts are too hard to understand without translation" (Musely, 2025).

4.3 DISCUSSION

Based on these findings, several recommendations for educators were proposed. Educators should develop structured, daily content to provide consistency and focus. Using interactive videos and multimedia can enhance engagement and learning outcomes (Mukolo et al., 2024). Providing multilingual subtitles can help bridge language gaps and support comprehension (Zakaria et al., 2021). Lastly, leveraging visual strategies, such as using images and videos, can make learning more engaging and effective (UpGrow, 2024).

The survey answers show the kinds of Instagram material students find most useful for learning English. Reels are especially well-liked since they frequently incorporate brief, interesting movies introducing new words and phrases. This is consistent with results from Martínez-Domingo et al. (2025), who observed that Instagram supports digital competence in communication and teamwork (Martínez-Domingo et al., 2025). Students also like posts with instructional value, such those defining terms or offering methodologies or organised lessons. Another favourite format is stories since its graphic and interesting character.

Although utilising Instagram to learn English has several advantages, students have certain difficulties. Divergent information on the site can cause distractions that hinder concentration on learning. This aligns with the research by Fazal et al. (2022), which emphasises Instagram's part in preserving relevance and inspiration in education. For some consumers, the requirement for a good internet connection to view information can also be an obstacle. Complicating the learning process even more are issues, including poor English, slang, and ambiguous sentences. Similar difficulties in his comprehensive literature review of Instagram in English language acquisition (Nasution, 2023) were observed in Nasution (2023).

Respondents gave English teachers to consider using Instagram as a teaching tool some insightful advice. Structured materials, such as interactive movies and consistent word definitions, can improve knowledge. Supporting the premise of employing interactive and interesting videos, Maierová (2021) concluded that Instagram's popularity and visual attractiveness made it a useful tool for language acquisition. By including multilingual subtitles, students' understanding of the material will improve, therefore resolving the language obstacle. As Gonulal (2019) in his qualitative systematic evaluation (Gonulal, 2019) emphasises visual learning and engagement, courses can be more successful.

5 CONCLUSION

Particularly for vocabulary and auditory development, Instagram has shown considerable promise as a supplementary tool for learning Academic English. Student participation, drive, and access will all determine its success. Instagram can significantly help English language acquisition in tertiary

environments by means of an educator-led framework and well-chosen content (Rizal, 2021; Agustin & Ayu, 2021).

Furthermore, Instagram's interactive tools—stories, reels, live sessions—can produce interesting and captivating educational opportunities. Crucially for language development and progress are real-time feedback and peer engagement made possible by these tools. Teachers can use Instagram's popularity and accessibility by including it into the syllabus to improve students' learning results and motivation (Maierová, 2021).

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Designing Hand Gesture Learning Application for Mute and Deaf Communities

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ABSTRACT

According to the World Health Organization (WHO), approximately 5 percent of the world's population suffers from disabling hearing loss. Deaf people have little to no hearing and frequently communicate with others through sign language. The best way to connect with the deaf and hearing-impaired community is by learning sign language. However, due to the significant challenges associated with signing, many deaf people are unable to participate in even these basic interactions. Moreover, there are only 95 sign language interpreters registered with the Malaysian Federation of the Deaf (MFD), compared to the 40,743 hearing-impaired people with disabilities (OKU) registered with the welfare department in 2021. Thus, there is a need to develop a functional learning module application as an alternative method to learn for basic communication. A wheel cycle technique is used to design and develop the application. The wheel cycle consists of four phases: Phase 1: Analysis, where the necessary analysis is gathered depending on the existing scope; Phase 2: Design, where the sign language learning module application is designed; Phase 3: Prototype, where a prototype is constructed based on identified relationships and patterns; and Phase 4: Evaluation, where a summary is configured based on judgement through reasoning. The findings show that the application has good potential as a sign language learning module application. The user interface is user-friendly and follows a minimalist design approach. In conclusion, the application is expected to benefit the mute and deaf communities by shortening their learning curve.

KEYWORDS: Sign language, Mute, Wheel Cycle, Deaf, Learning module, Disability

1 INTRODUCTION

Communication is a fundamental human right, yet millions face barriers due to hearing loss. Globally, the World Health Organization (WHO) estimates that 5 percent of people live with disabling hearing loss, relying on sign language as their primary means of interaction. Despite its critical role, sign

language education remains neglected, isolating deaf and hearing-impaired communities. In Malaysia, this gap is starkly evident: only 95 registered sign language interpreters serve 40,743 hearing-impaired persons with disabilities (OKU) (Muthiah, 2022). This disparity underscores a systemic issue: the lack of recognition and integration of sign language in society, which marginalizes deaf individuals and limits their participation in basic social interactions.

This study offers a sign language learning package meant to instruct fundamental communication skills for daily use with the mute or deaf communities to solve this problem. By focusing on functional viability, user-friendliness, and cultural relevance, the research aims to bridge communication gaps and promote inclusivity. The significance of this work lies in its potential to empower individuals with essential sign language skills, fostering social integration and aligning with the linguistic identity of deaf communities.

2 LITERATURE REVIEW

A learning module for the disabled community is a well-organized grouping of information that will educate others about impaired people. One or more subjects, concepts, or themes may be supported by a learning module. This could mean that there are limited numbers of applications available that are functional for learning sign language. According to one study, the authors created an application to help people who are physically disabled. Before conducting a user trial on the Android platform for a Japanese input application with auto scan functionality, they modified the specification based on the results of the experiment from a button-converting mechanism to a mechanism that transforms the input object itself. A verification experiment is conducted before the application is created in order to test and evaluate the functionality of the generated Android application. The impact of assistive technology on modern society has provided opportunities for people with impairments. It helps them with difficult or near-impossible daily duties and allows them to live a simpler life. Deaf persons frequently struggle with communication, particularly face-to-face communication. According to Samonte et al. (2019), Assistive Technology should be viewed as a collaborative tool rather than a tool for the blind. The capabilities of the hardware and software used in assistive technology must be taken into account based on the limitations of the target user.

The popularity and usability of smart devices such as smartphones and smartwatches have led to the development of several aided technologies. Assistive solutions based on smart devices are far more usable than other technologies. Research has been conducted to design a mobile assistant to help people with disabilities use their mobile phones (Fatahillah & Asfarian, 2020). The wheel method is used to implement the project. The four stages of the Wheel cycle approach are analysis, design, prototype, and assessment. Contextual questions are asked of the user as part of the analysis, which is then described using a work activity affinity diagram and modelled using a hierarchical task inventory. Android Studio was used to create a media application for learning sign language that describes the letter and word structures (Nurpiena et al., 2021). Graphics interchange format (gif) images of various gesture types will be used to display the content in this application. The developed application will be smaller in size compared to programs that display videos, as the GIF format was chosen due to its smaller file size. Similar programs that use video as their primary medium contain up to three times more data than those using GIFs.

Human-computer interaction (HCI) is a multidisciplinary field of study concerned with the design of computer technology and, more specifically, the interaction between people (the users) and computers. Although it began with a focus on computers, HCI has since expanded to cover almost all forms of information technology design. Since decades, since Human Computer Interaction (HCI) became widely available, sign language recognition (SLR) has been studied. Recognition of gestures is the cornerstone of sign language translation. In order to recognise sign language, gesture recognition is crucial. Feature extraction, feature representation, categorisation, and pre-processing make up the broad framework of vision-based SLR. Typically, preprocessing involves localising the hands and removing noise. To choose a suitable method of presenting the important information, use sign gesture representation. To provide the next classifier with condensed and discriminative descriptors for a better recognition purpose, features must be extracted. How to extract the most distinguishing features from photos or videos and which classifier is the best to yield reliable results are currently the difficulties encountered in SLR (Zheng et al., 2017).

A platform for learning American Sign Language at their own pace is offered via the Android app SignSchool (Siong et al., 2021). The programme includes a sign language dictionary that lets the user look up the sign for a word. It also divides indications into a number of groups according to the subjects they relate to. It also includes games that offer a variety of options to aid in the learning of sign language, as well as a feature called SignBuilder that generates random signs to increase students' sign vocabulary. However, they only offer their applications in English; Malay is not one of those languages.

The learning module used to perform this research is based on the literature review of the articles. The goal is to create a functioning learning module prototype for determining whether the hand movement is done correctly. Android Studio is chosen as the platform, as this research is for the creation of a sign language learning module.

3 METHOD

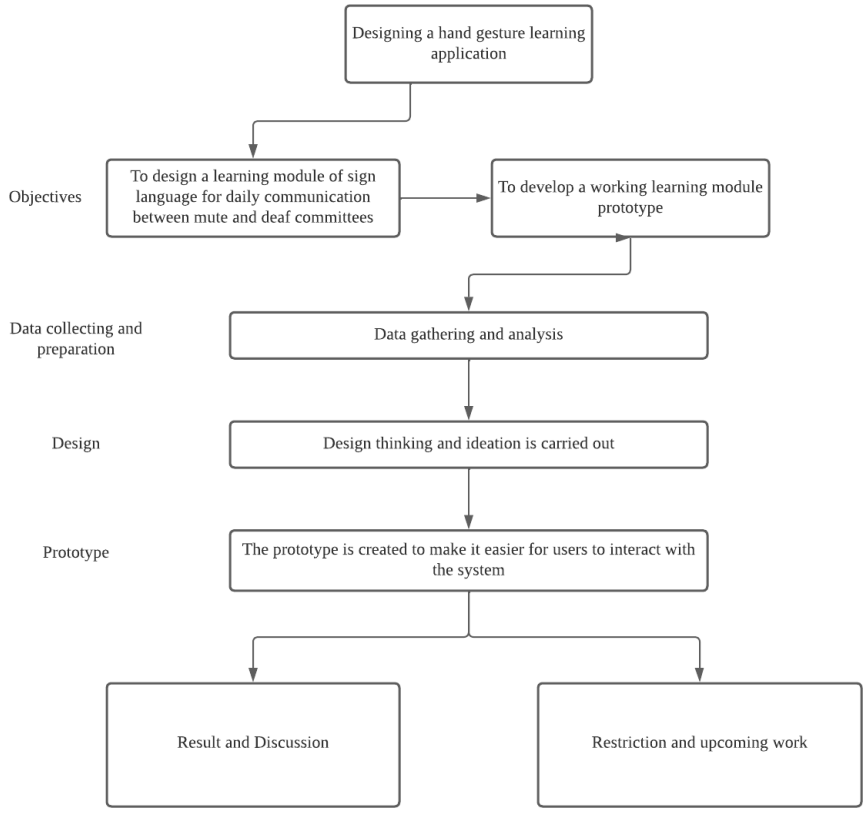


Figure 1: Flowchart

3.1 Research questions

Based on the severe lack of sign language interpreters in Malaysia (95 interpreters for 40,743 hearing-impaired people) and guided by the framework for technology-mediated learning autonomy, this study examines how digital tools can help close communication gaps (Muthiah, 2022; Reinders & White, 2016). The following question guides this study because of the growing dependence on technology for language learning and the pressing need for scalable solutions to advance inclusivity:

- What is the solution to make people understand basic communication in sign language?
- How to ensure that the application can be used by users?

3.2 Phase 1 : Data collecting and gathering

The purpose of the data collection was to better understand the communication barriers that Malaysian deaf and mute communities face, especially the lack of familiarity with sign language in society. Literature reviews and interviews with deaf people brought to light everyday challenges made worse by a

lack of social support and a lack of public knowledge of sign language. In order to verify cultural relevance, gesture datasets were selected from the American Sign Language (ASL) dictionary and verified using Malaysian Sign Language. Thematic analysis of interview responses was used to identify user needs, such as multimedia support (images/videos) and intuitive navigation.

3.3 Phase 2: Design

User interactions, such as category-based browsing and sequential gesture navigation (e.g., "next/previous" buttons), were mapped using a storyboard-driven methodology (Figures 2 & 3). Android Studio was used to create medium-fidelity prototypes that struck a balance between flexibility and detail. Simplicity was given top priority in the interface, with gesture categories shown on a homepage for quick access. For instance, the "Alphabets" section lets users cycle through letters, while the "Greetings" category features detailed video demonstrations of signs like "Hello."

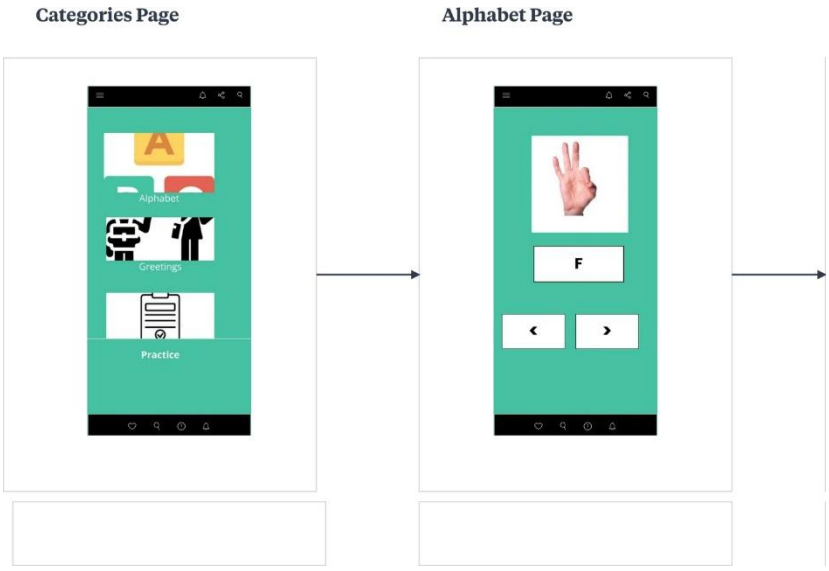


Figure 2: Storyboard

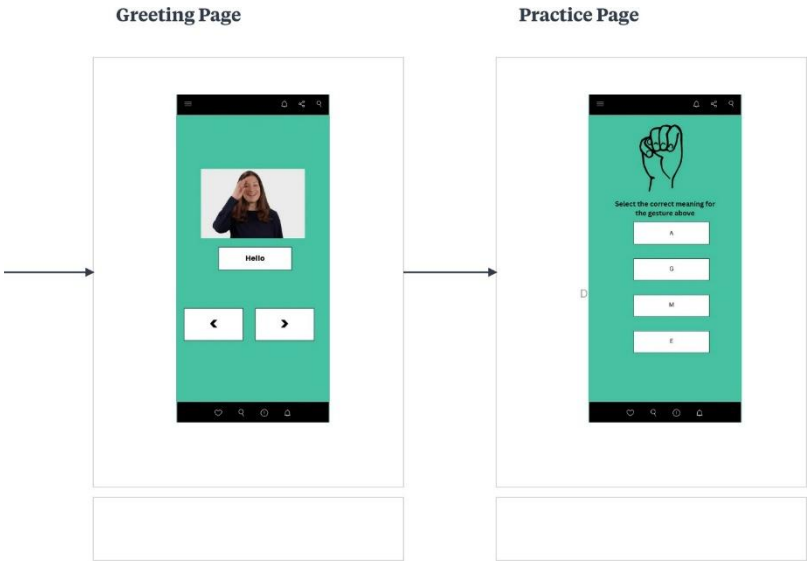


Figure 3: Storyboard

3.4 Phase 3: Prototype

The results of the previous design phase were put into practice during the prototype stage. This included creating learning media application interfaces, research instruments, instructional materials (such as gesture demonstrations), and testing standards to assess the functionality of the program. A prototype with the .apk extension was developed using Android Studio and installed on Android smartphones for evaluation. During development, a medium-fidelity design approach was used to strike a balance between flexibility and detail. Through pilot testing, prototypes were iteratively improved based on input from ten deaf/mute users.

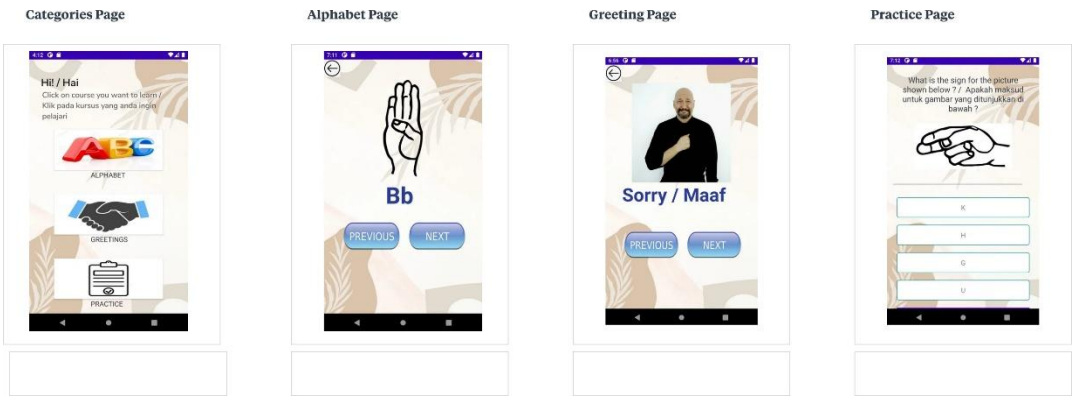


Figure 4: Prototype

4 RESULT

The system architecture, user interface design, and implementation challenges are the three main pillars around which the results of the Android application's development and assessment are organised.

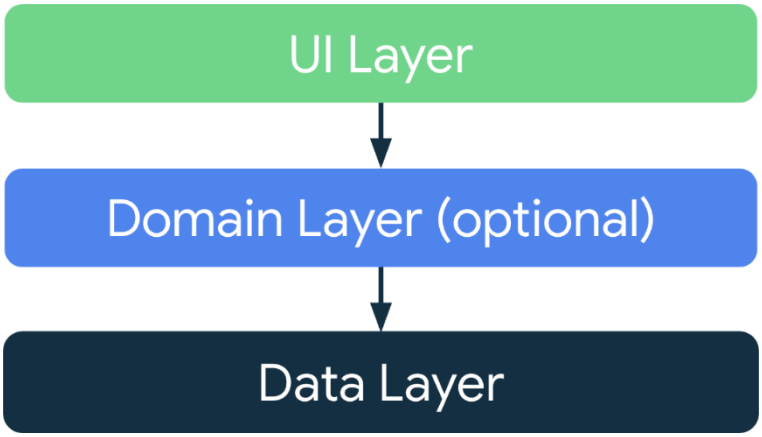


Figure 5: App architecture diagram

The user interface (UI) layer and the data layer comprised the system architecture. Real-time user interactions and dynamic content rendering were guaranteed by the UI layer, which was created with Android components like activities, fragments, and view state managers. Fragment transactions, for instance, allowed for seamless transitions between greeting modules and alphabet pages (such as going from "A" to "B"). Repository classes were used by the data layer to manage a SQLite database, centralise data operations, and reconcile disparities between sources. In addition to allowing for scalability through

the addition of new gestures or categories, this layer stored structured sign language content, such as alphabets, greetings, and practice questions.

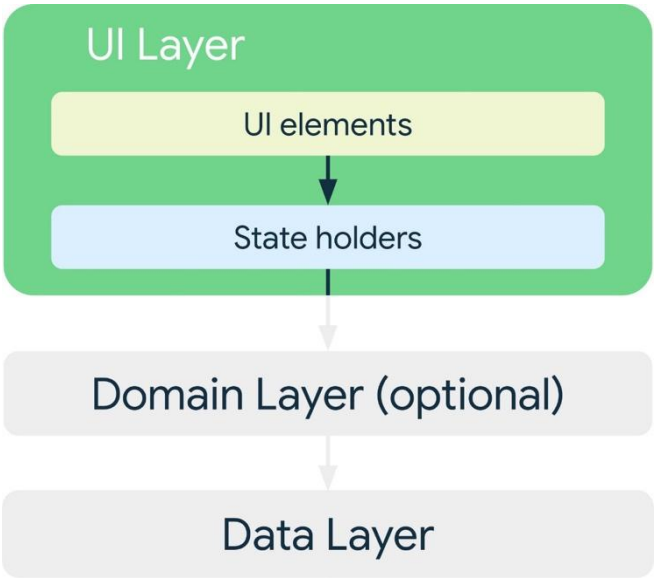


Figure 6: The function of the UI layer's role

Accessibility and easy navigation were given top priority in the user interface design. This is to make it easier for users to access learning modules, the homepage included categories that were clearly arranged (such as Alphabet and Greetings). Capital and small letters were shown on alphabet pages along with the sign language animations that corresponded to them. There were also navigation buttons to allow users to cycle through the letters in order. While the practice module used a multiple-choice format with visual cues, the greeting pages combined bilingual descriptions (in both English and Bahasa Malaysia) with animated demonstrations to show gestures. Users were given prompt feedback on their responses, which strengthened their understanding by providing clarifications and corrections.

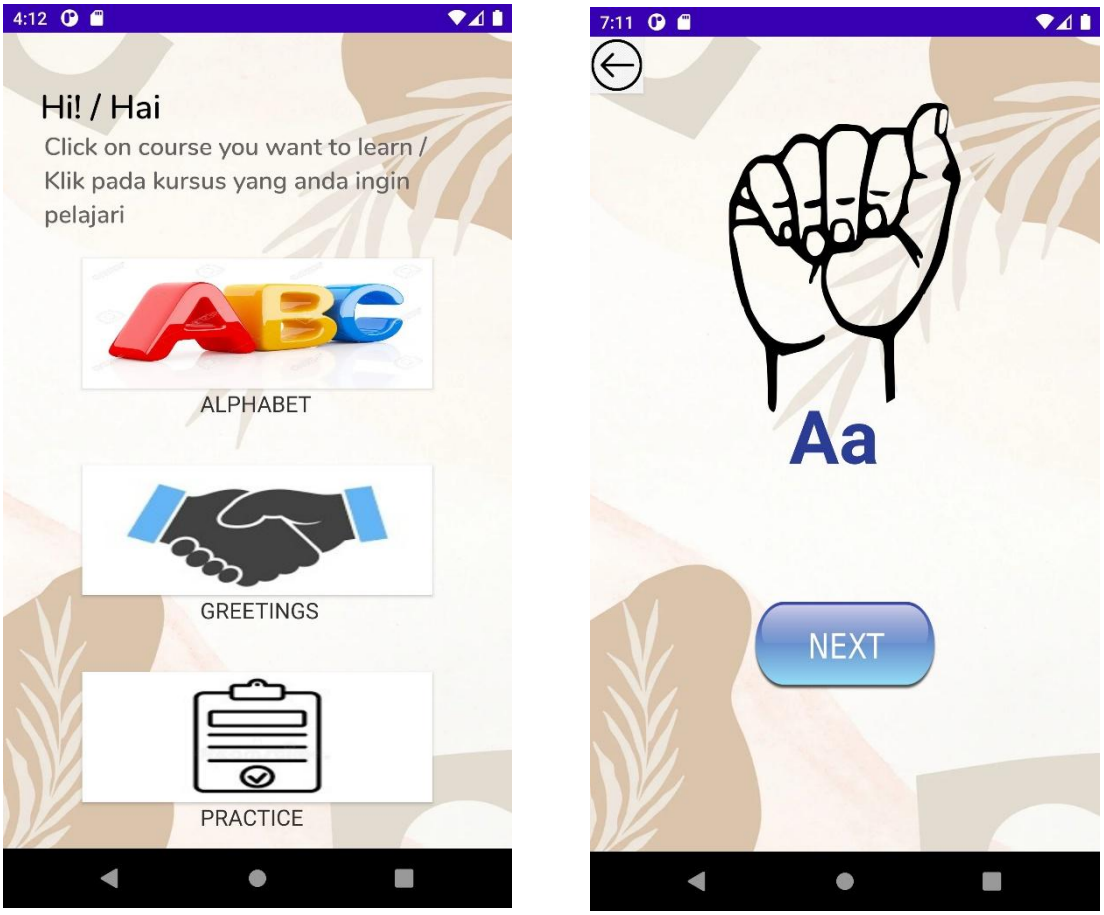


Figure 7: Homepage & Homepage/Alphabet A

5 DISCUSSION

The study's findings show that an Android-based sign language learning app with a modular and user-centred approach to meeting basic educational needs has been successfully developed (Naranjo-Zeledón et al., 2021). The program guarantees scalability and maintainability by following Android's suggested architectural practices, which include separating the UI and data layers. While the data layer centralises resource management, allowing for future expansions and efficient updates, the user interface layer efficiently controls the rendering of dynamic content, including animated GIF demonstrations of signs (Novaliendry et al., 2023). Bilingual labels (in English and Bahasa Malaysia) improve accessibility for Malaysian users, and the content is arranged hierarchically into categories (such as alphabet, greetings) to make navigation easier (Muniandy & Zaharudin, 2024). The practice module's multiple-choice format and real-time error correction reinforce learning objectives.

However, challenges like performance optimisation and device compatibility highlighted how crucial responsive design is. This ensures seamless operation across devices, adaptive layouts and optimised file sizes for GIFs were required due to variations in screen resolutions and hardware capabilities. Although the application satisfies its fundamental functional requirements, it still has limitations in terms of content depth (such as the lack of sophisticated vocabulary) and user progress tracking (Alaghband et al., 2023). These limitations draw attention to areas that could use improvement in the future, like adding specialised sign categories to the content or integrating backend systems for customised learning pathways.

This work has effects for both the technical and educational fields. In terms of education, the app offers a structured, self-paced resource for novices, addressing a need for easily accessible sign language materials in Malaysia's multilingual setting. Technically speaking, the modular architecture emphasises flexibility and cross-device performance while acting as a model for scalable mobile learning apps. To increase accessibility, future versions might investigate more sophisticated features like cross-platform

compatibility or gesture recognition with device cameras (Ramli & Yee, 2023). In the end, this research contributes to increased inclusivity and communication accessibility for hearing-impaired communities by addressing existing limitations and utilising the app's scalable framework.

6 CONCLUSION

Through encouraging accessible education in Malaysian Sign Language (MSL), this study effectively created a mobile learning application to close the communication gap between the hearing and the deaf communities in Malaysia. The application promotes inclusivity by streamlining the learning process for MSL gestures and vocabulary through a minimalist design philosophy and user-centred development. Although the project's primary goal was accomplished, its shortcomings, such as its lack of real-time gesture recognition and inadequate datasets, highlight the necessity for additional developments.

Future studies should concentrate on adding a variety of sign language categories to datasets and incorporating real-time gesture detection through the use of cutting-edge computer vision technologies in order to increase the app's impact. Gamified learning modules, community-driven content, and regional MSL dialects could all be added to the application to increase user adoption and engagement. The app would become a comprehensive platform for lifelong learning through collaboration with linguists, educators, and the deaf community, ensuring cultural and functional relevance. In the end, these improvements might spark a national awareness of MSL, promoting a culture in which empathy and understanding are valued above barriers to communication.

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Artificial Intelligence in Private Higher Education in Malaysia: A Comprehensive Analysis of Adoption Trends and Barriers

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ABSTRACT

Integrating artificial intelligence (AI) in private higher education institutions has gained significant attention, reshaping administrative processes, teaching methodologies, and student engagement. Unlocking tomorrow's learning A transformative path for AI in Malaysian private higher education. Several universities have implemented AI for their institutions; however, their AI adoption process lacked well-defined implementation guidelines. Therefore, this paper provides a comprehensive analysis of AI adoption trends, examining its benefits and challenges in private universities. Key barriers, including financial constraints, ethical concerns, and institutional resistance, are explored. Through an extensive review of scholarly literature, the paper aims to offer insights into how private higher education can effectively harness AI technologies in their system while maintaining academic integrity and educational excellence.

KEYWORDS: Artificial Intelligence, Higher Education, Technology Adoption, Implementation Barriers, Educational Innovation.

1 INTRODUCTION

Technology is advancing faster today than ever, with evidence of its impact on all facets of our lives. In the 21st century, technology has emerged as a transformative force in the education sector, reshaping how knowledge is delivered, accessed, and assessed. Integrating digital tools and platforms into the learning environment has revolutionized classroom instruction and expanded educational opportunities beyond traditional boundaries. From interactive whiteboards and e-learning platforms to virtual classrooms and AI-driven tutoring systems, technology enhances teaching methodologies, fosters engagement, and enables personalized learning experiences.

One of the most significant impacts of technology in education is its ability to facilitate access to information and learning resources, regardless of time and location. Online learning management systems (LMS), digital libraries, and open educational resources (OER) have democratized education, enabling learners from diverse backgrounds and geographical locations to access high-quality content. Furthermore, tools such as video conferencing, discussion forums, and collaborative applications support real-time interaction and knowledge sharing, thereby promoting inclusivity and learner autonomy (Hanim Mohsin et al., 2024).

Furthermore, emerging technologies such as artificial intelligence (AI), virtual reality (VR), and data analytics are opening new educational frontiers. AI-powered platforms can assess student performance, recommend tailored learning paths, and automate administrative tasks, allowing educators to focus more on student development. Meanwhile, immersive technologies like VR enable experiential learning in science, medicine, and engineering fields. As technology continues to evolve, its strategic application in education holds the promise of fostering innovation, improving educational outcomes, and preparing learners for the demands of a rapidly changing digital world (Aydin, Aydin & Sirkeci, 2024) 2024). Artificial intelligence (AI), generally expressed by the public as the ability of machines or computers to think and act as humans do, represents the efforts towards computerised systems to imitate the human mind and actions (Gocen & Aydemir, 2020)

AI in Malaysian education today uses data-driven technologies and complex algorithms to improve learning, expedite administrative work, and offer predictive insights. With programs like the Fourth Industrial Revolution (4IR) strategy and the Malaysia Education Blueprint, the government is aggressively promoting the use of AI technologies in educational institutions. AI is being used by educational institutions to develop more individualised learning programs, raise student interest, and support more efficient teaching strategies. With the introduction of AI-powered grading tools and intelligent tutoring systems, Malaysia's traditional educational model is being drastically changed, leading to more effective and interesting contemporary learning environments (Michelle Chong Joo Chien, 2025).

The integration of artificial intelligence (AI) into higher education has garnered significant attention, particularly within private institutions that often possess greater flexibility and resources compared to their public counterparts (Henke, 2024). Even though artificial intelligence (AI) holds great promise for improving educational processes, the quick uptake of AI in Malaysian private universities raises several challenges that need immediate consideration. The increasing integration of AI technologies into educational systems presents several obstacles or challenges. Therefore, this study analyzes AI adoption trends and barriers in private Malaysian HEIs.

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2 AI ADOPTION IN PRIVATE HIGHER EDUCATION

Due to the growing usage of GenAI in higher education, researchers have been actively investigating its pedagogical efficacy and adopting it in a range of courses. (Lee, 2025). There are currently more than 40 private universities that offer programs at all study levels, like their public HEIs (Jaaffar et al., 2021). The Malaysian Education Blueprint Plan (PPPM) 2013-2025, Shift 7: Harness ICT to scale up quality learning throughout Malaysia, seeks to optimize the utilization of ICT for self-directed learning to broaden access to excellent teaching (Hashim et al., 2022).

Artificial intelligence (AI) is a term coined in 1955 by John McCarthy, Stanford's first faculty member in AI, who defined it as "the science and engineering of making intelligent machines." (Christopher Manning, 2022). Higher education institutions (HEIs) play a critical role in preparing a nation to be actively serious in producing talented human capital assets. One type of higher education institution is a private institution, in which the private sector owns and runs it. The term "private" merely means that students' tuition and investments provide the university's revenue (Yang et al., 2022). Modern developments in machine learning (ML) and artificial intelligence (AI) enable individuals to imitate and even surpass human intelligence, surpassing the capabilities of analog computers.

In recent years, private HEIs in Malaysia have gradually adopted AI, incorporating AI-driven tools into various elements of their operations, from administrative efficiencies to teaching advances and student support services. The emergence of these technologies has already had a profound impact on education, equipping students with new abilities and creating a collaborative learning environment at higher education institutions that will have a big impact soon. Private higher education institutions have increasingly embraced AI technologies to enhance various aspects of their operations. This integration indicates an increasing recognition of AI's ability to improve institutional competitiveness and student success in a shifting global educational landscape. The applications identified are often divided into three important areas:

a) Personalized Learning:

Artificial Intelligence (AI) is being incorporated into education in a revolutionary way that has the potential to alter the nature of teaching methods completely. A key component of this shift is the rise of personalized learning environments, in which artificial intelligence works to modify instructional materials and interactions to suit each student's particular requirements, preferences, and speed (Rajki et al., 2025). AI-driven platforms facilitate tailored educational experiences by adapting content to individual student needs, thereby improving engagement and learning outcomes(Li & Balinas, 2025). Research on Artificial Intelligence (AI) has been implemented as part of the trends, especially in the private sector of higher education, and has become an integral part of the learning process. It is considered that most of the private higher institutions embrace AI as a part of various aspects (Rajki et al., 2025).

AI is revolutionizing the way that we educate and learn. Once used by a single educational institution, private AI can create unique instructional tools, automate teaching tasks, and provide students with tailored learning experiences. Private AI for institutions, sometimes referred to as AI solutions customized for a particular company, can provide several advantages. They can boost academic performance, increase administrative effectiveness, and customize financial advice. Private AI can also be used by institutions to handle documents, examine photos, and even create chatbots to assist students.

Artificial intelligence (AI) is a major factor in the change of higher education, where personalized learning has gained popularity due to its ability to increase student engagement and academic accomplishment. AI systems use plenty of student data, including demographics, academic performance, and learning preferences, to adapt feedback, exams, and instructional materials to each student's needs. By using a variety of formats, such as text, video, or simulations, these systems modify information to accommodate varied learning styles, increasing engagement and motivation. Additionally, AI makes it possible to develop tailored tests and focused feedback that enhance formative and summative assessment. When compared to traditional learning environments, studies have demonstrated that AI-driven tailored learning enhances student engagement, retention, and academic outcomes, as demonstrated by higher task completion, retention rates, and test scores (Stylianos Kampakis, 2023)

AI-powered personalized learning systems have been integrated with Learning Management Systems (LMS), virtual tutors, and adaptive learning platforms to adjust curriculum, exams, and feedback to each student's unique needs. These systems use data analytics to monitor student behavior, preferences, and performance, allowing for dynamic changes to teaching materials and support. Private institutions are frequently more agile and resource-flexible, allowing them to experiment with AI solutions more quickly than public institutions. Trends include the usage of AI-driven analytics dashboards to assist teachers in tracking students' progress, intelligent tutoring systems for skill development, and AI chatbots for academic guidance. Predictive analytics is also becoming more popular as a tool for identifying students who are at risk and putting early interventions in place. Private universities are increasingly seeing AI-driven personalized learning as a strategic investment to improve educational quality, student satisfaction, and retention rates, even though deployment is still in its early stages.

It is becoming a leverage for the student through facilitating personalized learning in terms of instructional materials, assessments, and feedback. The AI algorithms can analyze vast amounts of data, from the learning preferences to the demographic information, through the eyes of students. Through the data, the institution manages to observe the individual strengths, weaknesses, and areas of interest among the students provided by the AI algorithm. AI can be adapted into a variety of applications with different learning styles and approaches. Most of the content is delivered in a variety of formats according to the preferences of students. This method contributed to student engagement and aligned with their preferred learning methods (Oyebola Olusola Ayeni et al., 2024). Personalized learning uses AI-powered algorithms to evaluate each learner's needs and adjust instruction in real time, increasing learning effectiveness and efficacy through entertaining and interesting content. For students who are having trouble in a particular subject or who are looking for effective study aids, AI-powered tuition systems can also offer on-demand help (Sumithra Salla et al., 2024). Table 1 shows the most common AI adoption for personalized learning used in private universities.

Table 10 Comparison Table: AI-Powered Personalized Learning Tools

Tool/Platform	Universities Using It	AI Features for Personalised Learning	Type
Camu (by Octoze)	MAHSA University	Adaptive learning paths, AI-based student profiling, risk alerts, content recommendation	SIS + LMS
Moodle + AI Plugins	Taylor's, Sunway, UCSI	AI dashboards, adaptive quizzes, and intelligent tutoring plugins	Open-source LMS with add-ons
Coursera for Campus	Sunway, APU, INTI	AI-recommended courses, personalized pacing, skills gap analytics	External learning platform
Microsoft Azure AI + Power BI	APU, Swinburne Malaysia	Predictive analytics, performance monitoring, personalized feedback through data dashboards	Analytics + BI Tools
Google Classroom + Add-ons	Some smaller private colleges	Auto feedback, personalized content using add-ons like Edpuzzle, Formative AI	LMS + Extensions

b) Administrative Efficiency:

The automation of routine administrative tasks, such as enrolment processes and academic advising, has resulted in increased operational efficiency. According to the article, the primary variables include the use of AI tools (intelligent tutoring systems, automated grading systems, and predictive analytics) and how they influence teaching methods, including adaptive assessment, administrative automation, and personalized learning. Educational outcomes, accessibility, engagement, efficiency, and ethical considerations, such as data protection and privacy, are the dependent variables. This study explores the challenge of balancing the need to address significant ethical issues with AI's potential to revolutionize learning in higher education. Given the rising use of AI in academic settings, which raises concerns regarding privacy and ethical standards, this focus is essential. The study provides a comprehensive perspective on AI's dual influence by synthesizing historical patterns and current literature through a systematic review.

By demonstrating AI's potential to improve educational outcomes and stressing the significance of ethical considerations for its responsible application, the findings contribute to ongoing conversations. This investigative study concludes that although AI has the potential to improve educational performance, its application necessitates careful consideration of ethical issues. An introduction to AI and its present and future uses opens the piece. The substantial impact of AI on higher education is then discussed, with an emphasis on the potential it presents, including individualized learning and administrative efficiency, as well as the main obstacles that institutions face when putting these technologies into practice. The findings are summed up, theoretical and practical ramifications are discussed, and future research options in this developing field are suggested (Nguyen et al., 2023).

c) Predictive Analytics:

By analyzing student data with AI, at-risk students can be identified, and prompt interventions can be implemented to increase retention rates. (Akinwalere & Ivanov, 2022) For example, institutions have employed predictive analysis to spot early signs of disengagement, enabling academic counselors to initiate support measures before issues escalate. Improved student performance and retention have been linked to this proactive approach. Palacios et al. (2021) analyzed a case study that predicted student retention using machine learning methods. The study demonstrated the value of data mining approaches in creating targeted interventions to enhance student retention and identified the key factors influencing attrition rates. By utilizing data-driven insights, educational institutions can develop

proactive strategies to improve student performance, allocate resources as efficiently as possible, and assist students who are at risk. However, integrating predictive analytics necessitates careful consideration of methodological, ethical, and privacy concerns to ensure responsible and effective deployment. These patterns indicate that commercial universities are taking the initiative to leverage AI to enhance administrative and academic operations.

d) AI Implementation in Private Malaysian Universities

Many Malaysian universities, including private ones, are using AI tools for administrative support in areas like scheduling, budgeting, enrollment management, student record systems, and even predictive analytics to identify at-risk students and initiate proactive interventions, according to a 2024 analysis from Higher Education Review (Janifha Evangeline, 2024). The following are a few of the private universities that have adopted AI in their universities.

1) Taylor's University, part of Taylor's Education Group, employs AI for adaptive scheduling, resource allocation, and learning analytics, allowing more efficient administrative operations (Janifha Evangeline, 2024)
2) Asia Pacific University (APU): APU incorporates data-driven systems and AI-enhanced dashboards in its student service management, administrative planning, and academic operations, supporting areas from enrollment to finances. APU has partnerships with tech companies like Microsoft, Cisco, Oracle, AWS, and ZTE (https://www.apu.edu.my/).
3) MAHSA University and International Medical College (IMC), Malaysia, both institutions have It offers a Unified Student Information System (SIS) and Learning Management System (LMS) with a framework that allows educational institutions to adopt modern learning concepts such as Outcome-Based Education (OBE), competency-based learning, and the flexible Choice-Based Credit System (CBCS) (Camu, 2025).
4) Multimedia University (MMU): AI & Analytics. MMU collaborates with tech companies like Microsoft, Cisco, Oracle, and ZTE, likely leveraging analytics and AI-powered tools in admin and student services.
5) First City University College: Future-Tech Labs: Equipped with Robotics & AI labs and robust IT infrastructure, First City supports AI-driven administrative and academic systems within its student management ecosystem (Uni(Uni Enrol, 2025)
6) HELP University Partners with The Great Discovery, USA: Utilizing cutting-edge AI-powered translation technology. The platform's real-time voice translation and AI voice translation capabilities for videos will enable students from varied linguistic backgrounds to easily engage with HELP's high-quality courses.

3 BARRIERS

Universities worldwide face an obvious challenge: despite changes in the market, competition, regulations, and objectives, they must continue to deliver quality in research, instruction, and knowledge sharing to support the nation's social and economic well-being. Many universities worldwide, including those in Malaysia, struggle to carry out their unwritten plans, yet it is crucial to interact with business and society, create money, and advance towards becoming entrepreneurial institutions (Jaaffar et al., 2021)

Even though AI has numerous potential uses, issues including insufficient digital infrastructure, worries about data privacy, and the requirement for educator upskilling continue to be major barriers to its broad use. The challenge of effectively integrating AI into courses while upholding academic integrity and adhering to pedagogical standards is one that institutions must overcome. For example. Although the use of AI-based solutions for academic material delivery and evaluation is growing, students often doubt the validity and dependability of feedback generated by AI. The level of transparency of AI algorithms exacerbates this worry since it may erode students' confidence and influence their readiness to depend on these tools for important academic assignments. These drawbacks could affect how well students perceive

AI as a learning aid overall, which would ultimately impact their engagement and satisfaction with curricula that utilize AI (Mat Yusoff et al., 2025). Lack of AI expertise and skilled personnel: many private institutions lack trained faculty and staff to implement and maintain AI systems.

One of the most serious obstacles is the lack of adequate technological infrastructure. Many private HEIs, especially smaller ones, struggle with inadequate high-speed internet connectivity, outdated hardware, and a lack of stable digital platforms capable of supporting modern AI systems. Private institutions frequently have fewer resources, limiting investment in AI infrastructure and tools (Ministry of Education Malaysia, 2015). Implementing AI technology requires significant upfront investment in specialized IT infrastructure, powerful servers, and advanced software platforms. Financial constraints constitute a significant barrier, as acquiring and sustaining these complex AI platforms, together with ensuring continuing technical support, requires enormous financial resources that many institutions may find difficult to allocate. The lack of specific national or institutional AI adoption frameworks impedes consistency in implementation. Inadequate hardware, software, or network capabilities on some campuses prevent efficient AI deployment.

A major barrier to AI adoption is a widespread lack of AI expertise and literacy among faculty members, administrative staff, and even leadership within these institutions. Many educators are inexperienced or uncomfortable with AI technology; hence, they are hesitant to incorporate new AI-powered tools and approaches into their teaching practices. To close the knowledge gap, comprehensive capacity-building and professional development initiatives are required. Furthermore, there is a scarcity of specialized AI experts and data scientists in Malaysia's private education sector who can lead the strategic planning, execution, and maintenance of AI integration activities.

Organizational and cultural resistance to change are also significant barriers. Senior academic staff can express concerns about AI replacing human functions, affecting job security, or radically changing traditional teaching practices. Deep-seated ethical concerns, notably those related to data privacy, algorithmic bias, and the possibility of unfair or inequitable outcomes from AI-driven decision-making systems, lead to a cautiousness or outright reticence in adopting. Furthermore, the current educational culture in some institutions may favor traditional teaching methods, restricting receptivity to novel, AI-driven solutions.

The availability and quality of data have a significant impact on AI systems' efficacy. Many institutions struggle to acquire, gather, and maintain the cleanliness and integrity of huge datasets required for efficient AI model training and operation. Furthermore, while Malaysia has broad digital transformation plans, particular regulatory frameworks and thorough rules for AI application in education remain lacking. This regulatory ambiguity generates uncertainty around crucial areas such as data governance, intellectual property rights, and the ethical deployment of AI, undermining institutional trust in fully implementing and growing AI systems.

4 METHODOLOGY

This study uses a literature-based research design. synthesising current knowledge and identifying important themes from secondary data sources are the goals to investigate the adoption patterns and obstacles of artificial intelligence (AI) in Malaysian private higher education institutions (HEIs). The study employs a narrative approach and a literature survey. Findings from a wide range of studies on artificial intelligence in education can be summarized, interpreted, and integrated using this approach. The analysis focuses on both theoretical advancements and empirical findings relevant to the private higher education sector in Malaysia.

1) Data Sources

To find literature, the following scholarly databases and search engines were used: Google Scholar and IEEE Xplore. To ensure an accurate and excellent assessment, numerous academic and reliable sources were examined, including

- Peer-reviewed academic journals
- Conference proceedings from trustworthy publishers

- Institutional reports from Malaysian universities and educational bodies.
- Policy documents issued by government agencies such as the Ministry of Higher Education (MOHE) and Malaysia Digital Economy Corporation (MDEC)
-

2) Inclusion and Exclusion Criteria

To maintain quality and relevance, certain criteria were set for choosing the literature:

Criteria for Inclusion:

- Works published between 2019 and 2024 that correspond with the start of the Fifth Industrial Revolution.
- Research centered on the use of AI in higher education, namely in private colleges in Malaysia.
- English-language articles.
- works that discuss AI systems, tools, applications, adoption patterns, barriers, or policy consequences.

Criteria for Exclusion:

- Articles released before 2019.
- studies without pertinent comparative insights that concentrate on non-Malaysian environments or governmental institutions.
- sources with no full text or scholarly authority.

3) Data Analysis Approach

- A thematic synthesis approach was used to assess the chosen literature, with narrative review components included for help. This comprised
- Finding recurrent themes and ideas requires reading the entire text several times.
- organizing the main conclusions according to both established and emerging themes (e.g., AI tools, adoption motivators, and hurdles).
- combining the themes into more general categories that reflect the problem and current state of AI deployment in private Malaysian higher education institutions.
- The data should be organized to show the frequency of themes as well as contextual information, particularly regarding national policies and institutional practices.

This approach guarantees that a thorough understanding of the state of AI integration in Malaysian private higher education is attained.

5 ANALYSIS

Artificial intelligence (AI)-powered educational systems have the potential to radically revolutionize Malaysian university decision-making processes, including admissions, grading, and peer assessments. However, the literature review shows that there is a lack of studies on AI adoption in private Malaysian institutions. Based on the literature study and the case studies from real-world applications, demonstrate how AI has the potential to revolutionize private higher education in Malaysia.

Although AI integration is still in its early stages in Malaysian private higher education institutions (HEIs), there is a growing understanding of its potential to improve learning experiences and simplify administrative operations.

- Multifaceted. Barriers remain: Despite enthusiasm, widespread adoption is hindered by significant difficulties like insufficient technology infrastructure, a noticeable lack of AI knowledge among academics and staff, and cultural aversion to change.
- Strategic intervention is crucial. To overcome these barriers, concentrated efforts in infrastructure investment, extensive capacity building, and the establishment of strong ethical and legal frameworks are required to foster an environment conducive to AI integration.

The integration of artificial intelligence (AI) into private institutions has the potential to significantly improve educational outcomes and operational efficiency. The three main areas of influence are predictive

analytics, administrative effectiveness, and personalized learning. According to the case studies, some colleges are integrating AI into their systems. Nevertheless, there are drawbacks to the use of AI, including the requirement for teacher upskilling, inadequate digital infrastructure, and data privacy issues.

Beyond direct teaching and administration, AI is increasingly being used to facilitate research activities. While still in its earliest stages, there is rising acknowledgment of AI's ability to aid in data analysis, literature review, and even experimental design, hence shortening research cycles and encouraging innovation in the private higher education sector. Despite these hopeful improvements, the scale and depth of AI implementation in many Malaysian private higher education institutions are still in the early or pilot stage. Implementation is often fragmented, with AI applications confined to distinct departments or specific activities rather than being integrated holistically throughout the institution. As a result, the use of AI in private higher education institutions in Malaysia is a positive trend that has the potential to improve retention rates, student satisfaction, and educational quality. To guarantee responsible and efficient deployment, it is imperative to tackle the related obstacles.

The analysis indicates a dual narrative for Malaysia's private higher education institutions: a growing understanding of AI's revolutionary potential, as well as ongoing, multifaceted barriers to its widespread adoption. This is not a unique condition in Malaysia; similar challenges have been identified in other Southeast Asian environments. Navigating this route effectively requires a coordinated approach that includes strategic planning, targeted investments, and resilience.

To address infrastructure constraints, private HEIs must prioritize strategic investments in digital infrastructure upgrades, such as high-speed internet, cloud computing capabilities, and reliable data storage solutions. Phased implementation strategies, which focus on exploratory initiatives in certain departments before scaling up, can assist manage financial outlays and create institutional trust. Furthermore, developing an innovative and digitally ready culture through internal awareness programs and early adopter incentives might help to reduce resistance to change. Developing Human Capital Addressing the human capital shortage is critical. Comprehensive training programs, workshops, and ongoing professional development activities are critical for improving AI literacy among professors and administrative staff. These programs should not only emphasize technical abilities, but also the educational implications of AI, allowing educators to effectively integrate AI tools into their teaching techniques. Collaborations with industry experts and technology vendors can also help to transmit information and provide access to specific AI skills.

The creation of clear ethical frameworks and institutional standards governing AI usage in education is critical for fostering trust and ensuring equitable implementation. These frameworks should address data protection, algorithmic transparency, and bias reduction while offering explicit rules to academics, staff, and students. Policymakers and regulatory organizations have an important role in formulating national AI in education plans, offering financing incentives, and setting thorough ethical norms that provide clarity and support for institutions. By taking charge of these obstacles, Malaysian private higher education institutions can effectively use AI not only to increase operational efficiency and competitiveness, but also to encourage a more personalized, adaptable, and inclusive education for a diverse student population. This will guarantee that AI is used to empower learners rather than simply replacing traditional techniques.

6 CONCLUSION

AI is becoming a major force behind innovation in higher education because of the rapid growth of technology, which is continuing to reshape the educational landscape. Institutions are opening new avenues for individualized instruction, expedited administrative procedures, and improved student involvement as they incorporate AI-driven solutions. However, issues including policy formation, ethical considerations, and AI literacy must be addressed to achieve responsible and inclusive adoption. Higher education may develop into a dynamic and egalitarian system that equips students for the needs of an increasingly digital world by promoting a balanced approach that embraces AI's benefits while minimizing its risks. In the future, artificial intelligence (AI) is anticipated to further transform contemporary education in Malaysia using cutting-edge technologies including augmented reality (AR), virtual reality (VR), and AI-driven adaptive learning systems. These developments will support Malaysia's 4IR agenda by improving individualized learning and providing immersive learning opportunities that mimic real-world situations.

AI is also probably going to be a major factor in lifelong learning and skill development, facilitating ongoing education and upskilling in a labor market that is changing quickly. It will be crucial to incorporate AI-driven career counseling and job placement services into contemporary educational systems as sectors become more digitally integrated.

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Forensic Acquisition of Text Message in Whatsapp Messenger

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ABSTRACT

Nowadays, most people have mobile phone to connect with people around. In this era, mobile phone seems like a small computer that can do so many things with small size but multifunction. It is called smartphone. Many online chatting applications has been developed for smartphone. WhatsApp Messenger is the most top application that people using it and the application is free to download. WhatsApp has many powerful features where user can download or upload image, audio, video and exchange text message with other user. All information and message that has been sent and deliver over the WhatsApp are stored and collected by the device. Some of information are very sensitive and privacy and it might be risk to people live, career, family, company or organization. WhatsApp application is end to end encryption where message can only be read by sender and receiver to avoid man in the middle attack. Furthermore, there is no limit to send data through the WhatsApp messenger in text message or media. However, the use of this application can be manipulated by people with bad intention. Therefore, this paper will study on WhatsApp Messenger forensic acquisition based on text message.

KEYWORDS: Mobile Forensics, Online Chatting Application, WhatsApp Messenger, Text Messages.

1 INTRODUCTION

At this moment, everyone knows that mobile phone is not just a portable device that is designed for user make and receive calls, but it evolved far beyond basic voice communication. They now support wide range of function like online text messaging, editing multimedia, email, internet browser and many more. These devices also offered advanced features like GPS navigation, gaming, mobile payment through technologies such as near-field communication (NFC) and others. Mobile devices have quickly become a big part of our daily lives. They help us stay connected, find information, and use different services and technologies. Because we use them so much for things like chatting, working, and entertainment, these devices now hold a lot of personal and sensitive information like messages, photos, locations, and app data. There are many types of operating system in mobile devices but the most famous one is android and IOS. Android smartphone's operating system can occupy more than 87% of mobile market share worldwide. When there are more powerful features available in the devices, there will more chances for people to do harassment by text messaging such as fraud email, trafficking child pornography and many else. Indeed, mobile phone can store all the information of user such as contact number, text message, video, audio, search information, navigating, and geo location information [1]. There are many free application that can

use as free real time messaging transmision over internet such as WhatsApp, Facebook Messenger, Viber, WeChat, Line, Telegram and more. This application are free to download and low cost alternative compared to SMS and MMS like before. Based on statistic [2] the most popular global mobile messenger apps as of year 2025, WhatsApp has already surpassed 2.78 billion unique users globally

User will carry a lot of private information that very important to user and others people. Information from user's mobile phone are very sensitive and privacy to other people. Some people can use the information to threat user or cyber bullying. This thing happen very common in our daily life because of our mobile phone. So there are many digital investigators wants to investigate this issue and check all the information or artefacts happen in mobile phone. Besides, there are so many forensic software that digital investigators can use in acquisition forensic artefacts from mobile phone. This is why mobile devices are very important in digital investigations. It is because of they often contain evidence that can help solve criminal, civil, or even corporate cases.

2 RELATED WORKS

WhatsApp is an application that provide end to end encryption with various of communication of broadcast messages and group chats. While using WhatsApp messenger application, user can share text message, video, audio, contact, location with other individual or by group. Every user registered by their phone number and have their own profile such as picture, name and status. Their profile will store their information in central system where it can be download by other user contact names. But, some user do not understand that all the information of user collected by the device are stored dominantly in the device. This information might be as malicious intent for other user to attack their owner using software. So it is important for user to back up the message in WhatsApp application so that all the old message can still be viewed.

WhatsApp application has an auto back up system when user connect to internet. Based on a research [3] WhatsApp services can made a trace to criminal who used user information or doing other illegal activities who gained their accounts or personal information that may harassing user. All the activities can be made by such application to detect criminal activities. The criminal has streamline their illegal activities and encryption techniques can be detect by some application. So, it is need for user to know the information which is stored in the device that might be dangerous to individuals or might be useful for criminal investigation. The central system also provides other services like user registration, authentication and message relay [3]. WhatsApp is more effective cost than SMS since it can facilitates more user in a large group conversation where that is something SMS can not do. WhatsApp also a private nature network between user since it end to end encryption make it more unique. WhatsApp interpersonal can add member in a group by adding the phone number [4]. More people will use WhatsApp messenger application compared to SMS because it does not need money as long as connect to the internet. So there will many user willing to use WhatsApp application without thinking dangerous of the information might be used by criminal behind them. WhatsApp forensic on android system are very useful insight on how the message has been encrypted or decrypted and stored in the device [5]. All the data has been stored in the device. If forensic analyst recovering a whole device, all the information that been stored by WhatsApp messenger application can be viewed in a set of file.

3 METHODOLOGY

This section will describe about the research method that been used in the re-search. This research has been conducted based on National Institute of Standard and Technology (NIST) method which is collection, examination, analysis and reporting.



Figure 1: Digital forensic methodology by National Institute of Standard and Technology (NIST)

3.1 Preservation

In this initial phase, the process will collect, searching and documenting evidence. Evidence in physical and digital will be collected using forensically sound method and documented the chain of custody of all evidence.

3.2 Acquisition

In this phase, all the imaging and cloning data from the mobile device occurred. The process to acquiring the data will take several steps before the process of acquiring can be happen.

3.3 Examination and Analysis

Examination and analysis phase will use specialized techniques and tools. This may involve some process recovering data, examining logs, reconstructing timelines and many other processes. Then, analysis the evidence in relation to the investigation objectives.

3.4 Reporting

The last phase will be documented the investigation process and findings in a detailed report includes methodology used, evidence collected and analysis per-formed.

4 RESULT

4.1 Preservation

In this phase, investigator need to preserve all the device, tools and equipment needed. Data collection from the device will be search, collect and documented. In this research, data has been collected from the mobile device of Android phone. We use sample in this research to analyse the data as evidence analysis from the android phone that has been rooted. Rooted will not happen if the investigator not enter the developer access. To enter the developer access, investigator has through USB debugging. Every mobile device has different ways to USB debugging and rooted process. Rooted process occur with all the condition, techniques and security of data features.

	Device Description	Specification
	Device Information Manufacturer	OPPO
	Product Model	X9007
	Operating System version	4.4.2
	Serial Number	E36a354a
	Rooted	Yes
	Imaging Start UTC	2019-01-04 08:51:23
	Imaging End UTC	2019-01-04 10:58:58

Table 1 : Specification of evidence

Table 1 show the device that has been used in this research. The specification retrieve after the phone has been rooted.

4.2 Acquisition

Acquisition where investigator perform imaging data of the whole device. This research use Magnet Acquire for imaging process to acquiring all the data from the device. If the phone not enable the USB debugging, process of imaging the data will not happen because pc cannot detect the device. Time needed based on how much data and memory available in the device. Figure 2 shown the process of imaging data from the device by using Magnet Acquire.

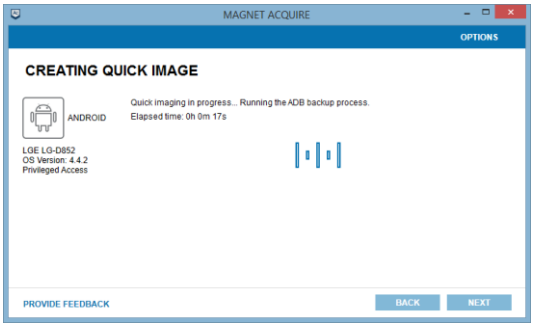


Figure 2 : Imaging process of the device

4.3 Examination and Analysis

Data that has been acquiring from the device comes in the raw data. Investigator will read the data the hex editor. Data that has been acquired from the whole device. So, investigator need to find the WhatsApp data only in the raw data. Figure 3 shown the raw data from acquiring process of the device.

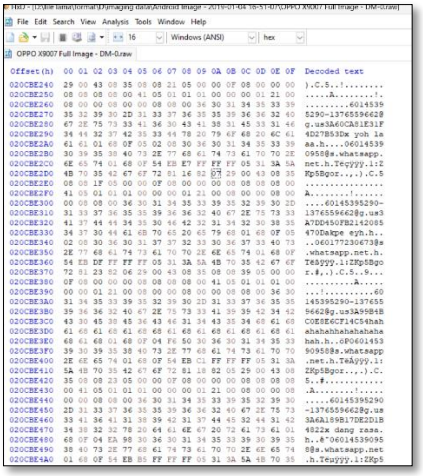


Figure 3 : Raw acquiring data

Data need to preprocessing and analysis in some process. All the unwanted data need to remove and get the key of every data. Figure 4 shown the data that has been processing from the raw data.

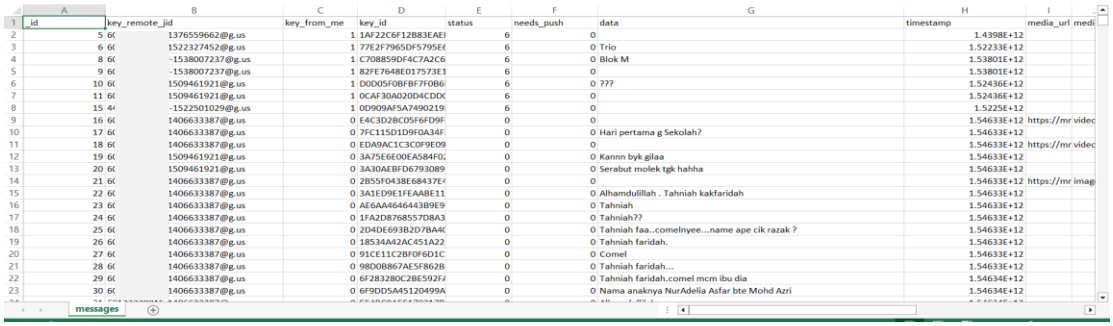


Figure 4 : Preprocessing Data

4.4 Reporting

Lastly, after analyze the data from the device, all the data has been process include media, photos, videos, audios, files, and text messaging. All the data can be acquired and process to investigate but this research only focus on the text message that has been spread to user as a personal or group. As a result, the table 2 shows the structure of the message attributes

Field name	Meaning
_id	Record sequence number
Key_remote_id	WhatsApp ID of the communication partner
Key_from_me	Unique message identifier
Status	Message status: “0”= received, “4”=waiting, “5”= received by destination, “6”= control message
Recipient_count	Number of recipients (broadcast message)
Remote_resource	ID of the sender(only for group message)
Needs_push	“2” if broadcast message, “0”= otherwise

Table 2. Structures of the message attributes

From the message attributes, investigator can define whether the message has been sent to personal or group user. Investigator also can detect if the message is broadcast message or not and the status of the message. If the status of the message is 0, means the message has received, while 4 is waiting, 5 is received by destination and 6 is control message. Recipient count means that how many users has received the message that has been sent from the device.

5 Conclusion

After study the papers that related to mobile forensic, WhatsApp, and how to acquire data in WhatsApp messenger, there are still obstacle in obtaining WhatsApp artefacts acquisition to get details WhatsApp messages that focus on android. There also some weakness in some of the software in terms of acquisition selected data and information needed. Acquiring data from the mobile have may ways and many tools and software needed to use. Data from the WhatsApp are too many and various types of data can take time for researcher. Sometimes, text message that has been spread through the WhatsApp can be mistaken and run some people image, name, reputation and bring harm to users. Therefore, this paper is proposed a research based on forensic acquisition on the text message in WhatsApp Messenger to profiling the message has been spread to users.

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Teaching Legal Terminology *Bona Fide* to Accounting Students

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ABSTRACT

Bona fide, derived from Latin, means 'good faith' or 'with sincere intention'. In legal contexts, it represents genuine actions taken without deception or ulterior motives, making it essential for accounting students to understand due to its direct relevance to ethical decision-making and legal compliance in their profession. This paper aims to explore the understanding of the term *bona fide* among accounting students, at selected branches of Universiti Teknologi MARA (UiTM). Data for this study were gathered through questionnaires distributed to students at UiTM Tapah, Arau, and Jengka campuses in Malaysia. A total of 200 students participated, with 47% taking Introduction to Commercial Law and 53% taking Introduction to Partnership and Company Law. The findings reveal that 67.5% of the respondents were familiar with terms such as *bona fide* and *mala fide*, with 90% correctly identifying the meaning of *bona fide* in a given context. Additionally, 78.5% found legal terms like these easy to understand, and 51% attributed their understanding primarily to effective lecturer explanations as the most helpful learning method. These findings provide valuable insights into pedagogical approaches that support the comprehension of legal concepts, reinforcing the importance of *bona fide* as a cornerstone of ethical and legal compliance in the accounting profession. It also contributes to the literature on students' perceptions of their experiences in learning legal terms and provides valuable insights into the importance of understanding *bona fide* in the context of accounting education.

KEYWORDS: Legal terms, Bona fide, Good faith, Non-law students, Pedagogy.

1 INTRODUCTION

Non-law students are required to study a law subject as part of the compliance requirements in their course. This can be particularly challenging for those who are encountering legal studies for the first time, especially since the nature of studying law differs significantly from their primary field of study. Unlike

subjects in their discipline, which may focus on calculations, technical applications, or business concepts, law requires critical thinking, case analysis, and the ability to interpret statutes and legal principles. Thus, non-law students may struggle with the complexity of legal terminology, the case-based learning approach, and the abstract reasoning involved in legal studies.

This paper focuses on accounting students from several branches of Universiti Teknologi MARA (UiTM) to explore their understanding of the term *bona fide*. Understanding legal concepts is crucial for accounting students, as their profession requires ethical decision-making, legal compliance, and adherence to regulatory frameworks. One such fundamental concept is *bona fide*, which translates to 'good faith' or 'with sincere intention'. Although the purpose of good faith varies across legal systems, the principle itself shares a common origin and wording. It is a foundation for developing legal principles that apply to specific situations and give rise to appropriate causes of action. In legal and professional contexts, it signifies actions or transactions conducted honestly, without deceit or hidden agendas.

Previous studies have highlighted the challenges faced by students with a non-law background in learning legal subjects. However, this study specifically focuses on accounting students' comprehension of the term *bona fide*, examining their familiarity with its meaning, their ability to apply it in legal and professional contexts, and the factors that influence their understanding.

2 LITERATURE REVIEW

A particular challenge for non-law students is the understanding legal terms. When studying law for the first time, these students often feel worried and uncertain about their ability to comprehend and apply legal concepts effectively.

2.1 Non-Law Students

Legal education is an essential component of various professional disciplines, including accountancy, where accreditation requires students to study law (Abdul Razak et al., 2020). However, non-law students often perceive legal subjects as difficult and unengaging, primarily due to the complexity of legal concepts and the substantial reading workload (Abdul Razak & Azmi, 2019). Therefore, many students struggle with legal terminology, feeling uncertain about how to study the subject effectively, which can hinder their comprehension and application of legal principles (Abdul Razak et al., 2020).

2.2 Legal Terminology: *Bona Fide*

According to Uçaryılmaz (2020), *bona fide* or good faith is a fundamental legal principle that establishes a moral standard of honesty, loyalty, and reasonableness for various actors in social relationships. Bork and Wandt (2020) explained that the purpose of good faith varies across legal systems; however, the principle itself shares a common origin and wording. It is a foundation for developing legal principles that apply to specific situations and give rise to appropriate causes of action. One of the key challenges in legal education is the understanding of legal terminology, particularly terms like *bona fide (good faith),* which have significant implications in various areas of law, including contract, corporate, and employment law. In the field of accounting, the principle of *bona fide* plays a crucial role in financial reporting, auditing, and corporate governance, requiring professionals to uphold integrity and transparency.

2.3 Effective Teaching

Prior research indicates that non-law students often struggle with legal terminology due to unfamiliarity with legal discourse. However, effective teaching methodologies can bridge this gap. Lecturers must adopt effective pedagogical approaches to enhance students' interest in the subject. Khan (2021) found that selecting an appropriate pedagogy facilitates knowledge transfer and fosters student engagement in learning. Traditional lecture-based learning remains the dominant mode of instruction in legal education, with studies supporting its effectiveness in knowledge transfer (Poon & Kong, 2014). However, alternative pedagogical approaches, such as case-based learning, interactive discussions, and real-world applications, have been shown to improve comprehension among non-law students (Mohd Zakuan

et al, 2018). Additionally, the integration of technology in education has transformed teaching strategies, making legal learning more accessible and engaging. Thus, effective teaching methodologies are essential to enhance non-law students' engagement with legal subjects.

3 METHODOLOGY

This study employs a descriptive research method to analyse accounting students' comprehension of the legal term *bona fide*. Data collection is conducted using Google Forms**,** an online survey tool that facilitates efficient and structured data gathering. According to Kumar & LokeshaNaik (2016), Google Forms is a user-friendly platform designed for collecting information through customizable web-based forms, making it a practical and accessible tool for conducting academic research.

The survey consists of questions designed to assess students' familiarity with *bona fide*, their ability to apply it in legal contexts, and the factors influencing their understanding. The questionnaire is distributed electronically to accounting students across selected UiTM branches, ensuring a broad and diverse sample. By utilizing Google Forms, this study benefits from real-time data collection and ease of accessibility, allowing for efficient analysis and interpretation of findings.

In conducting the research, a structured questionnaire was created using Google Forms and distributed to 200 accounting students from UiTM Tapah, Arau, and Jengka campuses. The survey consists of four (4) sections: Section A – basic information of respondents; Section B – understanding of legal terminology; Section C – teaching and learning approaches; and Section D – general perception of law as a subject. The sample comprised students enrolled in two law-related courses: Introduction to Commercial Law (47%) and Introduction to Partnership and Company Law (53%). The questionnaire evaluated students' familiarity with the term *bona fide,* their ability to correctly identify its meaning, and their perceptions of the ease of understanding legal terms. Additionally, students were asked to identify the most effective learning methods for comprehending legal concepts.

4 FINDINGS AND DISCUSSION

The majority of respondents in the survey are familiar with legal terms such as *bona fide* and *mala fide*. One of the primary challenges faced by non-law students is the complexity of legal terminology and principles, which can create barriers to understanding and engagement. To address these difficulties, lecturers can simplify intricate legal topics by providing clear, structured explanations. Furthermore, the use of relatable real-world examples can enhance comprehension by enabling students to connect abstract legal principles to familiar contexts. Additionally, incorporating visual tools such as infographics and mind maps can facilitate the reinforcement of key concepts, improve memory retention, and enhance the overall accessibility of legal material for non-law learners. In summary, the survey findings indicate that students can generally identify the meaning of *bona fide*. These findings underscore the importance of *bona fide* as a foundational concept in accounting education. By understanding and applying this term, students are better equipped to navigate ethical dilemmas and legal challenges in their future careers. The results also highlight the need for lecturers to employ clear and engaging teaching methods to enhance students' understanding of legal terminology.

4.1 Familiarity with Legal Terminology: *Bona Fide*

The term *bona fide* has deep roots in both common law and statutory interpretation. It is frequently used in contract law, corporate law, and employment law to determine the legitimacy of actions or intentions. The findings revealed that 67.5% of the respondents were familiar with terms such as *bona fide* and *mala fide*, indicating a reasonable level of awareness among students. Notably, 90% of the participants correctly identified the meaning of *bona fide* in a given context, demonstrating a strong grasp of the term. 78.5% of the students found legal terms like *bona fide* easy to understand, suggesting that the integration of such concepts into the curriculum is effective. The results are presented in Figure 1.

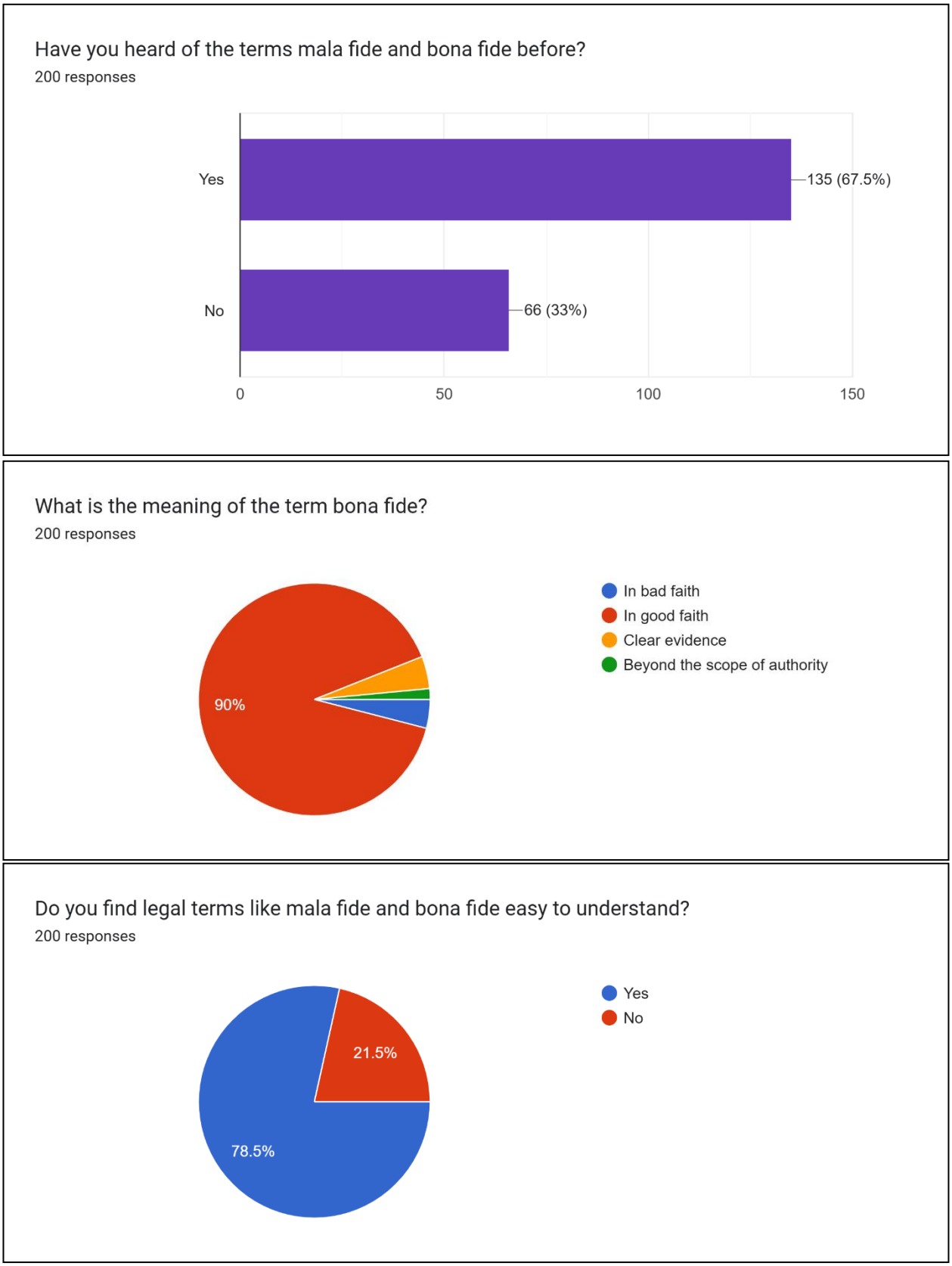


Figure 1: Familiarity with Legal Terminology: Bona Fide

4.2 Effective Pedagogical Strategies in Law Subject: Insights from Students' Preferences

Traditional legal education has long relied on reading, memorization, and summarization. However, the integration of technology has enhanced learning accessibility and significantly transformed teaching approaches in higher education.

To determine the most effective pedagogical strategies for teaching law, Section C – Teaching and Learning Approaches includes five (5) questions:

i. How do you prefer learning legal terms?
ii. Which method helps you most in understanding legal terminology?
iii. What are the main challenges you face in understanding legal terminology?
iv. Would you like to see more interactive activities in the teaching of legal terminology?
v. How confident are you in using terms like mala fide and bona fide in a real-life accounting situation after learning through interactive approaches?

Based on the data, 79.5% of the students preferred lectures and notes in learning legal terms and 25.5% students choose role-playing activities as a method in learning legal terms. The results of the students' preferred methods for learning legal terms are presented in Figure 2.

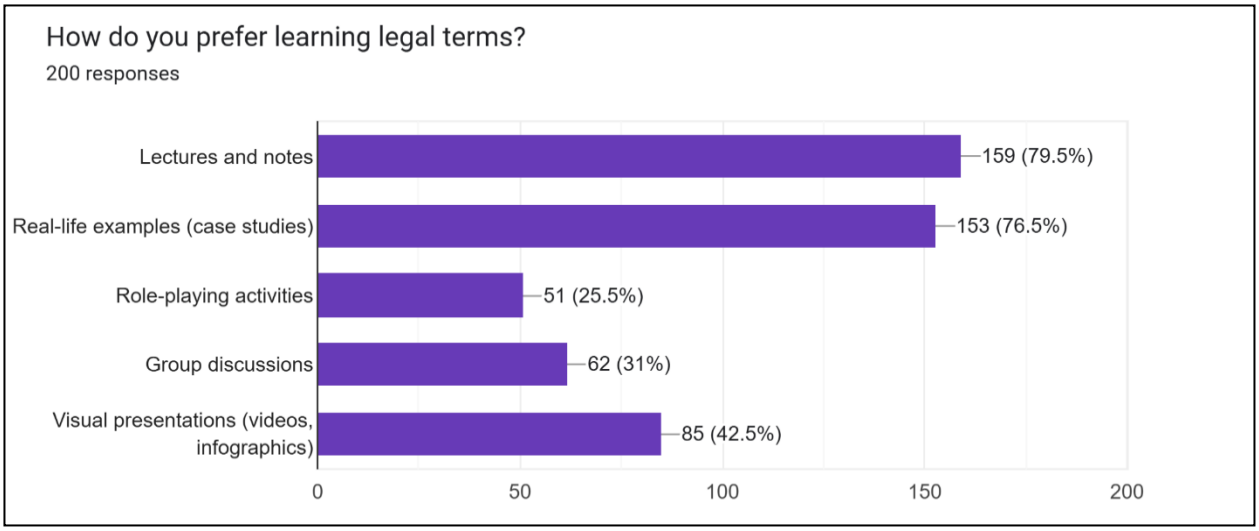


Figure 2: Students' preferred methods for learning legal terms

The data shows that 51% of the students identified lecturer explanations as the most helpful learning method for understanding legal terminology, emphasizing the critical role of teaching quality in facilitating the comprehension of legal concepts. Additionally, 17.5% of the students preferred real-world case studies, 16% favoured interactive quizzes or exercises, and 12% chose simple PowerPoint slides as their preferred learning methods. These findings highlight the diverse learning preferences among students and suggest that a combination of teaching strategies may enhance their understanding of legal terminology. The detailed results of students' preferred learning methods are presented in Figure 3.

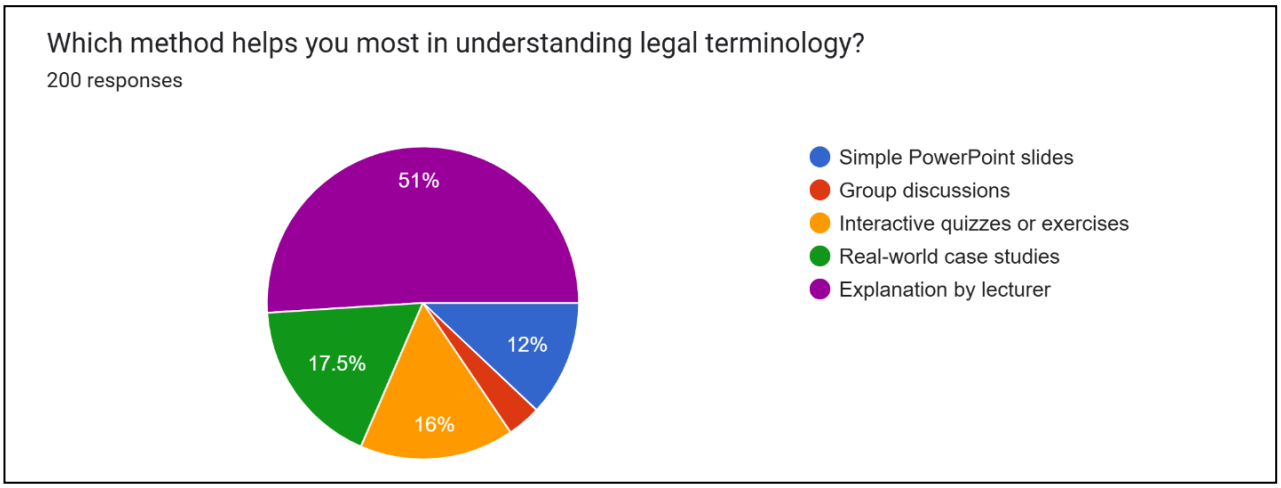


Figure 3: Students' preferred methods for understanding legal terminology

5 CONCLUSION

This study aimed to explore the understanding of the term *bona fide* among accounting students at selected branches of Universiti Teknologi MARA (UiTM). The findings revealed that a significant majority of students were familiar with the term and could accurately identify its meaning, reflecting a solid foundation in legal terminology. By incorporating more interactive and practical methods of teaching, as well as emphasizing the real-world applications of legal terminology, lecturers can help bridge the gap in legal understanding. These insights underscore the importance of integrating clear and engaging pedagogical approaches into accounting education to enhance students' understanding of legal and ethical principles. This study contributes to the broader literature on non-law students' experiences in learning legal subjects, offering valuable insights into how to improve their confidence and competence in this area. It is hoped that this paper will serve as a valuable resource for both educators and students, particularly non-law students, by providing practical strategies to enhance their understanding of legal terms. By fostering greater confidence in studying law-related subjects, this research aims to support students in achieving academic success and professional excellence in the field of accounting. Further research in this area could offer valuable insights into more effective teaching strategies, ensuring that accounting students and similar cohorts acquire the necessary legal knowledge to navigate their future careers confidently.

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Assessing Students' Familiarity with the Legal Term 'Separate Legal Entity'

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ABSTRACT

The doctrine of a separate legal entity establishes that, upon incorporation, a company acquires its own legal identity, allowing it to own property, enter into contracts, and sue or be sued by its members. This study aims to assess students' familiarity with the legal term 'Separate Legal Entity'. A structured questionnaire was distributed to students from various disciplines i.e. law, business, accounting, economics, and hotel and tourism management at UiTM Perak Branch, UiTM Terengganu Branch, and Universiti Sultan Zainal Abidin. The questionnaire evaluated students' familiarity with the term, their preferred learning methods, and their perceptions of the effectiveness of different teaching strategies in understanding this legal term. The findings reveal that while students demonstrate a reasonable understanding of the term, they prefer traditional teaching methods such as lectures and notes. These approaches were found to be more effective in helping students grasp the complexities of the separate legal entity principle. This preference can be attributed to the structured nature of lectures, which allow for a systematic explanation of legal terms and doctrines. Additionally, notes become essential reference material for understanding case laws, statutes, and legal principles. The study highlights the importance of aligning teaching methods with students' preferred learning styles to improve their comprehension of legal terms, offering valuable insights into the effectiveness of current legal education practices. This paper hopes to contribute to the ongoing

discourse in legal education by advocating for a balanced integration of conventional and modern teaching strategies to enhance students' understanding of legal concepts and terms such as the separate legal entity.

KEYWORDS: Separate legal entity, Teaching methods, Law subject, Legal terms.

1 INTRODUCTION

The doctrine of a separate legal entity is a fundamental principle in corporate law, establishing that upon incorporation, a company acquires a distinct legal identity, separate from its members. This legal concept allows companies to own property, enter into contracts, and initiate or defend legal proceedings independently. Understanding this doctrine is crucial for students across multiple disciplines, including law, business, accounting, economics, and hotel and tourism management.

This concept was firmly established in the landmark case of Salomon v A Salomon & Co Ltd [1897] AC 22 and continues to underpin the legal framework governing corporate operations worldwide, including in Malaysia. Through this doctrine, companies are granted the capacity to own property, enter into contracts, and initiate or face legal proceedings in their own name, independent of the individuals behind them.

This paper seeks to assess students' familiarity with the term 'Separate Legal Entity' across multiple academic disciplines. In particular, the study focuses on students from UiTM Perak Branch, UiTM Terengganu Branch, and Universiti Sultan Zainal Abidin, encompassing a diverse pool of respondents from both law and non-law backgrounds. By combining doctrinal legal research with a quantitative survey, the study also explores students' preferred approaches to learning legal concepts, offering insights into how different teaching methods influence their understanding of fundamental legal doctrines.

By assessing current levels of comprehension and aligning them with preferred pedagogical approaches, this research seeks to contribute significantly to the discourse on legal education, particularly in multidisciplinary environments. Moreover, it advocates for a balanced integration of traditional and modern teaching methodologies to enhance learning outcomes.

2 LITERATURE REVIEW

The concept of a separate legal entity was firmly established in the landmark case of Salomon v A Salomon & Co Ltd [1897] AC 22, where the House of Lords confirmed that a duly incorporated company possesses its own legal personality. This doctrine has since become a cornerstone of corporate law, influencing legal and commercial practices worldwide. Scholars have debated the effectiveness of different pedagogical approaches in teaching legal concepts, emphasizing the importance of aligning teaching methods with students' preferred learning styles to optimize understanding.

2.1 Legal Education

Harith et al., (2023) report that law-related subjects are commonly required prerequisites in higher education institutions, with all students—including those from non-law disciplines—mandated to take them. Legal education plays a crucial role in various professional fields, including accountancy (Abdul Razak et al., 2020). However, students frequently find legal subjects challenging and disengaging, primarily due to the complexity of legal concepts and the extensive reading requirements (Abdul Razak & Azmi, 2019). Consequently, many students struggle with legal terminology and remain uncertain about how to approach their studies, which can hinder their understanding and ability to apply legal principles effectively (Abdul Razak et al., 2020).

2.2 Separate Legal Entity

Ramli et al., (2025) indicate that Malaysian company law is rooted in common law principles, which are predominantly codified in the Companies Act 2016 (CA 2016). Under common law, a company is recognized as a corporate entity established by legal statute, possessing a separate legal personality distinct

from its directors and shareholders. This doctrine and its legal implications were firmly established by the House of Lords in the landmark case of *Salomon v A Salomon & Co Ltd* [1897] AC 22.

A key feature of the common law concept of separate legal entity is that once a company is incorporated, it is recognized as a legal person. This means the company can own property, sue and be sued in its own name, and exists separately from its owners or shareholders. Shareholders are only liable up to the amount they have invested. Additionally, a company is considered an artificial legal person and enjoys perpetual succession, meaning it continues to exist regardless of changes in its membership (Ayub et al., 2020).

Hassan et al., (2012) determine that the majority of theories on corporate entity emphasize that the legal personality of a corporation is artificial, as the concept of the body corporate as a legal person is not grounded in physical reality. Instead, it exists because the law, through state recognition, designates it as a legal person for specific purposes or objectives. This understanding of corporate personality is crucial for students' comprehension of legal terminology, especially terms such as 'separate legal entity,' which are fundamental in corporate law.

2.3 Effective Teaching

Khan (2021) highlighted that choosing the right teaching methods promotes knowledge transfer and enhances student engagement. While traditional lecture-based instruction remains the primary mode of legal education, research supports its effectiveness in transmitting knowledge (Poon & Kong, 2014). Additionally, the integration of technology in education has transformed teaching practices, making legal studies more accessible and engaging. Teaching law is challenging, and lecturers must employ effective pedagogical approaches to ignite student interest. Understanding students' learning experiences is crucial to assessing the effectiveness of these teaching methods (Khan, 2021).

3 METHODOLOGY

This study employs a mixed-method research design, combining doctrinal legal research with quantitative survey-based research to assess students' familiarity with the legal term 'Separate Legal Entity'. The research began by identifying and defining the legal concept of a separate legal entity.

To complement the doctrinal research, a quantitative survey was conducted to gather empirical data on students' understanding of the term. A structured questionnaire was developed and administered using Google Forms as the data collection tool. This online platform was selected for its accessibility, ease of distribution, and ability to collect responses efficiently from a large number of participants across different campuses.

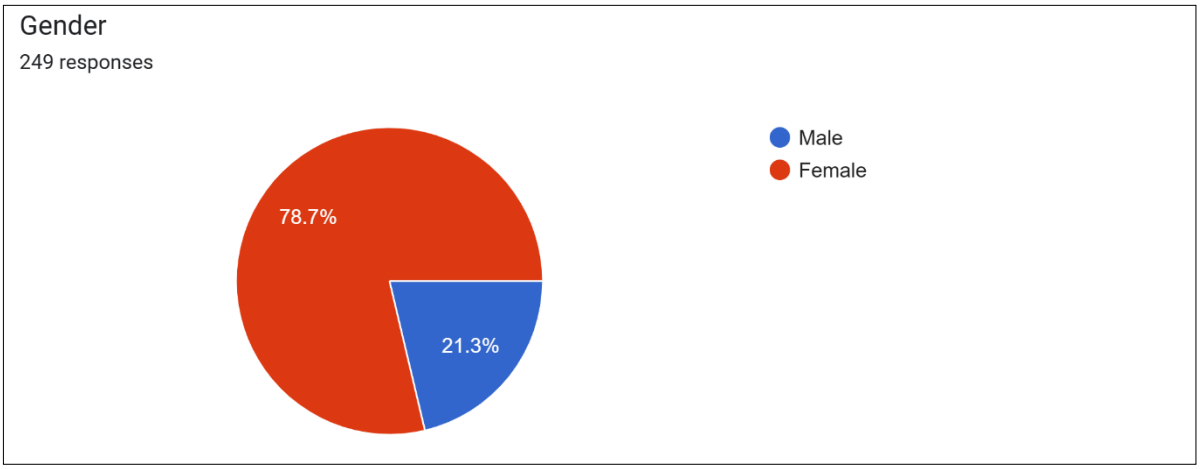
The questionnaire consisted primarily of close-ended items, including multiple-choice questions and Likert-scale statements, to ensure that responses could be quantified and statistically analyzed. This structure supports the objective measurement of student familiarity and perception. The survey link was distributed via email and WhatsApp to students from five academic disciplines — law, business, accounting, economics, and hotel and tourism management — across UiTM Perak Branch, UiTM Terengganu Branch, and Universiti Sultan Zainal Abidin. A total of 249 students responded to the survey. The questionnaire comprised four (4) sections:

- Section A: Basic information of respondents;
- Section B: Understanding of legal terminology – Separate Legal Entity;
- Section C: Understanding of legal terminology – Corporate Veil; and
- Section D: Teaching and learning approaches.

4 FINDINGS AND DISCUSSION

Figure 1

Respondents' Gender

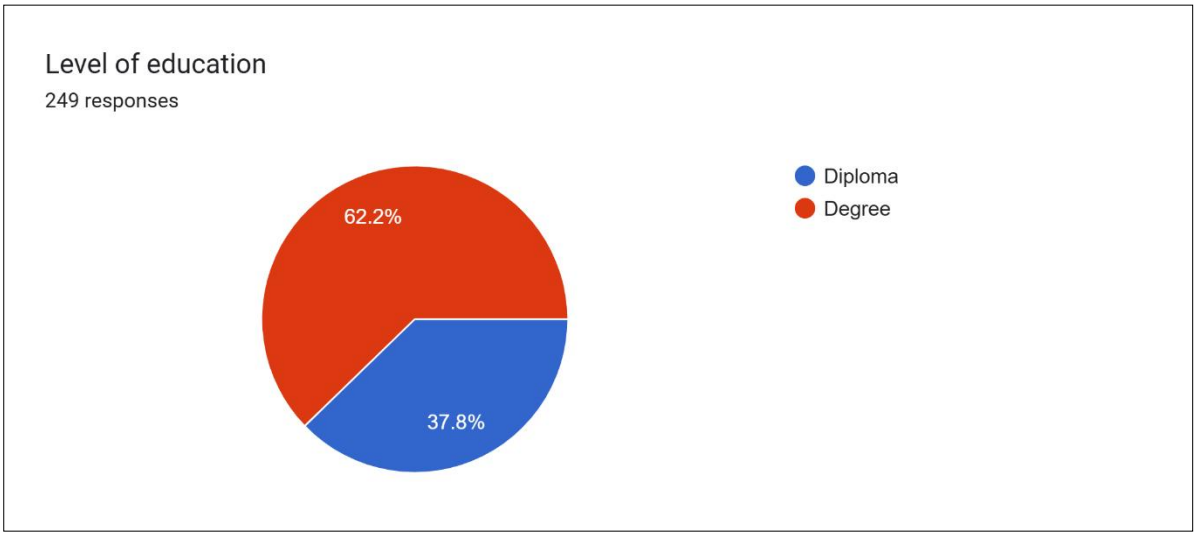


Note. Distribution of respondents by gender.

A total of 249 respondents participated in the study, comprising students from Universiti Teknologi MARA (UiTM) Perak Branch, Universiti Teknologi MARA (UiTM) Terengganu Branch, and Universiti Sultan Zainal Abidin. Of these respondents, 78.7% were female and 21.3% were male, as shown in Figure 1.

Figure 2

Respondents' Level of Education

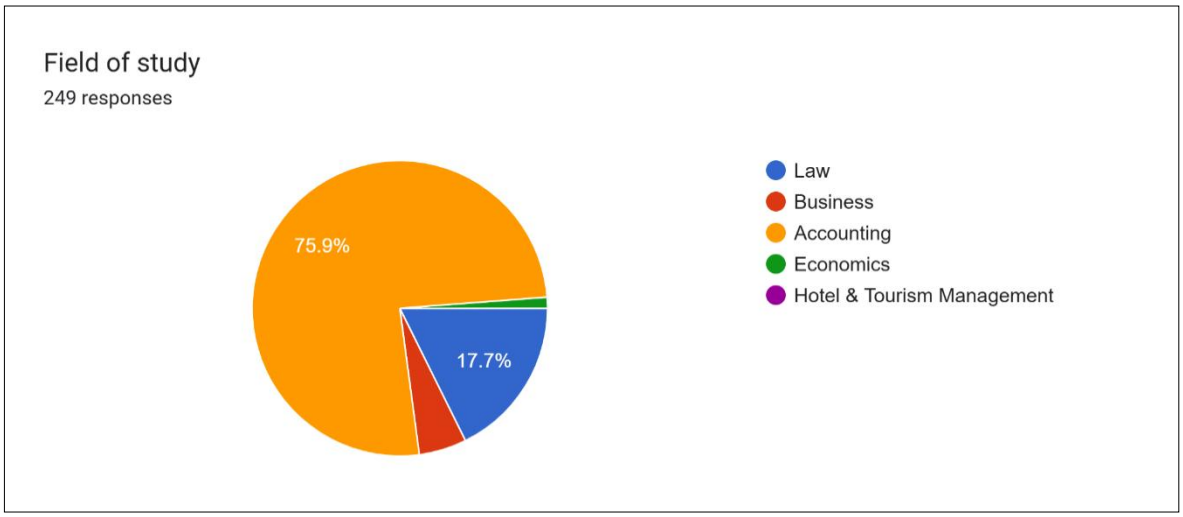


Note. Distribution of respondents by level of education.

There are two levels of education among the respondents: Diploma and Degree. Of the total respondents, 37.8% are Diploma students, while 62.2% are Degree students. Figure 2 illustrates this distribution.

Figure 3

Respondents' Field of Study

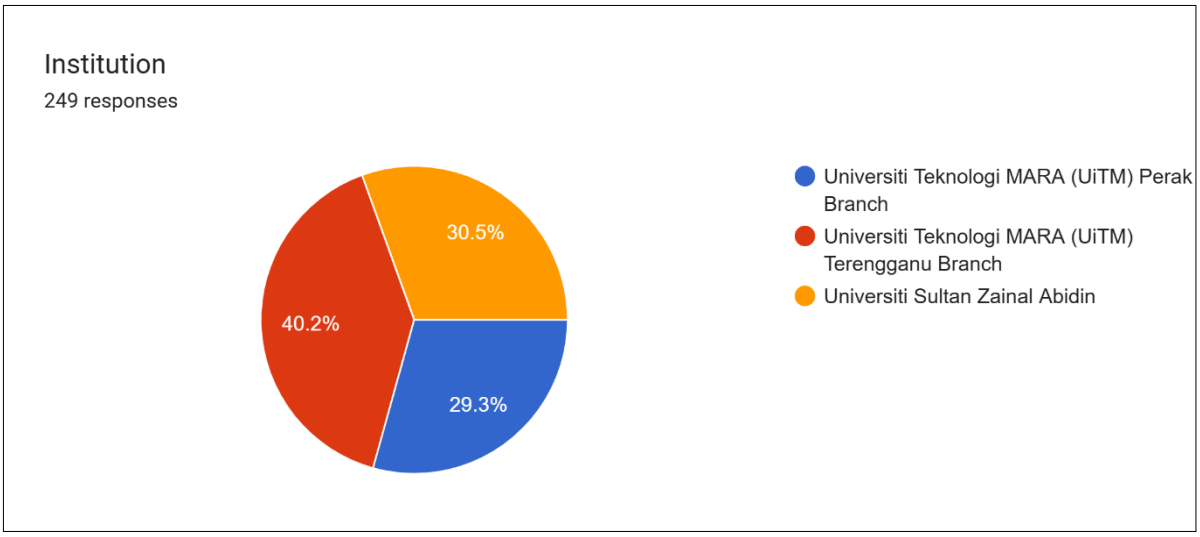


Note. Distribution of respondents by field of study.

A total of 249 respondents participated in the study, comprising 75.9% accounting students, 17.7% law students, and the remaining respondents from business, economics, and hotel and tourism management, as shown in Figure 3.

Figure 4

Respondents' Institution

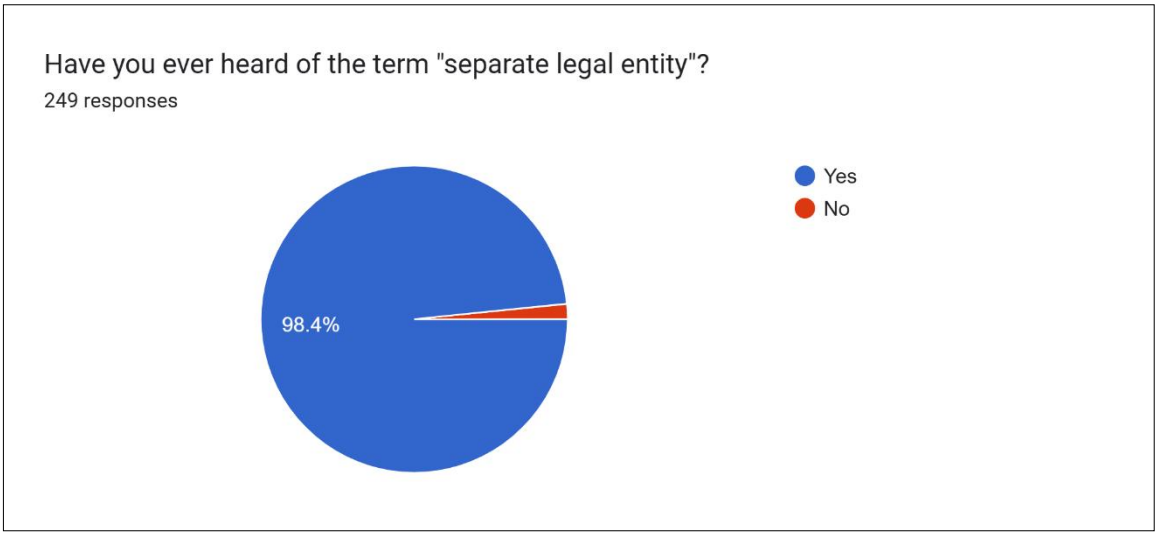


Note. Distribution of respondents by institution.

Out of the 249 respondents, 40.2% are from Universiti Teknologi MARA (UiTM) Terengganu Branch, 30.5% from Universiti Sultan Zainal Abidin, and 29.3% from Universiti Teknologi MARA (UiTM) Perak Branch. These respondents participated in answering the questionnaire distributed via Google Form. Figure 4 shows the percentage of respondents from each institution.

Figure 5

Respondents' Familiarity with the Term "Separate Legal Entity".

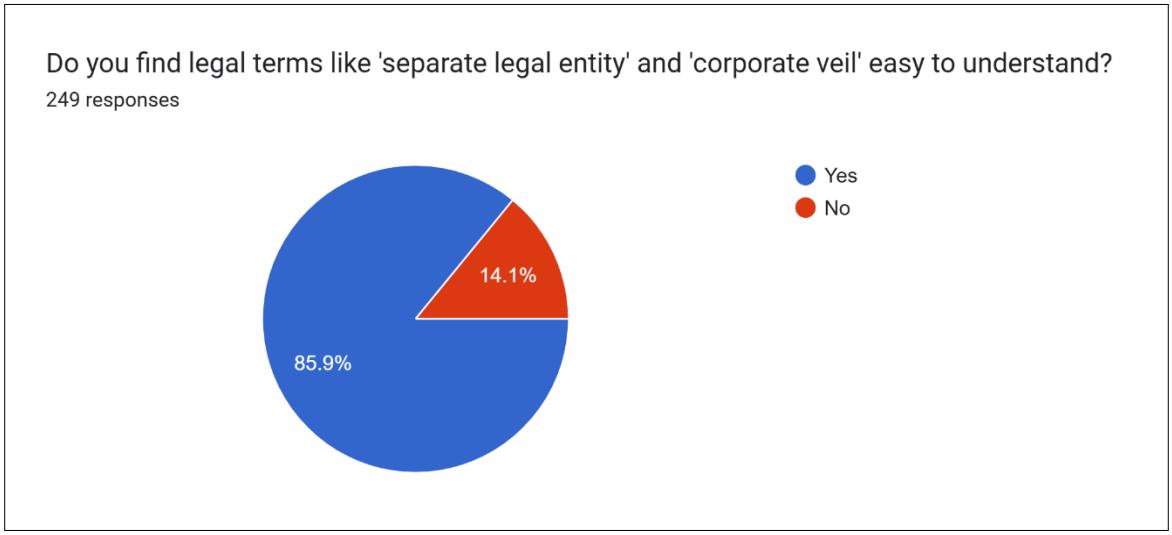


Note. Distribution of respondents by familiarity with the term "Separate Legal Entity".

The majority of respondents in the survey are familiar with the legal term *separate legal entity*, which is commonly used in corporate law. The findings reveal that 98.4% of the respondents have heard of this term, indicating a high level of awareness among the students. The results are presented in Figure 5.

Figure 6

Respondents' Understanding of the Term "Separate Legal Entity" and "Corporate Veil".

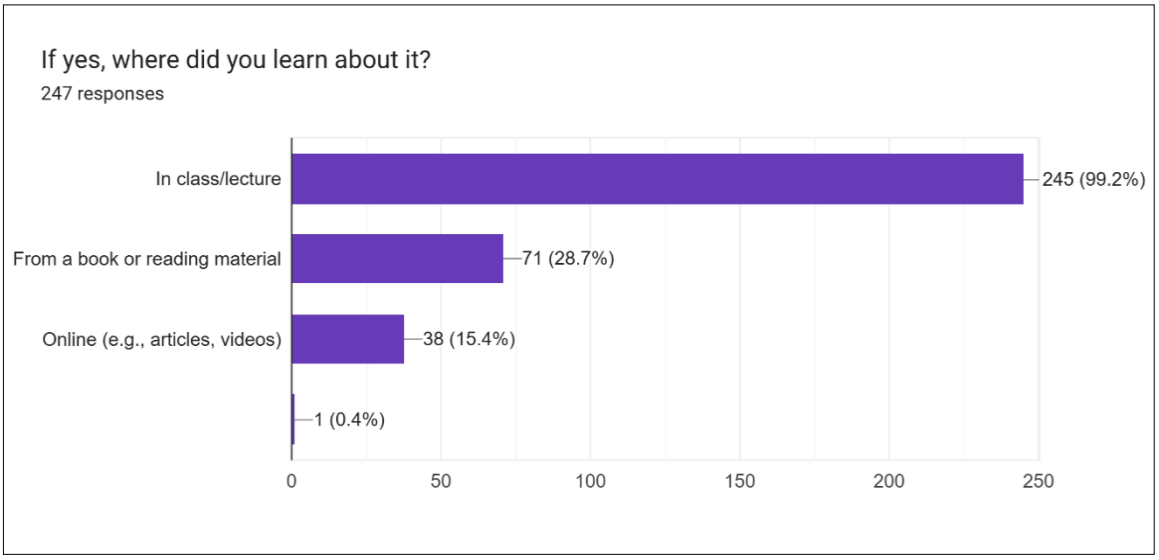


Note. Distribution of respondents by understanding with the term "Separate Legal Entity" and "Corporate Veil".

To assess respondents' understanding of two corporate law terms — *separate legal entity* and *corporate veil* — the findings reveal that 85.9% of the respondents found these terms easy to understand, while 14.1% did not. The results are presented in Figure 6.

Figure 7

Respondents' Learning Sources.

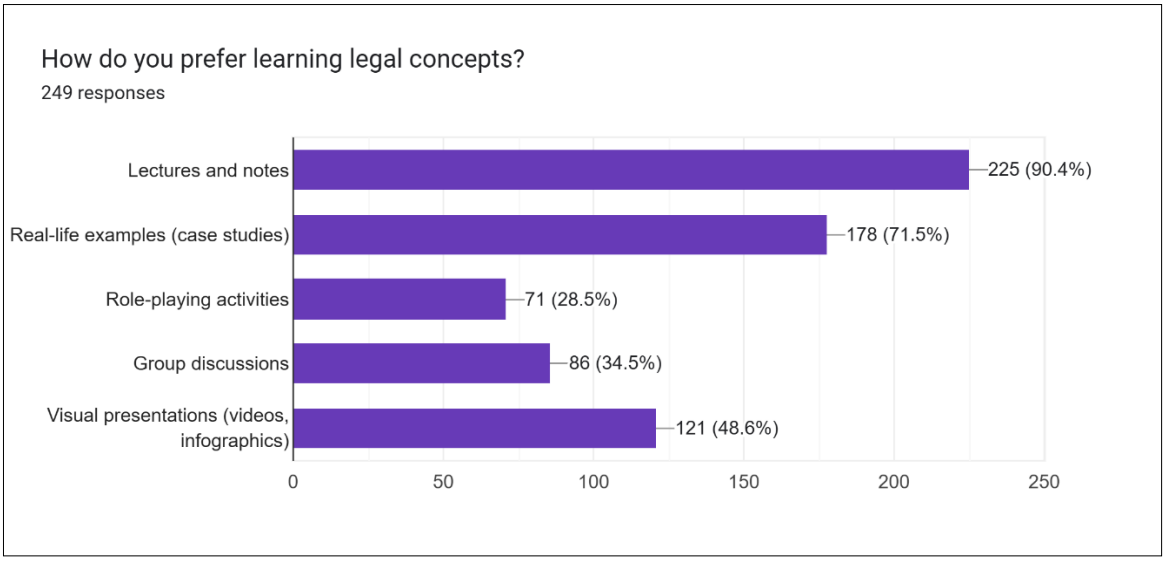


Note. The distribution of respondents by their learning sources for the term "separate legal entity."

The data shows that 99.2% of students identified class lectures as their primary source of learning about the concept of *separate legal entity*. Additionally, 28.7% learned from books or reading materials, while 15.4% gained knowledge from online sources such as articles and videos. The detailed results of students' learning sources are presented in Figure 7.

Figure 8

Respondents' Preferable Learning Methods for Legal Concepts.



Note. The distribution of respondents by their preferable learning legal concepts.

Lecturers' explanations and notes are the most preferred method for understanding legal concepts, with 90.4% of respondents choosing this approach. Additionally, 71.5% of students preferred real-life examples and case studies, 48.6% favoured visual presentations such as videos and infographics, 34.5% chose group discussions, and 28.5% preferred role-playing activities. These findings highlight the diverse learning preferences among students and suggest that a combination of teaching strategies may enhance their understanding of legal concepts. The detailed results of students' preferred learning methods for legal concepts are presented in Figure 8.

5 CONCLUSION

This study offers valuable insights into the learning preferences and understanding of legal concepts among students, both law and non-law, across various universities. The findings indicate that lecturers' explanations and notes are by far the most favoured method for learning, with 90.4% of respondents selecting this approach. This preference highlights the central role of traditional teaching in students' comprehension of complex legal topics. However, the strong inclination towards real-life examples and case studies (71.5%) further emphasises the need for practical application in legal education, ensuring that theoretical knowledge is grounded in real-world contexts.

The data also reveals that a significant majority of students (99.2%) rely on lectures as their primary source of learning about the "separate legal entity" concept, reinforcing the importance of classroom instruction in shaping their understanding. With 85.9% of students reporting that these corporate law terms are easy to comprehend, it is evident that exposure to structured learning, particularly through lecture-based methods, positively impacts students' grasp of legal concepts.

Moreover, the high level of familiarity with the term "separate legal entity," recognised by 98.4% of students, suggests a strong baseline awareness of fundamental legal principles, which is crucial for further academic growth. Despite this, the study also highlights the varying preferences among students for additional resources, such as books, online materials, and multimedia presentations, indicating that a diverse teaching approach would better cater to the range of learning styles.

In light of these findings, it is clear that legal education can be significantly enhanced by integrating both traditional and modern teaching methods to improve learning outcomes. A balanced approach that combines lectures with case studies, multimedia, and interactive activities would address the varied preferences of students and facilitate a deeper understanding of complex legal concepts. This study, therefore, contributes to the ongoing discourse on legal pedagogy by addressing the diverse needs of students in both law and non-law disciplines.

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Bahasa Melayu (BM) Interference in English Tense Usage: A Study on Form 3 Students in Ipoh

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ABSTRACT

This study investigates how Form 3 students in Ipoh, Perak, use English verb tenses in relation to Bahasa Melayu (BM). Through teacher interviews and student essay samples, the study finds common grammatical errors associated with BM interference. Results indicate that writing in English that is directly translated from BM contains tense and structural errors. The study also suggests useful teaching methods to deal with these issues, emphasizing the significance of contextualized learning and explicit grammar learning.

KEYWORDS: Bahasa Melayu, English, tenses, writing, teaching methods

1 INTRODUCTION

English is taught as a second language in Malaysia, but students frequently struggle to understand its grammatical patterns, especially verb tenses. Bahasa Melayu (BM), a student's first language, has a significant impact on these challenges because it lacks tense markers and instead uses time adverbs to express temporal information. This study examines how much BM influences how English tenses are used and suggests methods to help Form 3 students in Ipoh, Perak, write more accurately.

According to Schmidt and Frota (2020), errors in second language (L2) writing are not just errors that need to be fixed; they also provide important information about the learner's interlanguage, a transitional linguistic system that represents the student's current degree of grammatical and syntactic comprehension. Malihah and Noor (2024) assert that interlanguage systems are not merely a transitional stage but are dynamic and complex, influenced by a variety of cognitive processes. Context, task, and communication style are some of the factors that make these systems flexible, highlighting the importance of interactional components in language acquisition. numerous outside factors. Researchers may better understand how L2 learners process and learn English by looking at the mistakes that students make. They can also learn more about how their L1 influences their learning trajectory (Lightbown & Spada, 2021).

By examining the errors students make, researchers can gain a deeper understanding of how L2 learners process and acquire English, as well as how their L1 impacts their learning trajectory (Lightbown & Spada, 2021).

In the Malaysian ESL context, many secondary school students struggle with English verb tense usage due to the influence of their first language, Bahasa Melayu (BM). Unlike English, BM does not mark verb tenses through inflection but relies on contextual cues and time adverbs such as *semalam* (yesterday)

or *nanti* (later). This linguistic difference often results in direct translations from BM into English, producing tense-related errors like "He go yesterday" instead of "He went yesterday." Studies have shown that these errors are common among Malaysian learners due to the syntactic and morphological differences between the two languages (Ramli, 2023; Mohamad Sazali et al., 2024). Such interference not only hinders academic writing but also diminishes students' confidence in using English effectively. This study aims to explore the nature of BM interference in English tense usage among Form 3 students in Ipoh and identify pedagogical strategies to address this issue.

Research Objective

1. To examine how Bahasa Melayu (BM) structures influence students' use of English tenses.
2. To identify ways to minimize the influence of L1 (Bahasa Melayu) into L2 (English) tenses writing

Research Question

1. In what ways do BM grammatical structures influence students' English tense usage?
2. What are the ways to minimize the influence of L1 (Bahasa Melayu) into L2 (English) tenses writing?

2 LITERATURE REVIEW

First Language as a Source of Learning L2

Many academics have studied the impact of the first language (L1) on acquiring a second language (L2), and they have different opinions about it. According to Cummins (1981), depending on the degree of motivation and exposure to L2, L1 interference can have a positive as well as negative impact. The transfer of knowledge from L1 to L2 can be positive when students are exposed to L2 in large quantities, which helps them learn the second language. On the other hand, insufficient exposure to L2 frequently results in negative interference, leading to misunderstandings and linguistic mistakes.

Such interference is frequently reflected in syntactic and grammatical errors in L2 writing, which offers important insights into the language learning process. These errors are not spontaneous; rather, they reflect the underlying interlanguage systems that learners acquire as they advance in their L2 proficiency, claims Selinker (2023). Researchers and educators can create more focused and successful teaching interventions by analyzing these errors in order to gain a better understanding of learners' difficulties and coping strategies (Sheen & Ellis, 2024).

Language transfer, particularly from a student's first language (L1), has long been recognized as a significant factor influencing second language acquisition. In Malaysia, Bahasa Melayu (BM) is the dominant L1 among many learners, and its grammatical structure contrasts sharply with that of English. Unlike English, which relies on verb inflections to indicate tense (e.g., *go* → *went*), BM expresses tense through contextual clues and temporal adverbs such as *semalam* (yesterday) and *nanti* (later) (Aziz et al., 2023). Consequently, students often rely on direct translation from BM when constructing English sentences, leading to grammatical errors such as "He go yesterday" (Rahman & Samad, 2021; Yusof & Halim, 2022).

Word order and grammatical errors are also a result of structural differences between BM and English. For example, direct translation is a poor technique because BM grammar does not always match English sentence structures (Shukor & Ariffin, 2021). According to Lim and Maros (2020), students frequently construct phrases in BM in their minds before translating them verbatim into English, which raises the possibility of tense and structural mistakes.

Insufficient exposure to English in academic and everyday contexts worsens the problem. Tan and Noor (2023) suggested that certain Malaysian schools concentrate vocabulary over functional grammar when teaching grammar, which leaves tense usage with little attention. The internalization of proper tense forms is hampered by the combination of a lack of focused education and few opportunities for meaningful English conversation.

Overall, previous research shows that students' work consistently contains tense problems because to BM interference, a lack of exposure to real-world English input, and insufficient grammatical teaching.

2.1 THEORETICAL FRAMEWORK

This study is based on Cummins's (1978) Linguistic Interdependence Hypothesis (LIH), which holds that information and abilities learned in a learner's first language (L1) can be transferred to the learning of a second language (L2). Strong L1 proficiency can help L2 growth, as LIH highlights, but it also recognizes that transfer can be either positive or negative. Bahasa Melayu (BM) and English are two examples of circumstances where the structures of L1 and L2 differ greatly. This transfer may cause negative interference, especially in areas like verb tense usage where BM lacks inflectional morphology.

This viewpoint is supported by Turaeva (2020), who emphasizes that L1 interference frequently results in errors made when speaking and writing in L2. Because BM-speaking learners frequently use L1 structures that are incompatible with English grammatical rules, this theoretical framework helps explain why they frequently make tense-related errors in English. The idea also emphasizes how crucial proper L2 exposure and training are to reducing this kind of interference.

2.2 METHODS

The study used a qualitative approach that included semi-structured interviews and document analysis. In order to focus on an intermediate-level class of 20 Malay Form 3 pupils from a public school in Ipoh, Perak, a purposive sampling technique was employed. A 100-word essay on the subject of "My Holiday" was turned in by each student, and it was examined to find patterns of first language (L1) transfer, especially with regard to the usage of English tenses.

To gain deeper insights into students' writing challenges and coping strategies, follow-up semi-structured interviews were conducted with five students from the same class. In order to reduce the impact of L1 (Bahasa Melayu) on L2 (English) tense usage in writing, these interviews were conducted.

Additionally, two English language teachers who taught the class participated in semi-structured interviews. Additional insight into the educational setting and frequent language problems, such as L1 interference, that are seen in classrooms was gained from these interviews.

3.0 FINDING AND DISCUSSION

Table 1: Common Subject-Verb Agreement Errors Identified in Writing Samples from Form 3 Students

Student	Error	Correct sentence
12	Langkawi have many sea.	Langkawi **has** many seas.
16	It was very big and trunk.	It was very big and has a trunk.
20	In the water **have** many marine live like a fish, sea horse and many. Lastly, restaurant have a marine life side dish. At the beach, **have** a shop sell a marine life grill.	In the water much marine life like fish, sea horse and many. Lastly, the restaurant **has** a marine life side dish. At the beach, a shop sells a marine life grill.

In the essay *"My Holiday,"* a pattern of subject-verb agreement errors emerged across multiple student scripts, particularly in the writing of students 12, 16, and 20 (see Table 1). These included overgeneralisations such as *"Langkawi have many sea," "It was very big and trunk,"* and *"In the water have*

many marine live like a fish, sea horse and many." The syntactic rules controlling verb inflection and subject-verb agreement in English appear to be poorly understood based on these errors.

Such mistakes are largely attributable to first language (Bahasa Melayu) interference. In BM, verbs do not inflect for number or tense. For example, both singular and plural subjects in BM are followed by the same verb form: *"Dia ada..."* (He/She has...) and *"Mereka ada..."* (They have...). This contrasts sharply with English, where verbs change depending on the subject (e.g., *has* vs. *have*, *is* vs. *are*) (Marzuki & Subramaniam, 2021). Consequently, learners often apply BM grammatical structures directly to their English writing, leading to errors such as *"restaurant have"* instead of *"restaurant has."*

Moreover, phrases like *"in the water have many marine live"* indicate direct translations from BM structures such as *"di dalam air ada banyak hidupan laut,"* where the existential verb *ada* (there is/are) lacks a one-to-one structural equivalent in English. Learners unaware of this difference may form grammatically incorrect constructions due to literal translation (Yunus et al., 2022; Nordin et al., 2024).

The findings highlight how crucial it is to teach contrastive grammar in ESL classes, especially in Malaysian situations. In addition to offering contextualized grammar exercises that support proper subject-verb agreement, teachers should specifically highlight the main distinctions between BM and English verb forms. It has been discovered that guided error correction, visual grammar charts, and consciousness-raising exercises assist students internalize proper forms and decrease L1 transfer errors (Ramli, 2023; Mohamad Sazali et al., 2024).

Table 1.1: Direct Translation Patterns and Their Impact on Subject-Verb Agreement and Verb Tense

Student	**Error**	**Correct sentence**
5	In kedah have a interesting place.	In Kedah there **is** an interesting place.
7	Pangkor Island very beautiful.	Pangkor Island **is** a very beautiful.
8	We see the beautiful view at London and we so happy for the place at London. They so good people for teaching me.	We see the beautiful view of London and we **are** so happy about the place in London. They are so good people for teaching me.
15	I very excited to visit Kota A Famosa.	I **was** very excited to visit Kota A Famosa.
20	My family and I very exited.	My family and I **were** much excited.

Table 1.1 shows that many students translate straight from Bahasa Melayu (L1) to English (L2) without taking into account the English sentence structure as a whole. Strong first language interference can be observed here, especially in the utilization of verb tenses and subject-verb agreement. Additionally, when writing in English, students contacted for this study acknowledged that they frequently use direct translation from their mother tongue.

3.1 INTERVIEW WITH STUDENTS

An unstructured interview was conducted with Form 3 secondary school students to explore strategies for minimizing the influence of L1 (Bahasa Melayu) on L2 (English) tense usage in writing.

Student 1

> **Interviewer:** How do you usually study? For example, when your teacher gives you learning materials to review at home, how do you go about studying them? If you have an English exam coming up, how do you prepare for grammar topics like tenses?
>
> **Student:** I learn from exercises.

Student 4

> **Interviewer:** What is your preferred method for memorising grammar rules? What works best for you?
>
> **Student:** I read and do exercises.

Student 5

> **Interviewer:** How would you like tenses to be taught in class? What teaching method helps you understand them better?
>
> **Student:** Do a lot of exercises and tests.

Student 2

> **Interviewer** Okay, let's talk about how to minimise the influence of your first language, Bahasa Malaysia, when writing in English, especially when it comes to using tenses. What is the best way for you to learn English tenses?
>
> **Student** I will read novels in English.
>
> **Interviewer** Alright.
>
> **Student** Also, I listen to songs and watch movies.

Student 5

> **Interviewer** How would you like tenses to be taught in class? How do you think your teacher can help you learn and remember them more effectively?
>
> **Student** I like it when the teacher uses songs, lyrics, and PowerPoint slides.
>
> **Interviewer** Okay. When you write in English, do you think in Bahasa Malaysia first?
>
> **Student** Yes.

Several students expressed a preference for engaging and multimodal learning strategies to improve their understanding of English tenses and reduce first language (L1) interference. Student 2 highlighted the use of English novels, listening to songs, and watching movies as effective ways to immerse in the language and enhance grammatical accuracy. Student 5 specifically favoured the use of songs and lyrics, along with PowerPoint slides, as helpful teaching tools for understanding and memorising tenses. Both students acknowledged that they tend to think in Bahasa Malaysia before writing in English, indicating a transfer from L1 to L2 during the writing process.

3.2 INTERVIEW WITH TEACHERS

Teacher 1

"The first thing I do to minimise errors is to use Bahasa Melayu when introducing English content. I will write instructions in Bahasa Melayu, and the students will also write in Bahasa Melayu initially. Then, they are required to translate the content into English using key vocabulary that I explain to them. I notice that this method helps them improve significantly."

Teacher 2

"In my view, students need to master grammar first. Unfortunately, our current CEFR-aligned syllabus does not support teaching grammar in isolation. We are encouraged to teach grammar implicitly through context, such as identifying verb tenses in reading passages. However, I believe this is insufficient. There needs to be a return to explicit grammar drills so students can write accurately and identify their own errors."

The teachers' responses highlight contrasting but complementary strategies to address BM interference in English writing. Teacher 1 supports using the first language (BM) as a scaffold to introduce key vocabulary and build understanding before transitioning to English. This supports Cummins' (1978) Linguistic Interdependence Hypothesis, which posits that knowledge transfer from L1 can benefit L2 learning when properly guided. On the other hand, Teacher 2 critiques the CEFR approach for downplaying grammar instruction and emphasizes the need for explicit grammar teaching and drills, particularly to support accurate verb tense use in writing. These insights underline the need for balanced, context-sensitive pedagogical approaches that accommodate both L1 influence and explicit language instruction.

The findings indicate that BM interference primarily stems from direct translation practices. Students often omit auxiliary verbs, misuse tense forms, and apply BM syntactic structures in English writing. Teacher input further supports the need for structured grammar instruction and strategic code-switching to guide learners from L1 understanding to accurate L2 application.

4 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study was limited in scope to a single Form 3 class in a public school in Ipoh, Perak, involving 20 students and a small sample of English teachers. While the qualitative design allowed for in-depth insights, the findings cannot be generalized to all Malaysian ESL learners due to the limited sample size and geographic scope. Additionally, the study relied heavily on written essays and interviews, which may not fully capture the breadth of learners' grammatical awareness or the unconscious influence of L1 structures. Future studies could scale these findings through larger, cross-regional samples and employ mixed-method approaches that include quantitative instruments such as error frequency counts, pre- and post-tests, or classroom-based interventions. Experimental studies could also assess the effectiveness of contrastive grammar instruction and consciousness-raising tasks in minimizing L1 interference. Such extensions would allow for a more robust understanding of how BM influences English tense acquisition and inform scalable pedagogical strategies across diverse contexts.

5 IMPLICATIONS

The results suggest that teachers should integrate targeted grammar instruction and contextual reinforcement into their lessons. Syllabus designers may need to reintroduce structured grammar teaching in line with CEFR objectives.

6 RECOMMENDATIONS

Teachers are encouraged to adopt several practical measures to mitigate the interference of BM in English tense usage. First, bilingual explanations can serve as a bridge to better comprehension, especially when introducing new grammar rules. Using both BM and English strategically allows students to understand the structural differences between the two languages.

Second, grammar instruction should be frequent and focused, involving drills and exercises that help students internalize correct tense usage. Activities should be context-based and integrated into writing tasks, ensuring that grammar is taught meaningfully.

Third, teachers should create an environment that immerses students in grammatically accurate English through extensive reading and listening activities. Exposure to correct structures helps students develop an intuitive grasp of tense usage.

Lastly, collaborative practices such as peer editing and teacher feedback should be implemented regularly to make students more aware of their errors and help them correct their writing habits. These strategies collectively support improved writing accuracy and long-term language proficiency.

7 CONCLUSION

This study concludes that BM interference significantly impacts English tense accuracy among Form 2 students. Direct translation and lack of tense awareness result in common grammatical errors. Both student work and teacher feedback point toward the need for explicit grammar instruction and gradual exposure to English sentence structures.

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Legal Education: Adapting Pedagogical Strategies to Meet the Expectations of Today's Digital Learners

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ABSTRACT

Teaching law to large classes presents significant challenges in terms of engagement, active participation, and meaningful feedback. In addition, one also has to consider that the current generation of students are accustomed to technology-driven environments and they have different expectations as compared to previous generation. Thus, traditional lecture-based methods may not be suitable in meeting the diverse learning needs of such large cohorts. This paper explores innovative pedagogical strategies designed to address these challenges, focusing on active learning, critical thinking, and practical skills development while aligning with the technological expectations of today's students. Key approaches discussed include Problem-Based Learning (PBL), which encourages collaborative problem-solving and analytical thinking through structured group activities supported by digital collaboration tools. The flipped classroom model is presented as an effective strategy, where students engage with pre-class materials – such as recorded lectures and interactive readings – participate in in-class discussions and case analyses, utilizing tools like live pools and clicker systems to foster active engagement. The paper also examines how adapting the Socratic method for large classes with interactive technology platforms enables real-time questioning and inclusive participation. Case based learning is expanded through digital tools that facilitate group analysis and discussions, while collaborative learning projects integrated with peer review systems promote teamwork and accountability. Multimedia tools like legal podcasts, videos, and interactive infographic cater to diverse learning preferences and enhance content delivery. Additionally, gamification strategies such as team-based challenges, legal trivia, and simulation games, are also looked at to gauge its suitability for teaching legal concepts. By incorporating these innovative teaching methods, legal educators will be able to have dynamic, student-centred learning environments for the current generation of students, thereby improving participation and comprehension for large scale classes.

KEYWORDS: Legal Education, Large Class Teaching, Digital Natives, Technology Integration

1 INTRODUCTION

One of the greatest challenges in higher education is the fact that the current generation of students are markedly different from previous generations. One is faced with a generation of young adults who have been immersed in digital environments from an early age, creating students who not only have a different

approach to learning, but also appears to have a shorter attention span and/or easily distracted. Traditional lecture and tutorial-based methods, which have been the norm of legal education, appears to be inadequate or ill-suited to be able to effectively teach such students.

This problem is compounded further by the increase of student intake yearly. For example, the first batch of students for the Faculty of Law, Universiti Malaya was approximately 40 students; but has now grown to almost 300 students.[3] Under the traditional lecture and tutorial model of teaching, one would not only have to give lectures to a large class, but also have to face the increase number of tutorial classes.[4]

In the end, one is faced with a problem from two angles: how do you effectively teach a heavily content type of course like law to (i) a large number of students, (ii) who has a different approach to learning - without causing either the student to be bored, or the lecturer from losing interest in teaching?

It is increasingly apparent that the traditional lecture/tutorial-based methods, which has long been a staple of legal education, are increasingly ill-suited to meet the diverse needs of large and digitally oriented student cohorts. As such, legal educators are compelled to reconsider and redesign pedagogical strategies to foster active engagement, critical thinking, and the development of practical skills. This paper explores a range of innovative teaching approaches—such as Problem-Based Learning (PBL), flipped classrooms, technology-enhanced Socratic methods, digital case-based instruction, multimedia integration, collaborative learning, and gamification—that are designed to enhance participation and learning outcomes in large-scale legal education contexts.

2 RESEARCH METHODOLOGY

This study adopts a qualitative case study methodology situated within empirical legal research. The focus is on the pedagogical challenges and strategies involved in teaching large undergraduate law classes[5] comprising tech-savvy students who are prone to disengagement. Data was collected through participant observation and reflective journals maintained after each teaching session. Observations focused on student behaviour, responsiveness to various teaching methods, and engagement with digital tools. Ethical considerations were observed by maintaining anonymity and focusing on pedagogical outcomes rather than student assessment.

3 CLASSROOM SETTINGS

Current students no longer listen attentively in class while jotting down notes. Instead, the scene of laptops and tablets being used in class has become the norm. No longer would you see students busy scribbling down notes but instead, they are accessing materials online and doing their annotations on their devices. Some would even use apps that would record the lecture to transcribe it, and eventually, one finds the attention span of students to wan as the class goes on. Thus, lecturers need to be more engaging in class, to have the students be involved in the lecture itself rather than being passive listeners. Engaging the students and maintaining it is a challenge, as well as simplifying the complex legal context in order to encourage discussion and critical thinking becomes the main struggle in the teaching and learning delivery.

Another aspect one has to consider is that there is a world of information at the hands of the current generation. Be it by the old-age method of googling (which is made much more efficient and convenient upon the AI used to identify what is needed) to the ever useful (yet unreliable) generative AI such as ChatGPT. The point is, the information we give in lectures can be redundant as students can obtain the information easily elsewhere. What the students need is not necessarily content, but the knowledge on how the content is applicable or used in a practical sense. This is where the methods come in.

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[3] This refers to the 2024/2025 academic year intake and is not reflective of the student numbers for the entire LLB programme.

[4] A tutorial class is a small group discussion class, typically comprising 10-12 students. However, due to the large intake of students, this has been increased to 20 students per class. A tutorial class typically would have a set of tutorial questions given at the beginning of the semester. These students would be required to have done the questions before class (homework) and the answers are discussed in the tutorial class.

[5] Observations and discussions with students are based on two academic sessions with classes ranging from 50 students to 300 students.

There are a few methods that the author has found to be useful, which is based on experimentation and obtaining student feedback. There is no perfect 'one' method as every student is different with varying levels and degrees of learning. In addition, one cannot stick to one method throughout but will have to change and diversify in order to keep the students' interest going. These methods are discussed below, but one important factor must be emphasized: depending on the context,[6] in order to achieve the best results when using these methods, the students should have some basic knowledge or foundation of the topic first. This is not to say that the knowledge is crucial for the methods to work, but rather, that it would achieve the optimum result in learning.

3 LECTURE

There is an inherent resistance from law educators from abolishing lectures. It is generally believed that a student would not be able to comprehend the complexities and intricacies of law by themselves, and thus, one feels the need to give a lecture. Whilst it is true that law is a 'content heavy' course, it does not mean that a student can only understand when the content is given to them by the lecturer. The information a lecturer gives is no different from what the students can obtain from other sources; thus, it makes the student very 'judgemental' during lectures. If a student is unable to obtain more from a class than he/she can by himself, then the student would lose interest in attending classes.

Thus, there lies the conundrum. The methods would work best if they did have some basic knowledge, but giving a lecture would take up precious time that is better spent on doing the methods. The author has found that the best way to overcome this is to have pre-recorded lectures. Not only does it appease the lecturer from the discomfort of not 'teaching', it gives the students the flexibility and opportunity to watch the recorded lectures repeatedly.

It is best that the pre-recorded lectures are broken down into a manageable 10-minute session based on the section of the topic. For example, formation of contract has five elements (offer, acceptance, consideration, intention and capacity). Traditionally, a lecture would consist of a one hour lecture of 'whatever you can cover in that one hour' on, say, offer. For a pre-recorded lecture, you would break it down to parts such as definition, requirements (each having its own separate recordings) etc. Instead of having a one-hour lecture on everything under 'offer', you would have several recorded videos on it.

Though this would result in a lot of videos, the advantages far outweigh the disadvantages. From the student's perspective, they can zoom in on the area that they have difficulty understanding and from the lecturer's perspective, you are able to easily re-record any section when there are updates to the law. You do not have to re-record an entire hour of the lecture. Lastly, the greatest advantage of pre-recorded lecture to the students is that they would be able to watch the videos repeatedly to understand a topic, and also use it as revision before examinations.

Thus, before using the methods listed below, the students are informed beforehand which videos they would watch prior to class. This is supplemented by the corresponding chapter in textbooks that they refer to, further giving them the opportunity to learn more on their own. When the methods below are used, it reinforces the knowledge initially gained by having a 'hands-on' approach and viewing it from a different perspective. The students would constantly rethink the law and after the exercise, would be able to view the pre-recorded videos again to reflect and better understand the content.[7]

[6] In general, the

[7] This is based on the Kolb's Experiential Learning Cycle, which is a four-stage process that describes how experience is transformed into learning. The cycle consists of concrete experience, reflective observation, abstract conceptualization and active experimentation. Learning is not a linear process, but a cycle.

3 PROBLEM BASED LEARNING

Quite simply, problem-based learning (PBL) refers to a teaching method whereby the students are given a scenario-based question or problem which mirrors real-world problems (or, one can actually use current 'trend' or news) to the students. Thus, instead of students being given information, they are the ones who need to solve it.

This method can be considered as a traditional method and is usually used in tutorials. It is undoubtedly a very useful tool to be used in legal education but although it is pertinent, using it in a large classroom or with many groups is not ideal. Yet, having a lot of tutorial classes to enable this can cause a lecturer to be burned out or bored, as they would be doing the same question to a different group, repeatedly in a week. Usually, by the fourth class, the lecturer is exhausted and finding the enthusiasm to deliver the content or encouraging discussion becomes less. One may even fall into the trap of giving the answers indirectly rather than having them speak when there is prolonged silence.

In order to use PBL effectively for a large classroom, it has to be mixed with using technology to foster and encourage discussions (Technology adapted Socratic method) or apply the gamification and café-world method (see below). In addition, PBL does not mean it is to 'solve' one problem per class. It can be split into several classes, discussing different parts of the question from a bigger perspective. This method requires extensive planning to achieve the optimum result and it is never a 'stand-alone' method.

4 FLIPPED CLASSROOM

Flipped classroom method refers to the fact that instead of the lecturer conducting the lessons in class, the students are given the materials beforehand. This can be in the form of pre-recorded lectures, chapters in textbooks, and articles; which essentially is the situation whereby the student learns by themselves. Class time is then used in order to do activities based on the self-learned 'lecture' or materials.

This method allows students to study at their own pace. Though this is what has been stated to be one of its advantages, it truly does depend on the student themselves. If they find the materials 'boring', then they would not have done the necessary reading before the activities are done. Personal observation of current students is that they are oft guided by 'interest' and 'quick gratification'. Law is a substantive subject that requires a lot of reading, so this becomes quite the conundrum. How can you make the reading material interesting enough for the flipped classroom to work effectively?

A 'professional' pre-recorded lecture is one method. Each lecture has to be short (no longer than 10 minutes) and to have it engaging by making it as if one is actually teaching someone rather than just talking in a monotonous manner. Activities then can be something that is more interactive, fun and rewards given for correct answers. The activities can also be a diverse method as those in gamification (expanded below). With the mix, students who enjoy the gamification would then 'bear' with the 'boring' materials in order to experience and learn from the activities better.

5 TECHONOLOGY ADAPTED SOCRATIC METHOD

This refers to using technology or digital tools and platforms that are available such as Slido. Wooclap and Mentimeter, to foster real-time questioning, anonymity, and group interaction. During the class, questions can be posed to the students who will then answer by logging into the digital tool via phone or laptop in order to send their answers. Getting the results and displaying them, plus discussing the answers as it pops up, makes the lecture much more engaging. This fosters and encourages active participation and can be a useful tool.

The difficult aspect to this is that most of it requires the institution to provide or pay for the full version of the digital tools to get the best options. Though there are free options, it is severely limited and can allow, for example, in Mentimeter, it only one method per lesson. This restriction can deter proper and active engagement. In addition, if one wants everyone to participate, waiting for all 300 to respond can take some time. Furthermore, as it is highly unlikely for most institutions to invest in subscribing to these online platforms, it would thus be upon the lecturer to find which platform has the best tools to fit their needs. This

takes time and would also require the lecturer to learn how to use the tools as well. Though daunting, once the tools are mastered, it makes the teaching engagement smoother and easier.

6 GAMIFICATION

This refers to applying game elements in the course delivery. Essentially, it is to integrate elements of play and competition, which can make learning both fun and foster teamwork. There are several ways this can be applied for legal education, and in some cases, it has already been implemented to a certain degree but it was never seen as 'gamification' *per se*. The application here are based on experimentation which had been conducted in a class which had been split into smaller groups. The context has not been done in large classes but it is believed that the foundation and concept can still be applied

6.1 Team Based Challenges

Team-based challenges encourage students to work together as a team to solve legal problems, or complete tasks within a limited time frame and compete with each other. These activities can be used by students of any level, and one has to be mindful about the questions and purpose of the tasks. A first year student, for example, is still grappling with the complexities of the law and would not be as articulate or skilled as a final year student. Thus, a first year student would need more direction and guidance as compared to a final year student. The more experience the student is, the more complex the question will be. One can even have one question with several components or complexities, which is then discussed by different groups. For example, one question has three issues, which can be viewed from two different perspectives or arguments. Thus, each issue is dealt with by one team for one perspective. You will then have one question which is dealt with by 6 groups. This would comprise of one team. Thus, you can have three teams who will then compete with each other on their points.

Such team-based challenges require a lot of preparatory work and to be conducted in two to three hours. Students have found such activity to be engaging as they can understand the way a legal principle is applied and how it can be viewed from different angles. This activity helps foster communication and deepen understanding of the legal principles, whilst challenging the other team encourages teamwork, confidence and a sense of accomplishment. These are essential soft skills, whether one decides to practice or not.

6.2 World Café Method

This method is similar to the Team based challenges – without the challenge. Its primary focus is to encourage discussions in a 'safe' and comfortable environment (simulating a café). It is based on seven integrated design principles which is all about encouraging discussions with each other about a question that has several complexities or angles. It is not just about 'giving ideas' but also to 'listen' to others. Basically, students are divided into groups that will discuss one angle of the question. After about 20 minutes of discussion, every member of each group will then go to another group. At the end, the representative of each group will then summarise the findings and understanding of their group, to other groups.

It is similar to the team-based challenge in the sense that the questions are discussed in groups, but instead of challenging their answers with the other group – they are sharing their findings and understanding.

This method had not been done by the author as it is too complex. It had, however, been done in a simplified form. There is no change of group members after a 20-minute discussion, but, the representative will then explain the context of the question that they had been discussing with other groups. The small group discussion and sharing of knowledge is kept. The feedback from the students is that they enjoy this method as they do not feel the pressure of having to answer to the tutor/lecturer, but it is discussed amongst their peers. They also noted that any misconceptions or wrong understanding are clarified amongst peers, and they notice or realise that they are not alone in making the mistake. This, in turn, makes them more comfortable in expressing their views and ideas.

The role of the tutor is to guide and listen and correct them if there are fundamental errors in the law or discussion. One also finds that there can be angles to the question that the tutor themselves did not see and is able to also learn from the students' perspective and understanding.

6.3 Quiz / Trivia / Multiple-Choice Questions (MCQ)

One normally has 'quizzes / trivia / MCQ as assessment tools but it can also be effective for reinforcing understanding the foundational knowledge. The purpose of this is not to test them on the complexities of the law, or even have complex scenario-based questions; but it is to see whether the important aspect of the law is understood. This is the foundation, the 'start' so to speak which gives the students the confidence that what they had learned, is correct.

Feedback from the students is that they found this non-graded 'assessments' on the basics of the law very helpful. One had shared that when they had got a wrong answer, they would re-read the text or materials to understand where the mistake was. If one still could not understand it, it was raised during class. The author has also found that such students who asked questions were clearer in the way they articulated what they could not understand, and they could grasp the explanation better. The author has also found that from these questions, the lectures were also then amended or tailored to explain the topic so that it is clearer for them and the same sort of question would not be raised again by the next student.

6.4 Simulation Games / Real-Life Examples

Simulation games refer to giving the students a realistic scenario situation for them to use what they have learned in a practical way. This is perhaps the most used method in legal education and though is most suitable for the final year students (doing their professional courses), it is not necessarily only applicable to them. Thus, you can have mock trials by using an actual case, students being active in legal aid centres whereby they would advise and meet with real clients (under the guidance of a practicing lawyer), and simulating opening a law firm.

These simulations allow students to apply legal theories in context, make strategic decisions, and see the consequences of their choices Such simulation games gives the students the sense of 'realism' and yet, they are in a 'safe space' whereby failures do not have dire consequences on actual lives.

7 CONCLUSION

There are numerous methods that can be used to engage student participation and encourage learning. It would entail the lecturer to have to learn how to use such methods, and to encourage or embrace the use of technology and different learning styles (or rather, different learners). Though the traditional lecture method may not be suitable, perhaps the new methods would be a far better model in the current times.

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e-Counseling in the 4IR Era: Challenges, Innovations for Educational Excellence

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ABSTRACT

The Fourth Industrial Revolution (4IR) has driven rapid transformation in education, including counseling practices. Digital technology, such as mobile applications, virtual reality (VR), and artificial intelligence (AI) opens up opportunities to develop more effective counseling sessions.
This scoping review aims to: (1) identify challenges in implementing e-counseling in the 4IR era, and (2) explore the latest innovations and technologies that support e-counseling. This study uses a scoping review approach and was conducted in databases such as Web of Science, Scopus, and Mycites with key keywords including "e-counseling", "4IR", and "education". The data obtained was analyzed thematically to identify patterns and main themes related to challenges and innovations of e-counseling. Several key challenges have been identified, including privacy issues, technological infrastructure constraints, and varying levels of digital literacy among educators and students. E-counseling in the 4IR era has great potential to increase the effectiveness and reach of psychological support in educational institutions. However, careful planning regarding ethics, counselor competence, and strengthening the technological infrastructure is critical before this system can be widely practiced. This scoping review provides initial guidance for formulating policies and best practices while enriching the literature related to e-counseling and supporting future educational excellence.

KEYWORDS: e-Counseling, 4IR Era, Challenges, Innovations

1 INTRODUCTION

The Fourth Industrial Revolution (4IR) has sped up digitalization in most industries, especially in education and counselling (Shuvo & Islam, 2023). e-Counseling, as understood, is the provision of counselling services via digital platforms such as email, live chat, and mobile applications, and the same has seen significant development in Asia. The practice, however, is confronted by numerous problems and requires innovative approaches to facilitate educational effectiveness and excellence (Jones et al., 2022). The widespread use of internet technologies has dramatically altered communication habits, particularly among younger generations who spend considerable time on social media for reasons like socializing, gaming, shopping, and information gathering (Foon et al., 2020). Counselors are using technology more to communicate with clients, exchange psychoeducational content, and guide new intervention modalities that take the "counseling room" to a virtual context, enhancing the quality of treatment, intensifying the therapeutic relationship, and improving clinical outcomes (Chiruvolu & Justin, 2022).

The expansion of electronic mental health interventions, such as those provided through telephone contact, video conferencing, text messaging, and other online media, underscores the capacity of technology to help alleviate disparities in mental health treatment access. The facelessness of these online platforms can minimize feelings of powerlessness and shame, thereby making it easier for clients to reveal intimate information (Situmorang, 2020). But it is also necessary to identify possible risks, including the aggravation of inequities in access, along with the necessity for careful consideration of ethical and practical consequences (Murphy et al., 2021). The application of digital platforms for mental health care has experienced significant expansion, especially following the COVID-19 pandemic, which led many practitioners to transition towards online service delivery (Lustgarten et al., 2020). The application of digital technologies to mental health treatment entails concerns of digital privacy that may increase the risk of involuntary violations of client confidentiality (Lustgarten et al., 2020). Within psychotherapy, the heightened application of technology is purposed to support enhanced communication, data handling, and utilization of digital software and hardware, hence revolutionizing the delivery of services (Lustgarten et al., 2020).

2 THE CHALLENGES 4IR ERA

2.1 Technological Framework and Access Considerations

Insufficient digital infrastructure, especially in rural regions, limits access to e-counseling services (Martinez-Martin et al., 2020). A large portion of the student body lacks stable internet access or suitable devices, and a digital divide amplifies disparities in access to mental health services. Personal computing technologies provide various challenges as well as potential benefits concerning the mental health of university students (Lattie et al., 2019). A strong infrastructure is crucial for the effective delivery of e-counseling services. In developing economy nations like Malaysia and India, technological infrastructure constraints, as indicated by poor internet connectivity and inadequate access to digital devices, undermine the effective execution of e-counseling initiatives. Research by Lim et al. (2021) demonstrated how disparity in access to digital technology between rural and urban areas makes it difficult for students to access online counseling services. The gap in digital literacy between students and counselors, particularly for older counselors, calls for specific training programs to bridge the gap. The availability of mobile phones and the internet even in low- and middle-income nations offers a unique opportunity to decrease mental health disparities via digital psychological interventions. The extensive utilization of mobile phones and internet connectivity can facilitate remote therapeutic sessions with privacy and ease of use, thus enhancing the accessibility of mental health services (Fu et al., 2020).

2.2 Counselors' Competencies in Technology

They should also have computer literacy to operate e-counseling sites. In spite of this, Ganaprakasam et al. (2024) found that the majority of the counselors in Malaysia are still insufficiently trained in the use of digital technology in counseling, and this results in reduced effectiveness of services. Many of the counselors do not have confidence in handling the technology aspect of e-counseling, including data privacy, security protocols, and the use of digital communication tools effectively. There is a need for more intensive training and professional development opportunities to help counselors make the transition to offering online services. 2.3 Ethical and Privacy Concerns Use of online platforms raises issues of confidentiality and privacy of client information. Chan et al. (2025) highlights the necessity of well-defined ethical guidelines in the practice of e-counseling to safeguard students' information. Formulation of well-defined ethical guidelines and legal procedures that are applicable to e-counseling practice is crucial to facilitate responsible and safe delivery of service.

3. INNOVATIONS IN E-COUNSELING TO IMPROVE THE QUALITY OF EDUCATION

The advent of rapid digital technologies has significantly influenced the educational support services, especially in counseling. E-counseling has become a crucial innovation, fostering improved accessibility, efficiency, and individualized guidance for students at all levels of education. Through the use of AI chatbots, virtual environments, and data analytics, e-counseling improves students' academic planning, emotional stability, and career decision-making. These innovations are essential to enhancing the overall quality of education to meet the varying and changing needs of learners in the digital era.

3.1 Application of Artificial Intelligence (AI)

Artificial intelligence used in e-counseling makes it possible to analyze students' data to predict potential mental issues and take proactive measures. Su et al. (2024) created an AI-powered counseling support system for Taiwanese elementary school students, and it resulted in a considerable development of the students' social-emotional skills. (G. et al., 2022) Machine learning technologies also offer the possibility to create training programs and feedback mechanisms for peer counselors, which may help to upgrade peer counselor-client competencies (Hsu et al., 2023). Apps such as Wysa have been used in Singapore to provide mental health support to youth. As noted by Lim (2025), AI chatbots can help students deal with stress and anxiety by providing 24/7 emotional support. The apps can provide immediate support and encourage students to seek additional help when needed (Oghenekaro & Okoro, 2024). Chatbot conversations have been shown to improve emotional well-being (Holt-Quick et al., 2021). Virtual reality (VR) and augmented reality (AR) in counselor training allow for the replication of actual counseling scenarios, thereby enhancing the skills of counselors in a secure setting. Muhammad (2023) found in a study that this technological intervention greatly aided counselors' self-efficacy in managing different client scenarios.

4. IMPACT OF E-COUNSELING ON STUDENT EDUCATIONAL ACHIEVEMENT AND WELL-BEING

The use of electronic counseling has been shown to have a beneficial effect on both student academic performance and overall well-being. Su et al. (2024) study identified that students who engaged in counseling via an electronic platform had better emotional control and academic performance. In India, e-counseling has helped students make more informed career choices, as indicated by Muhammad (2023). Recent research accentuates the potential beneficial impacts of e-counseling on various aspects of student growth, such as academic performance, psychological adjustment, decision-making capacity, and accessibility. For example, a quasi-experimental design study revealed that students engaged in online counseling demonstrated significantly better academic accomplishments in comparison to a control group (Heydari et al., 2024).

Likewise, a bi-annual survey of university counseling services throughout the pandemic indicated that students who utilized e-counseling had less emotional distress and a higher likelihood of graduation compared to their peers who did not utilize these services (Mammarella et al., 2024). E-counseling has also demonstrated beneficial effects on students' emotional well-being; a particular intervention study found positive affect and life satisfaction increases, and stress and anxiety reductions following online counseling (Celia et al., 2022). In career development, a web-based career counseling program demonstrated significant enhancement in the career choice ability of students compared to the control group (Pordelan & Hosseinian, 2021). Especially, e-counseling sites enhance inclusivity through widening access to counseling; for instance, online counseling specifically designed for physically disabled students has reduced barriers to service and achieved improvements in such students' academic hardiness and mental health (Khalijian et al., 2023). Collectively, these results bear witness to the beneficial effect of e-counseling on the academic performance, emotional wellness, good decision-making, and equal access to counseling services of students.

5. COMPARISON OF IMPLEMENTATION AND POLICY AMONG ASIAN COUNTRIES

Table 1: Comparison Among Asian Countries

Country	AI Integration in Counseling	Reference
Malaysia	Integrating AI into counselor training curricula; recommendation to add an AI module for digital preparedness.	Ganaprakasam et al. (2024)
China	Advanced e-counseling system with AI and big data to monitor student well-being; improved mental health outcomes.	Su et al. (2024)
Japan	Use of AI robots (e.g., PLEN Cube) to detect students' emotions and provide support.	Lim et al. (2022)
India	AI-based career guidance system that suggests paths based on student profiles; increased satisfaction.	Muhammad (2023)
Singapore	AI chatbots offering mental health support to youth; positive student response.	Lim (2025)

Some Asian countries have actively introduced Artificial Intelligence (AI) into counselor training and e-counseling practice with varying approaches and outcomes. In Malaysia, efforts are underway to introduce

AI in counselor training programs, with Ganaprakasam et al. (2024) proposing an AI module to equip future counselors with skills to face digital-era issues more effectively. China has been able to employ a sophisticated e-counseling system that uses artificial intelligence and data analytics to assess and improve the mental health of students, with Su et al. (2024) evidence showing significant improvement in the psychological well-being of these students. In Japan, AI-based robots, like PLEN Cube, are used to identify the emotional status of students and provide counseling services, a strategy pinpointed by Lim et al. (2022) as effective in resolving mental health issues. India has also adopted artificial intelligence in e-counseling, specifically in career guidance, with AI algorithms proposing careers based on student profiles, which has caused satisfaction in the use of counseling services (Muhammad, 2023). Singapore, on the other hand, uses AI-driven chatbots to offer mental health support for young people, with Lim (2025) recording a positive response from students. These are some of the advancements showing the region's escalating interest in enhancing counseling practices using artificial intelligence.

6. CONCLUSIONS

e-Counseling in the 4IR era has great potential to improve educational excellence and student welfare. Its adoption also requires careful attention to infrastructure concerns, counselor competence, and ethics. Emerging technologies such as AI, apps, and VR can be leveraged to improve counseling services if they are preceded by sound policy and appropriate training. Asian regional cooperation in policy-making and information sharing can drive quicker transformation towards effective and inclusive e-counseling. Technological change is rapidly changing the direction of counseling services, and integrating e-counseling in the context of the Fourth Industrial Revolution (4IR) is ushering in both prospects and dilemmas to advance further education excellence and student wellness

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SMART-PUBLISH Kickstarter Toolkit: Empowering Authors and Illustrators of Children's Storybooks for Special Needs

ABSTRACT
This study focuses on developing the SMART-PUBLISH Kickstarter Toolkit, designed to help special education students in Malaysia author, illustrate, and publish children's picture books. The study follows Richey & Klein's (2007) three-phase model: (I) Needs Analysis, (II) Design and Development, and (III) Usability Testing. In Phase I, data from 170 special education educators in Kuala Kangsar revealed strong support for entrepreneurship education in classrooms (M=3.69, SD=0.96) and a high demand for a toolkit to enhance entrepreneurial skills among students with special needs (M=3.99, SD=0.78). In Phase II, 12 experts, including authors, illustrators, and publishers, validated the toolkit's constructs using the Fuzzy Delphi Method (FDM), achieving over 70% consensus. In Phase III, usability testing with 27 educators confirmed the toolkit's effectiveness, with consensus levels exceeding 70%. The SMART-PUBLISH Kickstarter Toolkit is shown to support innovative teaching methods, empowering special education educators to foster entrepreneurial skills in their students through the creative process of producing children's picture books.

KEYWORDS: Fuzzy Delphi, Entrepreneurship, Kickstarter toolkit, Authoring and Illustrating, Students with Special Needs

1 INTRODUCTION

In Malaysia, there are several types of schools that cater to students with special needs. These include government schools that have special education programs, private schools that provide special education services, and special education schools that are specifically designed for students with disabilities. Students with special needs can attend these schools free of charge, and the government provides funding to ensure that these schools have the necessary resources and facilities to provide quality education to their students (Bahagian Pembangunan Kurikulum, 2019).

Additionally, the Malaysian government has implemented several policies to support the inclusion of students with special needs in mainstream schools (Nur Kamariah et al., 2022). This includes the provision of additional resources and support services, such as learning aids and assistive technology, to enable students with disabilities to access the curriculum and participate in classroom activities. The government also encourages the hiring of special education teachers and support staff to work with students with special needs in mainstream schools (Bahagian Pendidikan Khas, 2013).

Special education teachers in Malaysia are highly trained to provide individualized education plans (IEPs) (Hannah Aqilah Amran et al., 2019) for each student, which includes goals and objectives that are specific to their needs. The IEPs are regularly reviewed to monitor progress and make any necessary adjustments to the curriculum.

Overall, special education in Malaysia has made significant progress in recent years. The government's commitment to providing quality education for all students, including those with disabilities, has resulted in the development of a strong and comprehensive special education system. In line with this,

the inclusion of additional skills-oriented subjects in the special education curriculum also enhances the prospects of students securing appropriate jobs (Shaffeei, 2021). While teachers teach skill subjects at school, it is important to also provide students with special needs with an introduction to the fundamental principles of entrepreneurship education.However, there is still room for improvement, particularly in terms of access to resources and support services for students with special needs in remote and rural areas (Sharul Hapizah Musa, Elia Md Zain, Muhd Zulkifli Ismail, Hifzan Mat Hussin & Mohd Norazmi Nordin, 2021).

2 PROBLEM STATEMENT

With a population of over 34 million people, Malaysia is home to approximately 633,653 individuals are people with disabilities. The biggest obstacle facing people with disabilities today is the competition for employment opportunities after completing their education. While some are fortunate enough to continue their studies in colleges and universities, others are stay-at-home (Mohd Hadir Hj Mahat, 2022).

In Malaysia, employment opportunities for persons with disabilities have been historically viewed as an act of charity, and they are often stereotyped as welfare cases (Dzalani Harun et al., 2020).This perception has contributed to a lack of opportunities for people with disabilities in the job market, leading to high unemployment rates among this population. Individuals with disabilities encounter challenges when seeking employment primarily due to a lack of understanding of disabilities (Selvi Narayanan, 2018).

This leads to negative attitudes towards hiring people with disabilities and a reluctance to do so among employers. According to the database of the human resource management information system, individuals with physical disabilities are extensively employed in both the private and public sectors (Kementerian Sumber Manusia, 2022) while those with learning disabilities are the least employed among people with disabilities. In 2022, from 618 application no employment is recorded from the category of learning disabilities. Individuals with learning disabilities are those who experience neurological difficulties in areas such as comprehension, language usage, speech, writing, reasoning, reading, spelling, and counting (Siti Rubiyani Omar & Abd Aziz Sulaiman, 2018).

This can significantly limit their employment prospects, with many being unable to find work after completing secondary education, particularly those who are classified as low-functioning. Under normal circumstances an employer is more willing and willing to employ a normal worker who can perform more than one task regardless of the obstacles and constraints compared to the disabled (Mohd Khaidir Othman et al., 2019). Essentially, entrepreneurship can be a viable option to assist individuals with disabilities in securing employment, particularly those who are unable to work full-time job.

3 RESEARCH OBJECTIVE

a) To identify the needs of developing a SMART-PUBLISH Kickstarter toolkit for entrepreneurship authoring and illustrating children's picture books for special education teachers to teach students with special needs.

b) To develop a SMART-PUBLISH Kickstarter toolkit for entrepreneurship authoring and illustrating children's picture books for special education teachers

c) To test the suitability of the SMART-PUBLISH Kickstarter toolkit and analyse educators' responses on the usability of the toolkit.

4 LITERATURE REVIEW

4.1 Entrepreneurship education in Special Education in Malaysia.

Entrepreneurship education in special education is gaining momentum in Malaysia. There is a growing recognition that students with special needs can benefit from entrepreneurial education, which can help them develop skills such as problem-solving, creativity, and self-reliance.The Malaysian government

has taken steps to promote entrepreneurship education in special education. For example, the Ministry of Education has launched programs to provide special education students with entrepreneurial skills, such as the Entrepreneurship Club program. The program aims to equip students with skills such as budgeting, planning, and marketing. The Ministry has also introduced the 1Malaysia Entrepreneurship Program for Special Education, which provides funding and training for students with special needs to start their own businesses.Private organizations are also stepping up to support entrepreneurship education in special education. For example, the Malaysian Association for the Blind has partnered with the Malaysian Global Innovation and Creativity Centre to launch the Empowerment through Entrepreneurship program for visually-impaired students. The program offers training and resources to help students develop entrepreneurial skills and start their own businesses.

Overall, there is a growing awareness of the importance of entrepreneurship education for students with special needs in Malaysia, and efforts are being made to provide them with the skills and resources they need to succeed. Thus, entrepreneurship behaviour must be instilled in students right from the school level. Entrepreneurship activities introduced must also consider aspects like students' strength, ability and interest.

4.2 Authoring and Illustrating Children's Story Books as an entrepreneurship activity for students with special needs.

Picture books are an important source of language, concepts and lesson for young children(Strouse et al., 2018). There are many kinds of storybooks in the form of picture books that take readers from magical to fantasy world characters, to the land of different animals or close to home about daily routines with rich illustrations. Picture books with its generic categorization entertains a wide spectrum of readers from an early age to adults and beyond (Hana Hladikova, 2014).It has a unique way to inspire anyone with the greater power of language visualization. Over the years the sales of children's picture books are seen hiking up serving as the latest trend in children's literature (Short, 2018).Having said that, publishing trends are emerging with new technologies that encourages innovative book format and designs offering new authors and illustrators to provide a greater range of books for children. In this article I present how we unlocked the hidden potential of students with special needs in authoring and illustrating children picture books and self-publish. This article focusses on the first phase of the development of kickstarter toolkit of entrepreneurship authoring and illustrating children story books. The toolkit will provide guidance and resources for individuals interested in creating entrepreneurial children's books, and identifying the specific needs and requirements of potential users is crucial to ensure its effectiveness. The analysis will identify the necessary components and features that should be included in the toolkit to meet the needs of educators and students in promoting entrepreneurship and creativity through the creation of children's storybooks.

5 METHODOLOGY

This quantitative study utilizes the design and development (DDR) approach as proposed by (Richey & Klein, 2012) . The research employs the DDR approach to develop the SMART-PUBLISH Kickstarter toolkit, which focuses on authoring and illustrating children's picture books for special education teachers. The purpose is to teach students with special needs the skills of authoring, illustrating, and publishing. The DDR approach is a systematic research design commonly used for developing products or tools. It involves analyzing data from participants, applying statistical analysis to the data, and conducting the inquiry in an unbiased and objective manner (Creswell, 2018). Developmental research serves the purpose of either generating generalizable conclusions or producing context-specific solutions to research problems (Richey & Klein, 2005). The justification for selecting the DDR approach for this study is its aim to develop a SMART-PUBLISH Kickstarter toolkit for smart publishing of children's picture books, including the identification of suitable constructs and items, expert validation of these elements, and testing the suitability of the developed product with the target population.

This approach provides researchers with a structured framework for designing their study and offers flexibility in selecting appropriate instruments and research methods for each phase(Ramlan Mustapha,

2017). Fundamentally this approach is going through three comprehensive phases (Richey & Klien, 2007). The phases are as follows:

I. Phase 1 is known as Need Analysis.
II. Phase 2 is known as Design & Develop
III. Phase 3 is known as evaluation or usability.

In this research, the Fuzzy Delphi Method (FDM) is used to analyse the collected data. The reason behind the selection of this research design is to validate and gain expert consensus on the constructs and the items in the SMART-PUBLISH Kickstarter toolkit. The FDM too allows the researcher to conduct a quantitative research design with triangular fuzzy numbers and defuzzification process to measure the experts' consensus. The FDM varies from the Delphi Technique by reducing the number of expert validation cycle, and the participants of the study remain anonymity (Mohd Ridhuan Mohd Jamil et al., 2017). Table 1 below shows the research method used in each phase for this study which was adapted from *Design and Developmental Research: Emergent Trends in Educational Research (2013).*

Table 1
Research methods based on DDR approach.

Phase	Research Method
Phase 1: Need Analysis	Literature Reviews, and Survey design (Score mean and percentage)
Phase 2: Design & Development	Focus Group Discussion, Literature Reviews and Fuzzy Delphi
Phase 3: Usability Test	Nominal Group Technique.

5.1 Phase 1: Need Analysis

In the DDR approach, the initial stage of research involves conducting a need analysis. This phase enables the researcher to pinpoint the requirements for developing a SMART-PUBLISH Kickstarter toolkit of entrepreneurship authoring and illustrating children's story books. Each research question leads to the development of the product to be developed. The need analysis phase is crucial in establishing whether there is a necessity to create a product or material that can aid professional practice. (Mahfuzah Zainol et al., 2021).

The need analysis phase aims to address the following research questions:

1. What are needs of developing a SMART-PUBLISH Kickstarter toolkit for entrepreneurship authoring and illustrating children's picture books for special education teachers to teach students with special needs.
    a. In general, what are the special needs educator's perception in implementing entrepreneurship education in the special education classroom.
    b. What are teachers' perceptions on methods used to carryout entrepreneurship education in the special education classroom?
    c. What is the teacher's perception on the needs to develop the SMART-PUBLISH entrepreneurship-based projects' Kickstarter toolkit like a toolkit for authoring and illustrating children's picture books?

In the need analysis phase, the target population comprises of educators who teach in the special education integrated program of Kuala Kangsar District, which includes both primary and secondary schools. There are a total of 17 primary schools and 8 secondary schools in the district that offer this program, with a combined special needs educator population of 280. The researcher utilized the judgmental sampling method to select 170 special education educators for this phase. This non-probability sampling

technique involves selecting participants based on specific characteristics(Zainudin Awang, 2015). To gain insight into the phenomena of interest from knowledgeable and experienced individuals (Ilker Etikan and Sulaiman Abubakar Musa, 2016) the researcher selected participants who were proficient and willing to provide information. Therefore, the special education integrated program educators from Kuala Kangsar District were selected using the judgmental sampling method for this phase, as the SMART-PUBLISH Kickstarter toolkit is intended to assist special education educators in teaching special educational needs students how to write, illustrate, and publish children's picture books. From the total number of special needs educators population, the required sample size for the need analysis phase is 162 (Krejcie & Morgan, 1970). However, the survey received a total number of 170 respondents. Participants for the need analysis phase is presented in table 3 below.

An instrument designed for this phase is a set of need analysis survey questionnaire. The survey consists of 5 sections on aspects relating to entrepreneurship education: Section A: Educator Details; Section B: Educator's perception in implementing entrepreneurship education in the special education classrooms, Section C: Methods used by educators to carryout entrepreneurship education in the special education classroom, Section D: Needs to develop entrepreneurship-based projects' SMART-PUBLISH Kickstarter toolkit. The survey questionnaire reached the participants through online as well as googles mails. This survey questionnaire aims to understand from educators, the needs to develop a SMART-PUBLISH Kickstarter toolkit for entrepreneurship activities such as authoring and illustrating children's picture books. The items for this questionnaire is adapted from Measurement Tool for Entrepreneurship Education (MTEE) by LUT University Finland in 2020(Finland, 2020). This is a self-evaluation tool primary and secondary level teachers in order to support the implementation of entrepreneurship education, thereby providing a pedagogical aid for the planning, assessment, and development of teaching(Oikkonen et al., 2015).The questions uses 5 points Likert scale. Data were analysed using SPSS and yielded the results discussed in the findings section of the paper.

5.2 Phase 2: Design & Development

SMART-PUBLISH Kickstarter toolkit is a guide for special education teacher who wants to teach students with special needs on authoring, illustrating and publishing children's storybooks. The core of this development study is based on experiential learning theory in entrepreneurship education (Koustas & Salehi, 2022), venture creation approach and the Three-Act-Structure Model (Field & Meltatasa, 2005). SMART-PUBLISH Kickstarter Toolkit consists of 3 sections as a main construct of the SMART-PUBLISH Kickstarter toolkit. The 3 sections are developed based on the Three-Act-Structure Model. However, a group discussion was also held with 3 experts from the area of authoring, illustrating and publishing to discuss suitability of the 3 sections selected based the Three-Act-Structure Model.

The design and development phase aims to answer the following research questions:

What is the design and development of Kickstarter Toolkit of entrepreneurship authoring and illustrating children's picture books.?

a. What is the suitable title of the Kickstarter toolkit?
b. What are the suitable contents of the Kickstarter toolkit based on expert's consensus?
c. What are the suitable outlines in the content of the manual book of Kickstarter toolkit based on expert's consensus?

In order to achieve the objectives of this phase, a Kickstarter toolkit to author and publish children's picture books was developed along with the Fuzzy Delphi Method (FDM) to answer the research questions. The Fuzzy method is an analytical method based on the Delphi method that draws on the idea of the Fuzzy theory. This method uses the independent consensus of a group of experts in the subject field. The purpose of this method was to elicit perceptions or judgements held by "experts" knowledgeable in a specialized area (Blair & UHL, 1993). A survey questionnaire was developed to get experts view on the appropriateness of the constructs and items suggested to form the screening tool. The questionnaire consists of 7 sections with 7-point Likert scale. Section A is experts demography; section b: experts view on the title of the Kickstarter toolkit, section c: experts view on the content of the SMART-PUBLISH Kickstarter toolkit, section d: experts view on the outlines of the manual book of SMART-PUBLISH Kickstarter toolkit, section e: experts view on the items of topic 1: steps to prepare the story in the manual book of SMART-

PUBLISH Kickstarter toolkit, section: f: experts view on the items of topic 2: steps to prepare the illustrations in the manual book of SMART-PUBLISH Kickstarter toolkit and section g: experts view on the items of topic 3: steps to self-publish and marketing in the manual book of SMART-PUBLISH Kickstarter toolkit.

Samples selected for this phase is by purposeful sampling technique. Samples are not selected randomly, so representativeness is not assured. Instead, they are selected for a purpose, to apply their knowledge to a particular problem based on a criterion (Hasson, Keeney, & McKenna, 2000). It is suggested that a range of 10 to 50 specialists should be considered (Jones & Twiss, 1978). As a result, a total of 12 experts were selected for the purpose of this research through the implementation of the purposive sampling technique. The composition of the group consisted of individuals who are experts in authoring, illustrating, editors and publishers The individual's possessing expertise in the sector held a minimum of a bachelor's degree as an academic credential, accompanied by a minimum of five years of practical experience.

5.3 Phase 3: Usability Test

The aim of this phase is to test the usability and suitability of the SMART-PUBLISH Kickstarter toolkit for authoring and illustrating children's picture books that emphasize entrepreneurship, especially among the user population consisting of special education educators. The SMART-PUBLISH toolkit has to go through a usability evaluation phase in line with the design and development (DDR) research approach Usability encompasses three key dimensions: effectiveness, efficiency, and user satisfaction, which collectively evaluate the user's experience and perception of a developed product. (Milano & Ullius, 1998).

In the context of this research, the aspect of satisfaction (Mazidah Mat Rejab, Suruayati Chuprat, Nurulhuda Firdaus & Mohd Azmi, 2018) is focused on special education educators from government agencies to evaluate the usability of SMART-PUBLISH Kickstarter toolkit. The level of usability of a developed product can be determined based on the expert's opinion and perceptions given upon using the product (Don J.F.J & Gwo H. T, 2012). In this research, SMART-PUBLISH was best tested by special education educators because they have the opportunity to observe the usability of the toolkit when teaching the special educational students in the classroom.

The research questions formulated in this phase are as follow:

What is the usability of SMART-PUBLISH Kickstarter Toolkit of entrepreneurship authoring and illustrating children's picture books from educators' opinions?

a. What are educators' opinions on the suitability of the title of the Kickstarter toolkit?
b. What are educators' opinions on the suitability of the contents of the Kickstarter toolkit?
c. What are educators' opinions on the suitability of the outlines of the manual book of the Kickstarter toolkit?
d. What are educators' opinions on the usability of the SMART-PUBLISH Kickstarter toolkit for teaching authoring and illustrating to students with special needs? The analysis of the data obtained from the survey questionnaire was conducted using Modified Nominal Group Techniques (NGT). In the context of NGT (Nominal Group Technique), the decision-making process entails the facilitation of a group discussion wherein several members engage in face-to-face interaction, ultimately culminating in the determination of a choice. (Aizzat Mohd. Nasurdin et al., 2006). The rationale behind the utilization of NGT is to facilitate the participation of all group members in a systematic manner, while minimizing the potential for mutual influence. In this study, the Modified NGT was employed because the researcher intends to evaluate the usability of the toolkit. Besides this reason, the researcher also intends to know the percentage value and the acceptance of each construct and items representing the toolkit from the users (special education educators). As for this research, a number of 27 potential experts from Ministry of Education who are the special education educators were selected to be the participants because they represent the target population who are going to use the SMART-PUBLISH Kickstarter Toolkit. The participants are teaching special education students from both the primary and secondary national schools.

7 FINDINGS

Data findings of phase (I), educators have stated that they are in support of entrepreneurship education in the classroom (M=3.69, SD=0.96), special education educators are consistently making efforts to promote entrepreneurial behaviors and skills among their students with special educational needs (M=3.89, SD= 0.83), and strongly agrees the needs of a toolkit for entrepreneurship activities (M=3.99, SD=0.78). Findings phase (II) reports, that the experts have a fair degree of agreement on the constructs and items suggested to form SMART-PUBLISH Kickstarter Toolkit. The constructs and items have met the threshold value of equals to and less than 0.2 and the experts' consensus equals to and more than 70% to form the SMART-PUBLISH Kickstarter toolkit. Finally, in phase (III), all the constructs and items of SMART-PUBLISH Kickstarter Toolkit has reached the agreement of usability according to the perception of the expert participants with group consensus equals to and more than 70%.

8 DISCUSSION & CONCLUSION

The Smart-Publish Kickstarter Toolkit aims to fill a significant gap within the school system by providing special education educators with the necessary tools to effectively instruct students with special needs. It serves as a means of connecting conventional educational resources with the unique requirements of children who have special needs (Jamshidovna & Bahodirovich, 2021).

Students who have special needs frequently encounter challenges in expressing their thoughts and emotions. This toolkit utilizes the medium of picture books, incorporating both authorship and illustration, to facilitate the expression of children in a manner that is both significant and pleasurable.

SMART-PUBLISH empowers special education educators a guide by providing an accessible and effective way to engage with their students. It equips educators with the tools and resources necessary to foster creativity, build self-confidence, and encourage self-expression, all of which are critical for students with special needs.

Finally, a notable feature of this toolkit is its emphasis on practical implementation in real-world of authoring, illustrating and publishing. By facilitating students in the process of developing their own picture books, it offers a concrete and purpose-driven learning opportunity. In addition to acquiring fundamental authoring and illustration skills,students experience a sense of accomplishment through the publication of their work.

Based on the findings of the study several recommendations can be made for further improve the performance of the toolkit. Incorperation of assisitive technologies like including speech recognition, text-to-speech, and sensory feedback, in order to address a wider range of special needs. Training and professional development programmes designed specifically for educators can be conducted, with the goal of improving their efficiency and effectiveness in using the toolkit. Finally there should be also a mechanism to monitor and measure the outcome of the toolkit. Future research innitiave can be taken to devise a method for monitoring and gauging the educational results and advancements made by students with special needs. The utility of these data can be demonstrated to various stakeholders through their utilisation.

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Future Direction for Sustainable Higher TVET Tertiary Level Education in Malaysia: Trends, Challenges, And Opportunities

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ABSTRACT

This review paper focuses on the future direction of Higher Technical and Vocational Education and Training (Higher TVET) at the tertiary level in Malaysia, specifically on how it can support sustainable economic growth and meet global workforce needs. Although sustainability is one of the key focuses of global education trends, there is a lack of research addressing how sustainability principles (economic, environmental, and social) can be fully integrated into Malaysia's Higher TVET curriculum. These principles could be instrumental in identifying quality and efficiency improvements to embed sustainability into Higher TVET. The objective of Higher TVET is to equip students with advanced, industry-relevant making it a crucial player in building a resilient and sustainable economy. The analysis reveals that new technologies, such as Learning Analytics, Industry 4.0, and digital skills, are being aligned with Higher TVET to ensure improve better prepare student preparation for the job market. Despite the potential, Higher TVET faces several challenges, including fragmented management, outdated curriculum, and a lack of recognition for certain occupational skills. However, there are opportunities for improvement, such as enhancing collaboration with industries, updating training methods, and making Higher TVET more inclusive and accessible in the future. Furthermore, a major trend is emerging with the growing demand for green skills and the increasing importance of lifelong learning, positioning Higher TVET as essential for creating a sustainable and inclusive future. The paper suggests strengthening policies, improving teaching quality, and expanding Higher TVET programmes to help develop a skilled workforce and prepare them to handle future challenges.

KEYWORDS: Curriculum Reform, Green Skills, Higher TVET, Industry 4.0, Learning Analytics, Lifelong Learning, Sustainability.

1 INTRODUCTION

1.1 TVET in Brief

In today's evolving global landscape, the role of Technical and Vocational Education and Training (TVET) has become increasingly important for the sustainable development of nations. The 21st century has witnessed a shift towards capital-intensive and labour-intensive production amid advancements in science and technology. TVET is widely recognized as a key driver in economic and sustainable development in

education. According to UNESCO-UNEVOC Reports (2019) on Malaysia's TVET country profile, the Malaysian education system incorporates a three-level TVET structure. The first level, the primary level, provides more exposure to practical skills. The second level consists of Vocational Schools and Technical Secondary Schools. The third level is tertiary education, where Higher TVET focuses on equipping students with higher-level technical and professional skills. TVET programmes provide individuals with the necessary skills and knowledge to bridge the gap between education and employment (Nor Aida, 2017). TVET aims to prepare students with specific industry-relevant skills. The International Labour Organization (ILO-UNESCO, 2020) has emphasized the need for institutions to drive innovation in digital TVET. As a result, TVET can train the skilled workforce required for operating and maintaining advanced technology while preparing workers for an evolving job market and emerging skills (Yusoff, 2020).

1.2 An Overview of Higher TVET

The Twelfth Malaysia Plan (2021–2025) and *Dasar TVET Negara* (National TVET Policy) have both prioritized the development of Higher TVET (HTVET) as a key driver of Malaysia's economic strategy. Through the Ministry of Education, the Malaysian government has introduced the concept of Higher TVET, emphasizing the need for a robust higher-level TVET system to meet industry demand.

The future of sustainable Higher TVET tertiary education lies in integrating emerging technologies, promoting inclusive and accessible education, and adjusting to shifting economic needs. TVET is one of the educational and training programmes designed to equip students with high-level practical skills and knowledge tailored to specific sectors, occupations, or vocations (Nor Aida, 2017). The students need to be armed with the necessary skills and knowledge to contribute productively to society. Additionally, Higher TVET can stimulate economic growth and development by enhancing labour productivity and competitiveness (Kibet, 2019).

For Malaysia's sustainable growth, Higher TVET is an essential element. In a technology-based employment market, skills are critical for both students and workers to acquire. Workforce training will need to address the uncertainties and risks of an increasingly challenging job market. Furthermore, with technological advancements driving the focus on sustainability in Higher TVET, technical skills need to be enhanced.

2 STATE OF THE ART REVIEW

2.1 The Background of TVET

The abbreviation TVET stands for Technical and Vocational Education and Training, a term used by UNESCO member countries. It is one of the main education systems in the world, with different countries implementing it through various approaches. According to UNESCO (2021), the term TVET has been used in Malaysia since 1990. In the United States, this programme is called CTE (Career and Technical Education), while in South Africa, it is known as FET (Further Education and Training). In Southeast Asia, the term VTET (Vocational and Technical Education and Training) is commonly used, while Australia uses VET (Vocational Education and Training) or VTE (Vocational and Technical Education).

The sustainability of TVET is a critical factor in developing a skilled workforce capable of addressing global challenges (Jayaprakash, 2024). In Malaysia, TVET must prepare skilled workers to support the country's development. Consequently, the perception that TVET is a second-class option should be eliminated (Yusoff, 2020). According to Jayaprakash (2024), maintaining the sustainability of TVET requires prioritizing green employment, aligning with sustainable development goals, and implementing practices that can reduce environmental impact while meeting labour market needs. A study by Nor Hidayah (2021) highlighted the government's critical role in ensuring sustainability by providing high-quality, industry-aligned training and collaborating with the private sector.

Under the Economic Transformation Programme (ETP), Malaysia must increase TVET student enrolment by 2025. Currently, there is an undersupply of TVET workers in 10 of the 12 National Key Economic Area (NKEA) sectors. NKEA sectors are identified as key contributors to economic growth under the ETP. The 10 affected areas are oil and gas, palm oil and rubber, financial services, tourism, wholesale and retail, education, electronic and electrical, business services, communication and infrastructure, and healthcare.

The COPTPA 2nd edition showed that the Ministry of Higher Education (MOHE), through MQA and DSD (Department of Skills Development, Ministry of Human Resource), has the responsibility to strengthen the TVET sector within the academic framework. Additionally, reviews from MQF (Malaysian Qualifications Framework), skills training, and vocational sectors have been merged into the TVET sector.

The code of practice for TVET programme accreditation under MQA is divided into seven areas, according to a study by Mohd Rozaimy (2022) which must align with the framework for sustainable Higher TVET.

Table 1: Seven Areas of Code of Practice for TVET Programmes

Area	Description
Area 1: Programme Development and Delivery	The programme aligns with the industry curriculum which can prepare students for the job market. This ensures that graduates meet current and future workforce demands.
Area 2: Assessment of Student Learning	This area focuses on evaluating student competencies. Regular assessment practices can lead to improvement in teaching methods and learning experiences.
Area 3: Student Selection & Support Services	A sustainable TVET system should prioritize inclusiveness to ensure all students, regardless of background, have opportunities for skill development.
Area 4: Teaching Staff	It is important to make sure the instructor or lecturer is competent and qualified. Continuous professional development for educators leads to improved teaching quality and better student outcomes for sustainable educational practices.
Area 5: Educational Resources	Educational resources ensure that institutions have the necessary tools, technology, and facilities to deliver quality education.
Area 6: Programme Management	This area involves strategic planning and the execution of educational programmes. A well-managed TVET system can better respond to labour market changes and industry needs.
Area 7: Programme Monitoring Review and Continual Quality Improvement	This can support the evaluation and enhancement of TVET programmes. Implementing all the feedback can allow institutions to adapt and innovate and ensure sustainability.

By integrating these areas into the framework of Higher TVET, institutions can create a more responsive and sustainable educational ecosystem.

The scope of TVET curriculum, according to the COPTPA 2nd edition and based on industry and occupational standards, comprises 50%–70% practical components. These subjects focus on psychomotor and work skills, including the industrial training component and field-specific components.

In Malaysia, TVET education aims to develop a technologically advanced, globally competitive, and successful nation. TVET plays a crucial role in cultivating scientists and academics, scholars, and semi-skilled workers who contribute to socio-economic development. One significant change in the TVET curriculum occurred when Malaysia restructured Technical High Schools into Vocational High Schools and introduced 22 vocational subjects into academic schools (Azmi, 2021).

TVET programmes in Malaysia are available at certificate, diploma, degree, and postgraduate levels, offered by various ministries and agencies. The Ministry of Education (MOE) provides the majority of formal TVET programmes and serves the highest number of students (UNESCO, 2015). Malaysia has

improved and innovated its TVET system in several ways. Currently, TVET in Malaysia also implements a dual training scheme similar to the German Vocational Education (Yusoff, 2020).

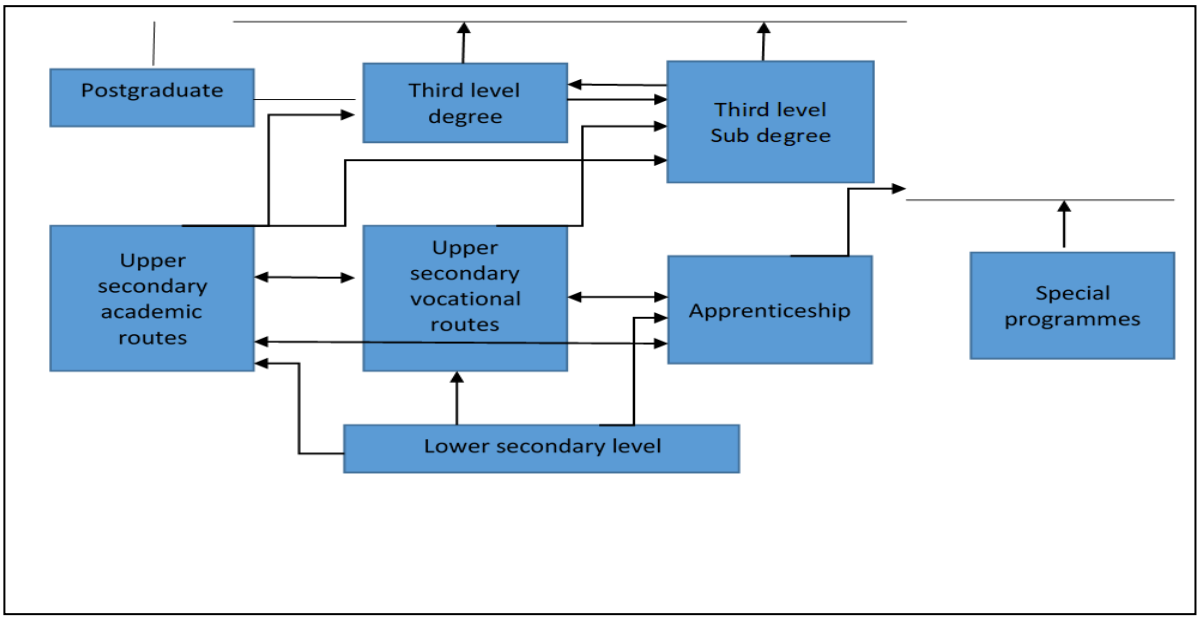
The Ministry of Higher Education's TVET system consists of four universities under the Malaysian Technical University Network (MTUN), 36 polytechnics, and 104 community colleges. Meanwhile, the Ministry of Rural and Regional Development (KPLB) oversees 280 TVET institutions. The various levels of HTVET, ranging from certificate and diploma to doctorate programmes, provide TVET graduates with expanded career pathways, enabling them to further their studies and secure better jobs (Chear, 2024).

2.2 The Background of Higher TVET

The education sector's role in the development of Higher TVET policy on a global scale, including Malaysia, is increasing. According to the Twelfth Malaysia Plan (2021–2025), the transition from TVET to Higher TVET involves redesigning the current vocational education system to establish a more advanced higher vocational education system, with a focus on enhancing the country's income level.

Figure 1 illustrates the range of TVET programme levels offered by nations in Europe and Eurasia. Most nations focused on upper secondary and tertiary education. A study by Yusoff (2020) revealed that the region's e-learning systems are increasingly facilitating lifelong learning, commonly known as continuous education. The Malaysian tertiary education system is categorized into three main sectors, as classified in the MQF: the skills training sector, the vocational and technical education sector, and the higher education sector.

Fig. 1: The Structure of TVET in Most European and Eurasian Countries



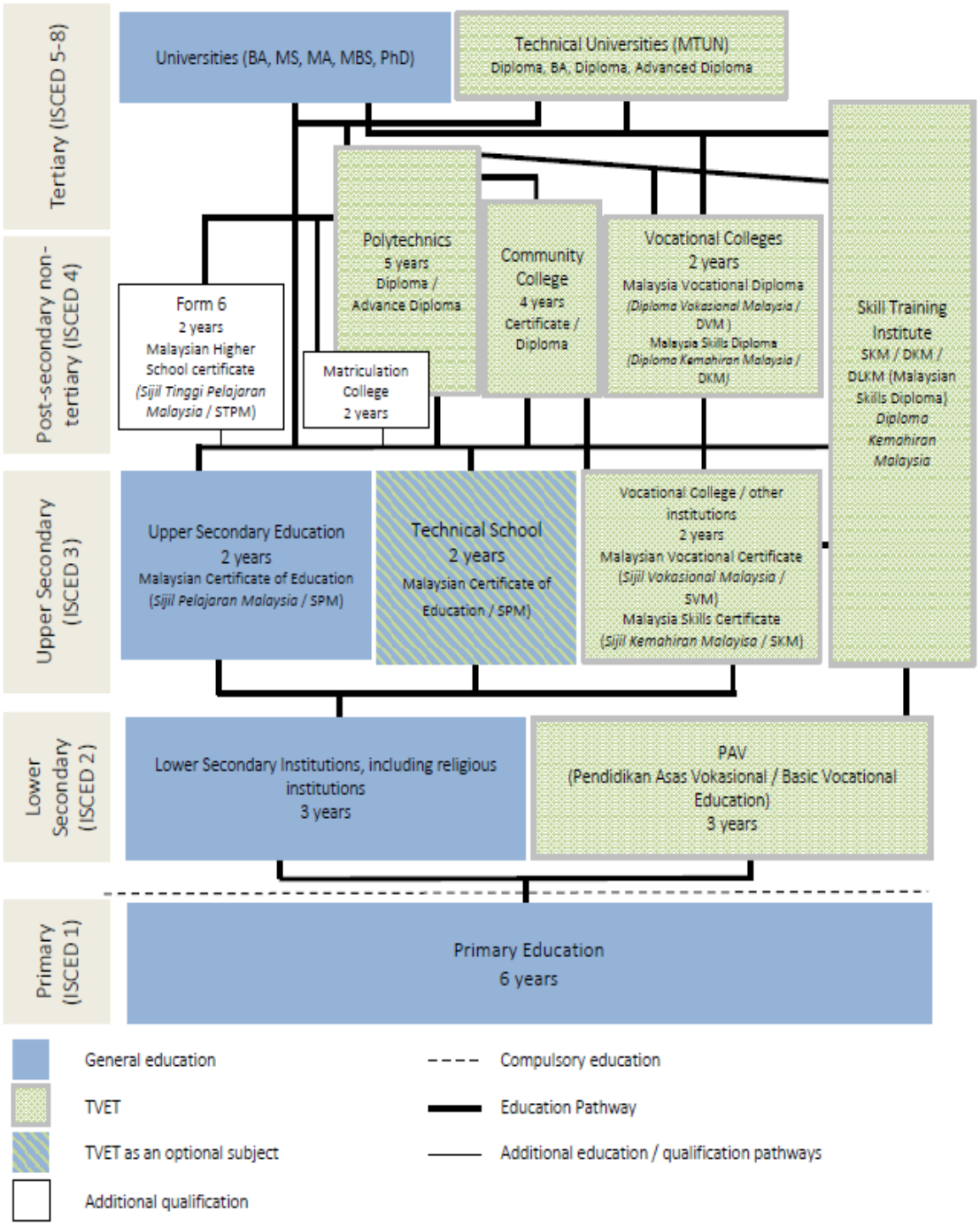
Tertiary-level Higher TVET typically includes diplomas and advanced diplomas that emphasize theoretical knowledge and practical skills in vocational fields. A bachelor's degree provides a deeper comprehension and broader skill in the chosen field of study, while professional certification offers a tailored programme designed to guarantee current and practical relevance (UNESCO TVET strategy 2016–2021)

Through the Ministry of Education's initiatives in Malaysia, TVET programmes are offered at various levels, ranging from certificate to postgraduate qualifications. Each programme is categorized into the skills needed for training, vocational and technical education, and higher education, as outlined in the MQF. The Twelfth Malaysia Plan (2021–2025) aims to enhance the vocational education system by transitioning towards Higher Technical Education and Training (HTVET). Tertiary HTVET includes diplomas and

degrees that combine theoretical knowledge with practical skills, while the regular TVET sector will offer pathways from primary to tertiary levels.

Figure 2, adapted from UNESCO-UNEVOC (2019), shows the education pathways within the TVET sector. The structured pathway consists of three levels, primary level, secondary level, and tertiary level.

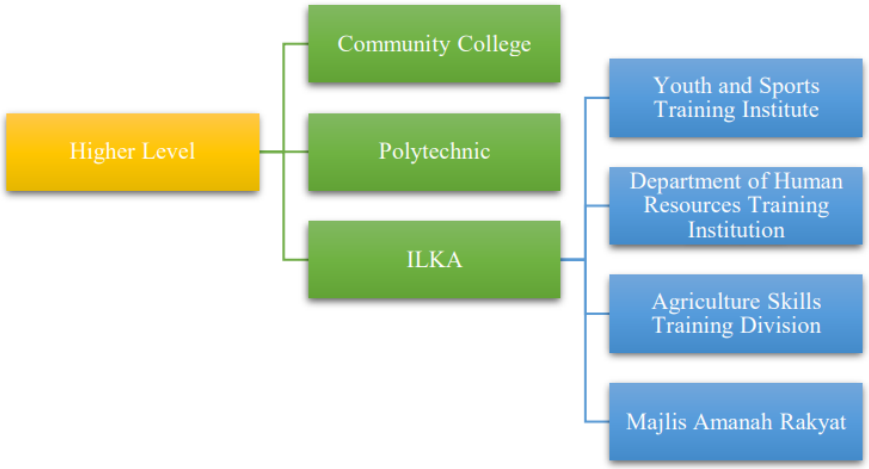
Fig. 2: TVET Pathways in the Malaysian Education System



The future of Higher TVET is impacted by a variety of trends, challenges, and opportunities as the world moves towards more sustainable practices and advanced technologies. To meet job market demands and close skill gaps, Malaysia's future TVET tertiary education should focus on improving employability skills, strengthening industry networking, and ensuring continuous evaluation (Jamaludin, 2018). The Malaysian Higher TVET system has implemented several innovative practices to enhance educational outcomes and align with industry needs. According to the Ministry of Education Malaysia (2019), three major institutions offer high-level TVET: community colleges, polytechnics, and Institusi Latihan Kemahiran Awam (ILKA). Admissions to high-level TVET institutions are now handled by the University Central Unit (UPU).

Figure 3, adapted from the Ministry of Education (2019), shows the structure of higher-level TVET institutions, highlighting the community colleges, polytechnics, and ILKA.

Fig. 3: Higher-Level TVET Institutions



Higher Technical Vocational Education and Training (HTVET) at the tertiary level is critical for providing students with advanced practical skills and industry-relevant knowledge. Research indicates that Higher TVET programmes are improving employability by aligning the curriculum with labour market needs and expanding the skilled workforce (Hassan, 2018). In South Africa, Higher TVET is focused for school leavers and the unemployed. Furthermore, it provides opportunities for individuals who have exhibited a lack of interest in or ability to pursue formal academic education (Sebola, 2020).

According to a study by Saibon (2019), to remain in the 21st-century employment market, graduates should also possess technical and vocational skills rather than relying only on academic performance. Moreover, high youth employment due to skills mismatches with labour market demands is one of the major global challenges. The Eleventh Malaysia Plan (2016–2020) identified a shortage of Higher TVET graduates needed to satisfy industrial demand. By 2025, Malaysia aims to increase the number of enrolments at Higher TVET from 250,000 to 650,000 students.

Higher TVET faces some challenges, including competition, service quality, image, recognition, fragmented delivery, outdated curriculum, and teaching staff capabilities. TVET colleges in South Africa are among the most understaffed institutions due to a shortage of trained workers. Higher TVET lecturers typically hold university qualifications equivalent to an Honours degree, while others possess only a post-secondary qualification or a test-based qualification. The most challenging issue is those with technical qualifications often lack pedagogical training (Sebola, 2020). Higher TVET colleges also face difficulties with student retention and success rates. High dropout rates and poor throughput remain significant concerns (Sebola, 2020). The highest level of accreditation in a TVET programme is a Diploma, offered by public or private polytechnics and training institutions. However, most students in the TVET system are

influenced to enter the labour market as soon as possible instead of pursuing Higher Education (Alam, 2021). According to Ariful Haq Kabir (2024), most universities in Bangladesh do not accept TVET diplomas, preventing students from registering in Higher Education programmes. This issue arises due to gaps between policies and practices regarding transitions from TVET to Higher Education.

The future of Higher TVET (HTVET) in Malaysia is shaped by evolving trends, sustainability initiatives, and emerging technologies. It focuses on improving employability and industry alignment. Major institutions such as community colleges and polytechnics play key roles, with the Ministry of Education overseeing admissions. HTVET programmes are designed to enhance practical skills relevant to job market demands, addressing the shortage of skilled graduates identified in the Eleventh Malaysia Plan. The transition to Higher TVET emphasizes integrating Industry 4.0 principles and improving skilled workers to meet workforce demands.

3 TRENDS AND CHALLENGES FACING HIGHER TVET EDUCATION

The transformation of TVET into Higher TVET involves re-engineering the current vocational education system to establish an advanced vocational education system that aligns with Industry 4.0 and contributes to high-income opportunities. The Malaysian government's National Transformation Plan 2050 (TN50) prioritizes technology in shaping the country's future from 2020 to 2050. The most highlighted component in this plan is Industry 4.0, which is not just about technology, but also its integral role in the learning process, especially the tertiary level, also referred to as Higher TVET.

Another challenge of Higher TVET is the uncertain direction of TVET graduates pursuing higher education, which can reduce awareness of the programme and associated career opportunities (Chear, 2024). Additionally, the Higher TVET ecosystem in Malaysia includes diverse certification processes, resulting in an unclear division of responsibilities, with institutions operating independently. Furthermore, the overlap of programmes across different ministries leads to wasted resources.

Higher TVET learning and teaching approaches are categorized into three themes: technology-mediated learning environments, industry-simulated TVET settings, and contextual learning experiences (Raihan Tahir, 2023). Industry 4.0 refers to the integration of the workforce with cyber technologies (Internet of Things). One of the most significant challenges for Higher TVET education schemes is adapting to Industry 4.0 demands. In the meantime, Higher TVET is expected to produce competent technologists across various fields and shape the future of a competence-driven workforce (Nor Aida, 2017). However, the lack of essential skill sets to transition towards Industry 4.0 remains a challenge (Saipudin, 2021).

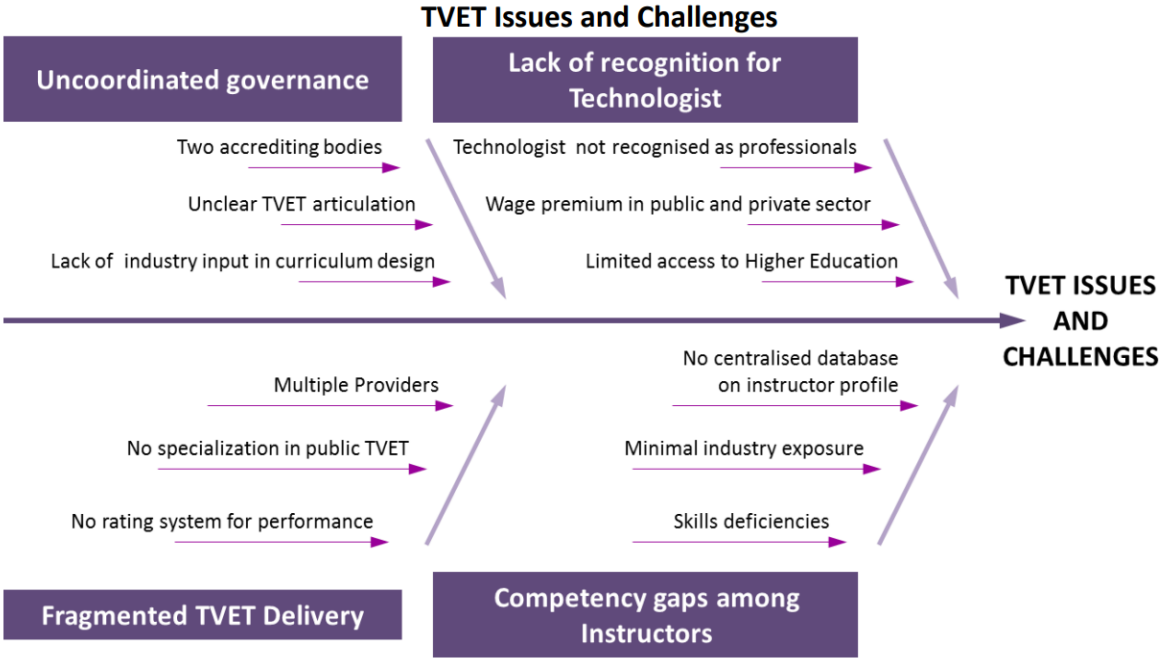
In addressing these technological challenges, the demand for high-level TVET and a skilled workforce has been identified. This demand is driven by evolving job roles, characterized by intensive work and increased data networking in Industry 4.0 (Spottl, 2021). Joseph (2023) suggested Work-Integrated Learning in TVET lecturer training to tackle the challenges and enhance industry-relevant competencies, such as supervision, support, and hands-on experience in TVET delivery. The TVET lecturers can gain valuable industrial experience through engagement with the latest technology and networking.

Strategy Paper 9 of the Eleventh Malaysian Plan (2016–2020) identified four key challenges for TVET, namely uncoordinated governance, fragmented delivery, lack of recognition for technologies, and competency gaps among instructors.

One of the significant challenges for TVET institutions is to find industries that offer industrial training or work-based learning for students. The number of industries capable of recruiting students as trainees has decreased, further impacting TVET graduates' employment prospects (Twelfth Malaysia Plan, 2021–2025).

Figure 4, adapted from the Strategy Paper Eleventh Malaysia Plan (2016–2020), illustrates the major TVET issues and challenges, including uncoordinated governance, lack of recognition for technologists, fragmented TVET delivery, and competency gaps among instructors.

Fig. 4: TVET Issues and Challenges



Achieving the objective requires consistent, coordinated, and concentrated efforts to bridge the misperception gap, attract youths into TVET, and retain them as high-quality talents to support the human capital needs of the economy (Yusoff, 2020).

In the Philippines, Rene (2021) identified significant challenges, particularly with TVET programmes' compliance with agency standards. Based on their study, 47% of employed graduates found their skills relevant to work, while 29% felt the training they received was not relevant to their current job.

Similarly, Ismail (2018) found that vocational and technical students in Malaysia are more likely to be unemployed if their teachers lack experience in teaching methods, focus solely on classroom management, lack relevant industry expertise, and show little interest in teaching the given courses. An effective TVET teaching and learning process requires well-trained and highly skilled vocational lecturers and teachers, as TVET strives to educate the students with technical knowledge and abilities that meet market needs (Mohd Rozaimy, 2022).

The Eleventh Malaysia Plan identified several key challenges within TVET, such as uncoordinated governance, fragmented delivery, and competency gaps among instructors. Additionally, difficulty in securing industrial training opportunities significantly impacts graduate employability. Changing these perceptions about TVET and developing skilled talents to meet the human capital needed require consistent efforts.

4 OPPORTUNITIES FOR HIGHER TVET AND SUSTAINABILITY IN THE FUTURE

In the TVET era, UNESCO's strategy focused on developing the skills of graduates. This is important for creating a more inclusive and sustainable society. During this period, TVET plays a key role in helping people improve their abilities while providing better job opportunities.

UNESCO continues to collaborate with a variety of global partners to prioritize TVET within the education agenda, assisting Member States in changing the landscape and ensuring its long-term sustainability. Industry 4.0 and its integration into technical and vocational training have been identified as essential areas for future research and giving guidelines for policymakers (Zaharah, 2020).

TVET plays a crucial role in promoting sustainable development by focusing on topics such as renewable energy, environmental preservation, and sustainable agriculture (Amin, 2023). In Higher TVET, tertiary education continues these topics to ensure students see how eco-friendly technologies and socially creative activities contribute more to a sustainable economy.

The practical component of Higher TVET programmes includes workplace experience that fosters strong industry collaborations. Higher TVET colleges have a significant opportunity to address the skills gap within the labour market by offering practical and vocational training aligned with industry needs. The mandate of TVET colleges and Higher TVET institutions includes enabling students to acquire practical skills and vocational competence, crucial for meeting the employment demands across various sectors (Sebola, 2020).

Yusoff (2020) highlighted the opportunity for higher TVET institutions in Germany to modernize their curricula by integrating digital competencies into their programmes. This initiative aims to equip students with digital skills such as data literacy, communication, and problem-solving, ensuring alignment with current market needs.

According to Othman (2023), Higher TVET plays a critical role in preparing the workforce for Industry 4.0, which focuses on artificial intelligence, big data, and the Internet of Things. By implementing high technology alongside sustainable practices, Higher TVET can help bridge the skills gap in developing industries.

Jayaprakash (2024) argued that TVET must incorporate sustainable practices to reduce environmental impacts while meeting labour market needs. Additionally, Hidayah (2023) suggested that green infrastructure should be introduced on TVET campuses to promote sustainability and improve educational performance.

Higher TVET programmes can improve the curriculum by integrating digital skills, bridging the skills gap, and contributing to a more sustainable future. The future direction of HTVET lies in integrated Industry 4.0 technologies, flexible learning, industry collaboration, and strategic partnerships.

Table 2 presents key findings and reflections from different authors on the role of TVET in sustainability, social mobility, and workforce development.

Table 2: Sustainable Higher TVET in the Future

Author	Key finding	Reflection
Ogur Eric Okoth, 2023	● TVET can tackle issues of poverty, inequality, and unemployment by providing opportunities for disadvantaged individuals ● TVET offers green economy skills, including renewable energy and sustainable agriculture	● By focusing on social mobility, TVET can reduce barriers to better economic prospects ● When focusing on sustainability, TVET programmes must prioritize environmental awareness and green practices
Simon McGrath & Shoko Yamada, 2023	● Higher education VET programmes are critical in shaping the development of sustainable skills ● High education institutions struggle to align the curriculum with industry needs	● University must integrate vocational education into higher curricula to meet sustainable development goals and strengthen industry partnerships to bridge the gap between education and employment
Maria-Ana Georgescu and Crina Gliga , 2020	● Vocational training must continuously improve sustainable work practices	● The lack of vocational education can negatively impact sustainable work practices
Syed Lamsah Syed Chear, 2024	● TVET graduates have multiple pathways to higher education, but talent evaluation remains a barrier ● High education institutions in TVET should adjust their curricula to include industry needs	● Creating a strong evaluation procedure is essential to ensure all TVET graduates can properly transition into higher education ● A highly skilled workforce can satisfy the changing demands of the labour market
Jiewan, 2023	● Higher vocational education is essential for producing highly qualified technical and skilled workers ● Higher vocational colleges must overcome challenges to achieve high-quality development	● Vocational education plays a crucial role in satisfying workforce needs ● Identifying and addressing all the challenges is necessary to ensure the sustainability of educational standards

5 CONCLUSION

Higher education at the tertiary level in Technical Vocational Education and Training (TVET) plays an important role in shaping competent workers to aid economic and sustainable practices. The advances in technology, coupled with shifting sectors, affirm the ongoing importance of TVET for the future. Emerging trends, such as learning analytics, Industry 4.0 technologies, and digitized capabilities, are expected to be integrated into TVET curricula. Aligning these components will ensure preparedness to fulfil the necessities of the modern job market.

Higher TVET faces several obstacles, including an outdated curriculum, a disharmonious management system, and issues related to recognizing vocational qualifications. A more comprehensive cooperative effort is required, not only from governments but also from educational institutions and industry associates, to remedy these deep-seated flaws and empower the Higher TVET system. More pertinent curricula, especially refined educational methodologies, fused with industry-focused ties, can enhance Higher TVET's ability to meet labour market needs and ensure a sustainable future direction in Malaysia.

Looking ahead, adaptability will be central to Higher TVET's future stability. The demand for environmentally friendly skills has increased significantly and the importance of continuing education is everlasting. Adopting these tendencies—green trends and lifelong learning—will help Higher TVET play a vital part in shaping a more sustainable economy in the future.

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Car Parking System Implementation Using PLC Fiddle as an Online Learning Tool

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ABSTRACT

Understanding Programmable Logic Controller (PLC) circuits can be a challenging task for students especially when relying solely on theoretical lessons. With limited hands-on experience, many students struggle to grasp the practical aspects of PLC operations. This paper aims to address this challenge by introducing PLC Fiddle, a free web-based online PLC simulator designed to enhance students' understanding of PLC circuits. The paper includes basic tutorials on how to use the features of PLC Fiddle along with a car parking system example that serves as a practical reference guide for learners.

KEYWORDS: Programmable Logic Controller (PLC), PLC Fiddle, PLC Simulation, Online Learning Tools, Car Parking System

1 INTRODUCTION

A programmable logic controller is an industrial-based digital controller designed to automate electromechanical processes in manufacturing, process control and industrial automation (DeGuglielmo et al., 2020). The development of PLCs began in 1968 when General Motors Corporation sought a controller that was easy to modify and maintain (Segovia & Theorin, 2012). In 1969, Bedford Associates, led by Richard E. Morley developed the Modicon 084 programmable controller (PC) as shown in Figure 1 to address this need (Patel et al., 2021; Rata & Rata, 2023).



Figure 1: Modicon 084 PC (Patel et al., 2021)

Later in 1974, Odo Josef Struger from Allen-Bradley improved the memory and processing capabilities of the PC by inventing the Bulletin 1774 as shown in Figure 2 (Segovia & Theorin, 2012). The group

coined the term “programmable logic controller (PLC)” which has become the standard terminology for these devices to this day.

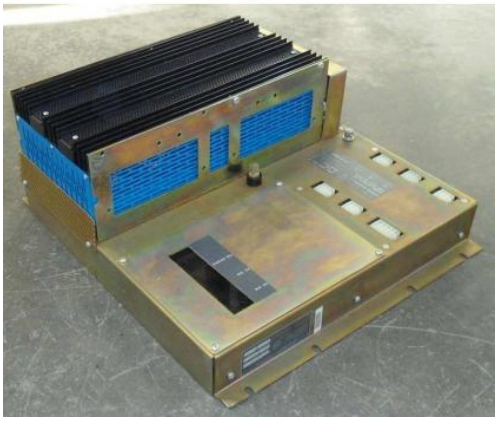


Figure 2: Bulletin 1774 PLC (Segovia & Theorin, 2012)

Compared to its predecessor, modern PLCs such as the Omron CJ1 PLC shown in Figure 3 are more compact in size. They offer advantages like ruggedness and resistance to vibrations, electrical noise, humidity and temperature variations making them well-suited to replace relay-based control systems (Engin, 2023).



Figure 3: Omron CJ1 PLC (Alphonsus & Abdullah, 2016)

PLCs are widely used in various applications including automated gate control, conveyor systems, car parking systems, elevators and many more. Typically, PLCs utilize a graphical programming language known as ladder diagram to control the operations. However, many students face significant challenges in understanding ladder diagram circuits when learning solely through theoretical instruction in the classroom. The abstract nature of PLC programming and the limited hands-on experience can hinder comprehension. Additionally, most PLC circuit simulation tools such as PLCSIM Advanced (Rogers et al., 2024), Factory I/O (Farzalizade Ravasjan & Sadighmanesh, 2022), Automation Studio (Huang et al., 2023), CODESYS (Benkraouda et al., 2023) and Rockwell Automation Studio 5000 (Alizadeh et al., 2024) are subscription-based software and require installation. This creates limited access for tutors to demonstrate PLC circuits in class. To address these challenges, this paper introduces PLC Fiddle, a free web-based PLC simulator at www.plcfiddle.com. PLC Fiddle allows students to experiment with PLC circuits in a virtual environment. This hands-on approach enhances their understanding of programming concepts. By simulating real-world scenarios, it helps bridge the gap between theory and practice through simulation-based learning (SBL).

SBL has emerged as a powerful instructional approach in technical and engineering education. It provides realistic and interactive environments that foster active experiential learning especially in scenarios where direct hands-on access is limited. According to Dittrich et al. (2022), simulations allow students to bridge the theory-practice gap by offering a safe, risk-free space to apply theoretical concepts in realistic contexts. In teacher education, SBL helps teachers work together, build confidence and stay

engaged (Dittrich et al., 2022). It works even better when followed by group discussions and feedback. This shows that it can make a big difference in how teachers learn and grow. Koh et al. (2010) highlight the educational benefits of using simulation in technical fields. The authors reported that applying simulation in an engineering module led to increased student motivation and improved understanding of the subject. Similarly, Vermunt (2023) explains that SBL helps learners build knowledge by working on real-world tasks. This is especially effective when using frameworks like the Promoting Expertise Through Simulation (PETS) model. The PETS model combines hands-on experience with theory to form a clear and practical understanding. It shows that simulation is not just about practice. It also helps learners develop expertise by connecting theory, reflection and real-world action in a structured way.

The main objective of this study is to demonstrate the use of PLC Fiddle as an effective teaching tool for developing PLC ladder diagrams. PLC Fiddle is an online PLC programming simulator. The study presents a simulation-based implementation of a real-world parking system scenario. This educational innovation is based on the constructivist instructional model. This model emphasizes active learning and a learner-centred approach. In technical education, hands-on skills and applied knowledge are essential. Instructional models that support these outcomes are especially effective. Using a simulation tool like PLC Fiddle allows students to build their understanding through interactive exploration. They also receive real-time feedback during the learning process. This approach follows key educational theories such as the constructivist learning theory. This theory promotes learning through experience rather than passive information delivery. It also supports the principles of problem-based learning. This encourages students to solve realistic and industry-relevant challenges.

2 PLC COMPONENTS

In general, a PLC consists of several components such as a power supply, control logic, external programmer connection, input and output (I/O) modules as shown in Figure 4 (Greeff & Ghoshal, 2004).

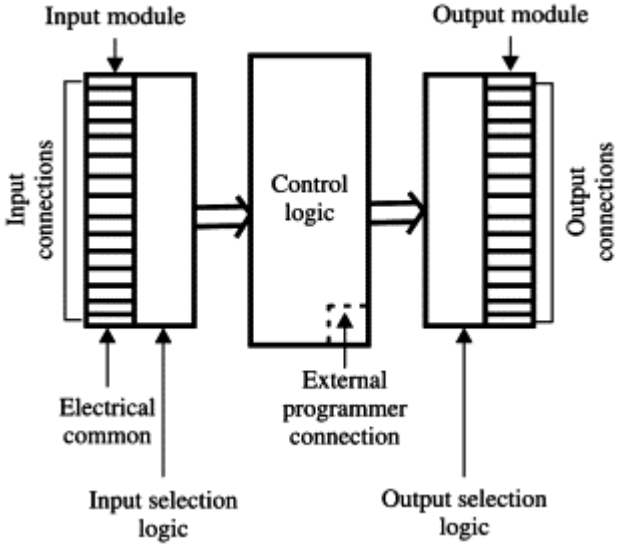


Figure 4: PLC components

The power supply provides the necessary electrical energy to power the control logic and I/O modules. The control logic or central processing unit (CPU) is the brain of the PLC. It processes input data and makes decisions based on that data to control the outputs. The external programmer connection allows the PLC to be connected to a handheld programming device or a computer for writing and uploading programs. The input module is used to connect the PLC to input devices such as sensors, switches and pushbuttons. Meanwhile, the output module connects the PLC to output devices such as solenoid valves, motors and actuators.

3 CAR PARKING SYSTEM WITH PLC FIDDLE

In this section, the features of PLC Fiddle will be introduced accompanied by examples to enhance understanding. PLC Fiddle is a web-based PLC simulator that allows users to design, simulate and debug ladder logic programs directly from a web browser without the need to install software or connect to physical PLC hardware (Aurachman, 2021). The simulator can be accessed at www.plcfiddle.com and its main interface is shown in Figure 5.

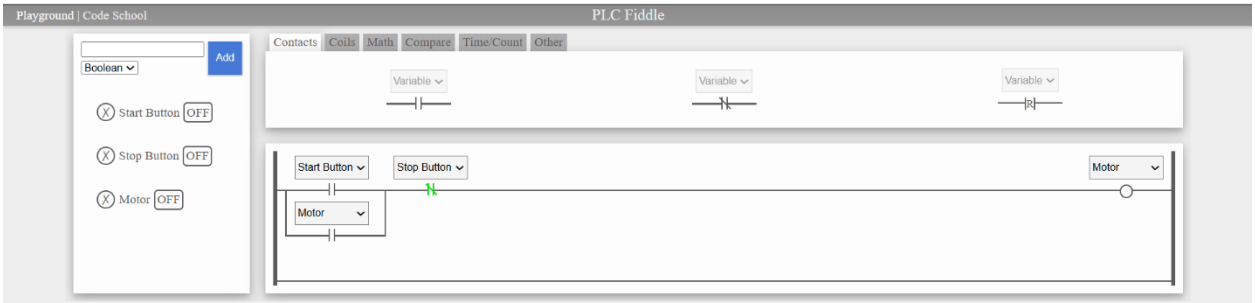


Figure 5: PLC Fiddle interface

It features a user-friendly interface with an intuitive drag-and-drop ladder logic editor. The simulator supports basic functions such as contacts, coils, mathematical operations, comparison functions and timer/counter blocks.

To demonstrate the use of PLC Fiddle, a car parking system as shown in Figure 6 is used as an example.

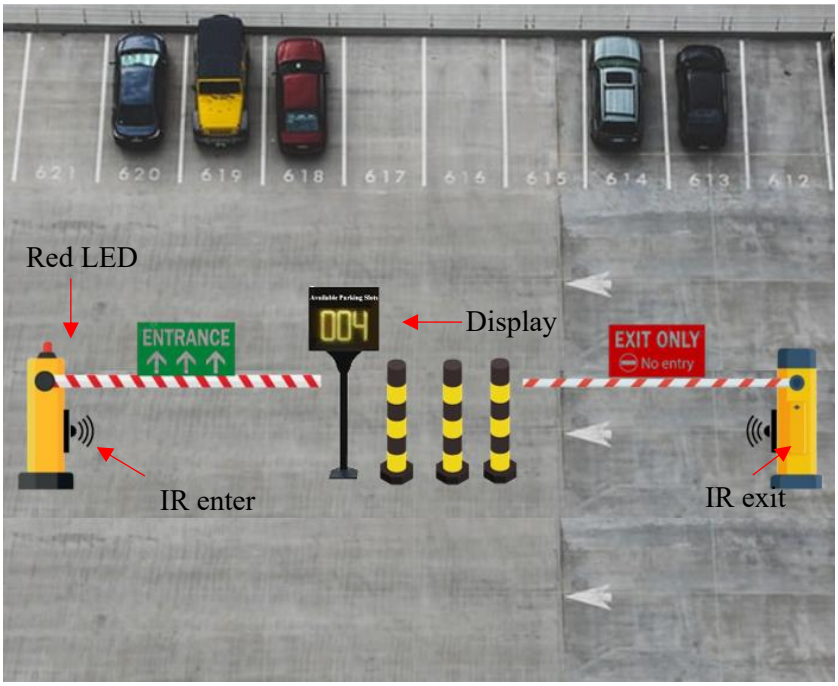


Figure 6: Car parking system

The system consists of a parking lot with 10 available spots and 2 barrier gates that control vehicle entry and exit. At the entrance, an infrared sensor labelled IR enter detects incoming vehicles. A red LED is mounted above the entrance barrier gate to alert drivers when the parking lot is full. If no spaces are available, the LED will light up and prevent the gate from opening even if a vehicle is detected. On the exit side, an infrared sensor labelled IR exit is used to detect the vehicles leaving the lot. Additionally, an electronic display is also available to show the number of available parking spaces.

3.1 Contacts and Coils Function

One of the key features available in PLC Fiddle is the use of contacts and coils. These are the fundamental building blocks in ladder diagrams. Contacts represent input conditions and consist of normally open and normally closed contact switches while coils represent the outputs. To develop the PLC circuit for the car parking system, the first step is to identify all the relevant inputs and outputs used in the system. In this case, the inputs include the infrared sensors at the entrance and exit while the outputs are the motors that control the opening and closing of the entrance and exit barrier gates.

In PLC Fiddle, the circuit can be created by simply dragging and dropping 2 normally open contact switches to represent the IR Enter and IR Exit sensors. Similarly, 2 coils can be added to represent the Entrance gate and Exit gate motors. When a vehicle approaches the entrance gate, the IR Enter sensor detects its presence and turns green to indicate activation. This, in turn, triggers the Entrance gate motor as shown in Figure 7 (a). Likewise, when a vehicle approaches the exit gate, the IR Exit sensor is activated and opens the Exit gate as shown in Figure 7 (b).



(a)



(b)

Figure 7: (a) Activation of IR enter sensor (b) Activation of IR exit sensor

3.2 Time/Count Function

The second features available in the PLC Fiddle simulator is timer and counter. Under this category, on delay timer, off delay timer, retentive timer, count up, count down and reset are available. To demonstrate this features, the car parking system can be upgraded by including a delay timer where both the entrance and exit gates will stay open for a certain time duration to allow the vehicle to enter the parking lot. Once the time duration is reached, the gates will close automatically and a counter is implemented to count the total car that enter and exit the parking lot.

In PLC Fiddle, the circuit can be further enhanced by dragging and dropping features like the on delay timer and count up functions. For the on delay timer, the preset value (PRE) which represents the desired time duration is set to 5 seconds. When the IR enter sensor detects the presence of a vehicle, it simultaneously activates the entrance gate motor and the timer. The timer begins counting up to 5 seconds as shown in Figure 8 (a). Once the timer reaches its preset value of 5 seconds, it activates the normally closed switch labelled Entrance gate duration.Q in the first rung and the normally open switch in the second rung. As a result, the entrance gate will automatically close and the total number of cars entering will be counted as 1.

A similar sequence occurs when a vehicle exits the parking lot. The IR exit sensor is triggered which opens the exit gate and simultaneously starts the timer with a 5-second delay as shown in Figure

8 (b). Once the timer finishes counting to 5 seconds, the output of the timer (the normally open switch labelled “Exit gate duration.Q”) closes to activate the counter. At the same time, the normally closed switch labelled “Exit gate duration.Q” opens to deactivate the exit gate and the timer.



(a)



(b)

Figure 8: (a) Entrance gate operation with on-delay timer and counter (b) Exit gate operation with on-delay timer and counter

3.3 Math Function

To update the available parking spaces on the electronic display, a mathematical function is applied. In this case, subtraction and addition modules are added to rung 2 and rung 5 of the circuit, respectively. Additionally, a number function labelled as Display is used to show the number of available parking spaces. Initially, the display is set to 10 indicating that 10 parking spots are available as shown in Figure 9 (a).

When the IR enter sensor is triggered, both the Entrance gate motor and the on delay timer are activated simultaneously. After the 5-second delay, the gate and timer are deactivated and the counter and subtraction module are activated. The subtraction module calculates the updated availability by subtracting the total number of cars entered from the initial value of 10. As a result, the display updates to 9 indicating that 9 parking spaces are now available as shown in Figure 9 (b). Once the count is updated, the counter is reset to zero using the reset function in rung 3.

Similarly, when a car exits the parking lot, the IR exit sensor is triggered activating both the Exit gate and a 5-second delay timer. After the delay, the system counts the exiting vehicle as 1. Then, the addition module adds the current display value which is 9 to the total number of cars that exited which is 1. This updates the display back to 10 indicating all parking spaces are available again as shown in Figure 9 (c). Finally, the exit counter is reset to zero, ready to count the next exiting vehicle.

3.4 Compare and Save Function

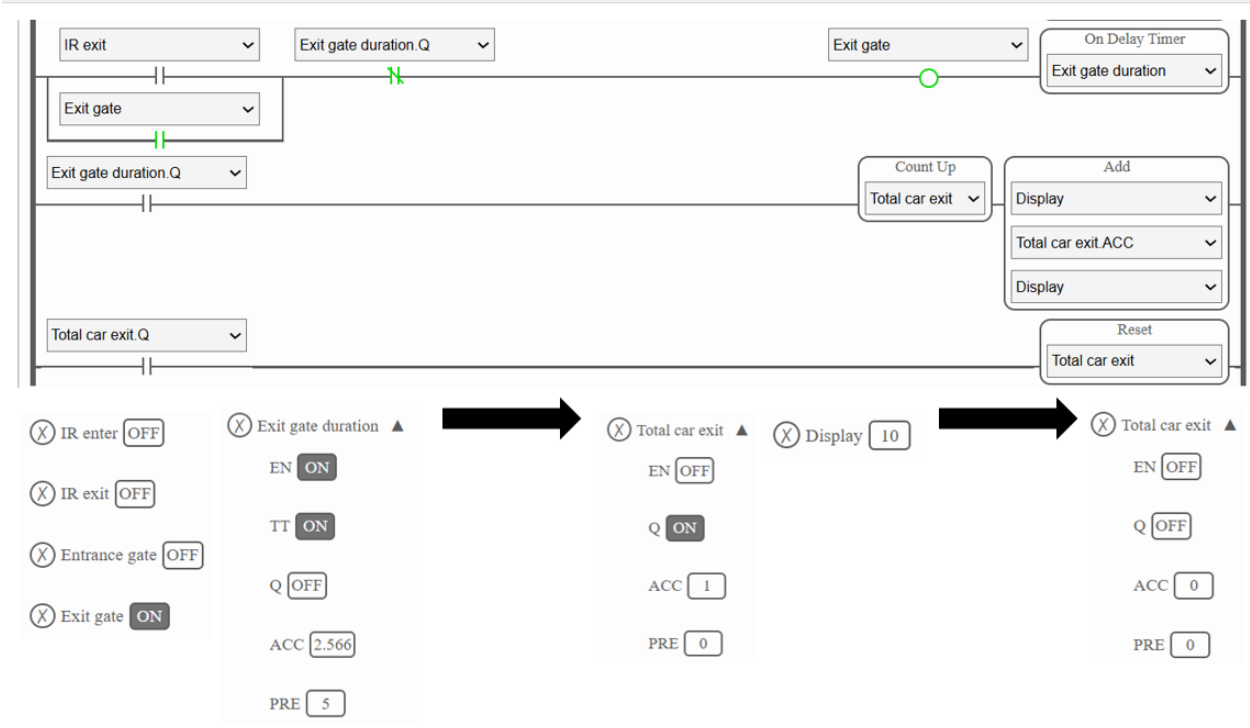
Lastly, the system can be further enhanced by implementing a security function. When the available parking spaces reach zero, the Red LED will be activated. This will prevent the Entrance gate from opening, even if the IR enter sensor detects the presence of a vehicle. To achieve this, an equality comparison function is added to the last rung of the circuit as shown in Figure 10 (a). The available parking spaces displayed on the screen are compared with a reference number of 0 indicating that the parking lot is full. Once the display shows zero, the Red LED light is activated. When the Red LED light is turned on, the normally closed switch for the Red LED light in the first rung will open. This prevents the activation of the Entrance gate and timer. Even if the IR enter sensor is triggered, the system will not allow the gate to open as shown in Figure 10 (b). The Entrance gate will only open if the display is not equal to 0 indicating that there are available parking spaces. Additionally, the simulation tool includes a function that allows users to save their project, enabling them to continue working on it in the future or share it with the community. For this project, the PLC Fiddle circuit can be accessed at https://www.plcfiddle.com:/fiddles/bb064688-ed0f-45be-8d63-b53e38b09393.



(a)

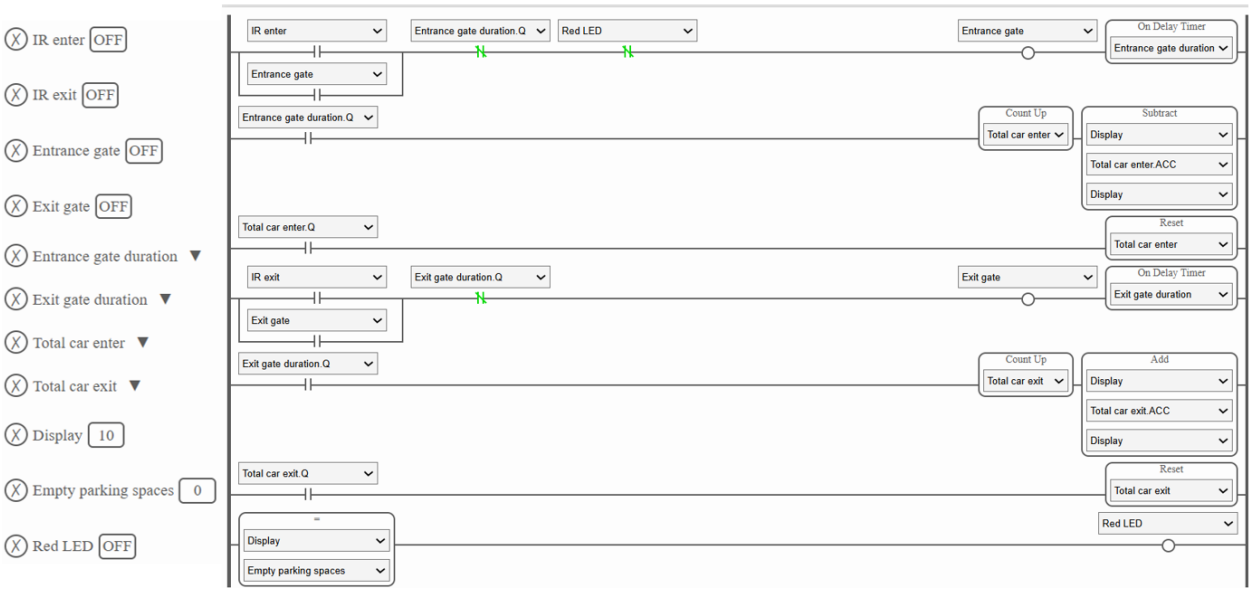


(b)



(c)

Figure 9: (a) Initial condition (b) Display updates after a vehicle enters (c) Display updates after a vehicle exits



(a)



(b)

Figure 10: (a) Red LED activation when parking spaces reach zero (b) Gate prevention with Red LED activation

4 CONCLUSION

In conclusion, this paper has demonstrated the effectiveness of PLC Fiddle as an educational tool that bridges the gap between theory and practical understanding. As a free, web-based PLC simulator, PLC Fiddle provides a user-friendly platform for students to experiment with ladder logic in real-time without the need for physical hardware or software installation. The car parking system example illustrates how students can utilize fundamental PLC functions such as contacts, coils, timers, counters, mathematical operations and comparison logic in a real-world context. The accessibility and functionality of PLC Fiddle make it a valuable tool for enhancing student engagement, promoting active learning and fostering a deeper understanding of PLC programming. The current study focused solely

on the design and demonstration of a PLC programming tutorial using PLC Fiddle. Future work will involve classroom implementation and the collection of student feedback and reflections to evaluate the instructional impact and learning effectiveness of the approach.

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Brand Awareness Enhancement for Small Businesses in the Digital Age: A Case Study of D-Kampung Coffee at Albukhary International University

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ABSTRACT

This study examines increasing brand awareness for small businesses in the digital age. It focuses on D-Kampung coffee at Albukhary International University. It assesses the current level of brand awareness. Identify key challenges and explore the impact of digital marketing tools and social media. Using qualitative methods Data were gathered through semi-structured interviews with clients, staff, and the university community. Research shows that digital platforms, especially Instagram, are critical in increasing brand awareness through high-quality interactive content. However, small businesses face challenges such as limited resources. Lack of digital marketing expertise and the time-consuming nature of content creation. This study integrates Aaker's Brand Equity Model with digital marketing strategies. It emphasises the importance of regular assessments and personalised customer interactions. Practical recommendations include investing in digital marketing skills. Leveraging influencer collaborations and continuous innovation to stay ahead of digital trends. This research provides valuable insights for business owners and marketers. The aim is to increase brand awareness and achieve sustainable growth. Future research should examine the long-term effects of digital marketing strategies and the role of emerging technologies in brand awareness.

KEYWORDS: *Brand awareness, small businesses, digital marketing, social media, Instagram, customer engagement.*

1 INTRODUCTION

1.1 Background

In an era characterized by rapid technological advancements and digital transformation, the landscape of business operations and marketing strategies has undergone significant evolution. Small businesses, in particular, are increasingly recognizing the pivotal role of digital platforms and technologies in enhancing brand awareness and reaching wider audiences. As such, there is a growing need to explore and understand the dynamics of brand awareness strategies in the digital era, particularly within the context of small businesses.

This digital revolution has not only redefined consumer behaviour but has also necessitated a fundamental re-evaluation of brand promotion and visibility strategies. Small businesses, as agile entities operating within this dynamic milieu, are increasingly cognizant of the transformative potential inherent in digital platforms and technologies. These platforms offer unprecedented opportunities for

small businesses to amplify their brand presence, engage with diverse audiences, and compete on a more level playing field with larger enterprises. Consequently, amidst this digital upheaval, there arises an imperative to delve deeper into the intricacies of brand awareness strategies, particularly within the context of small businesses.

This research aims to delve deeper into these issues by assessing the current levels of brand awareness among small businesses, exemplified by D-Kampung Coffee. The objective is to identify the primary challenges these enterprises encounter in establishing and sustaining brand awareness and to explore the influence of different digital marketing tools and social media platforms on brand awareness. Through a case study approach, this study offers a comprehensive examination of real-world practices, providing insights applicable to similar small businesses confronting a myriad of challenges and opportunities within the digital landscape.

The intended research will contribute to the academic field by addressing gaps identified in the literature concerning brand management strategies tailored to small businesses within the digital context. Additionally, it offers practical insights beneficial for small business owners and marketers seeking to adeptly navigate the complexities of the digital landscape. The anticipated findings are poised to delineate actionable strategies aimed at enhancing the digital presence and brand awareness of small organizations. Consequently, this research aids in fostering sustainable growth and competitiveness within the market.

1.2 Problem Statement

Despite the palpable advantages conferred by digital platforms, small businesses often grapple with a myriad of challenges in harnessing their potential to enhance brand awareness effectively. The confluence of limited resources, fierce competition, and evolving consumer preferences presents formidable obstacles that demand innovative and strategic solutions. Moreover, the dynamic nature of the digital landscape necessitates a nuanced understanding of emerging trends, best practices, and pitfalls to navigate. Therefore, there exists a critical gap in scholarship pertaining to the formulation and implementation of brand awareness strategies tailored to the unique needs and constraints of small businesses in the digital era. For instance, Smith and Johnson (2019) highlight the growing importance of digital marketing for small businesses but underscore the challenges these businesses face, such as budget constraints and limited expertise in leveraging digital tools effectively. Similarly, Jones et al. (2020) emphasize the need for small businesses to adapt their branding strategies to the digital landscape, but note a lack of comprehensive guidance on how to do so. Furthermore, recent studies by Brown et al. (2021) and White (2022) underscore the rapidly evolving nature of digital marketing trends and the difficulty for small businesses to keep pace with these changes. Despite these insights, there remains a dearth of research specifically addressing the formulation and implementation of brand awareness strategies tailored to the unique context of small businesses operating in the digital era.In this situation, there is an urgent need for empirical research delving into the effective strategies, and tactics used by small businesses to raise awareness of their brand in the digital realm. The study aims to shed light on the underlying mechanisms that drive consumer consciousness and engagement in the digital age. By considering successful case studies of D-Kampung Coffee at Albukhary International University, and identify best practices.

In this situation, there is an urgent need for empirical research delving into the effective strategies, and tactics used by small businesses to raise awareness of their brand in the digital realm. The study aims to shed light on the underlying mechanisms that drive consumer consciousness, and engagement in the digital age. By considering successful case studies of D-Kampung Coffee at Albukhary International University, and identify best practices.

1.3 Research Objective

a) To assess the current level of brand awareness of D-Kampung Coffee.
b) To identify the main challenges of small businesses in building and maintaining brand awareness.

c) To explore the impact of digital marketing tools and social media platforms on brand awareness for small businesses.

1.4 Research Question

In light of the aforementioned challenges and gaps in existing scholarship, this research endeavours to address these critical issues through a comprehensive investigation of brand awareness strategies tailored to the unique needs and constraints of small businesses in the digital era." Following this introductory sentence, the research questions would be presented as previously outlined.

a) What are the current brand awareness levels of small businesses in Alor Setar, Kedah, Malaysia? At what level and how will they differ within the digital landscape?
b) What are the primary challenges faced by small businesses in establishing and maintaining brand awareness in the digital era, considering the specific industry and location factors
c) How do digital marketing tools, including social media platforms, influence brand awareness for small businesses, and what are the key factors that contribute to their effectiveness?

1.5 Definition of Terms

There are five key terms in this study, and the terms are defined as follows:

1.5.1. Brand Awareness

It is the opportunity for individuals to retrieve brand identifiers and desired product categories or categories from memory in brand-related situations (Taylor & Bergkvist, 2022). In the context of this study this study specifically concerns the acceptance of D-Kampung coffee among digital landscape consumers in Alor Setar, Kedah, Malaysia.

1.5.2. Digital Marketing Tool

It means changing culture, organizational aspects and business processes to meet market demands through smart and digital technologies (Diaz et al., 2021). This includes but is not limited to social media platforms, such as Instagram and what's App. In this study, digital marketing tools are examined in the context of their impact on brand awareness for small businesses.

1.5.3. Instagram

It is a social media platform that is primarily focused on sharing photos and videos. It allows users to upload media that can be edited with various filters. Sort by hashtag and tag with geolocation Posts can be shared publicly or with pre-approved followers. Instagram's main features include Feed, which shows a chronological or algorithmic stream of posts from people you follow, and Stories, which are short videos or photos that disappear after 24 hours and can be enhanced with text, stickers, and more. And filters. Instagram also has Reels for creating and exploring short entertaining videos, and IGTV for longer video content. The platform also includes Direct Messages (DM) for personal communication. An Explore page that shows content tailored to users' interests, and a Shopping feature that allows users to purchase products directly through the app (Carpenter et al., 2020).

1.5.4. Strategy

It refers to a deliberate plan or set of actions designed to achieve a specific goal or set of objectives. This involves careful allocation of resources and a decision-making process that aligns with the long-term vision of the organization or individual. Basically Strategy is to determine the best path to improve outcomes by considering constraints and opportunities. It covers both the strategies used to implement these plans and the broader framework that guides decision-making. It allows one to adapt and respond to changing situations or new information. Strategy is fundamental in business, military, education, and other fields because it provides a structured approach to achieving success and maintaining a competitive edge in a dynamic environment (Aslam et al., 2022).

1.5.5. Small Business

It defined in this study refers to organizations with limited resources and focus on local markets (Osteryoung & Newman, 1993). These businesses often face challenges in terms of size and scope compared to larger companies. In the context of this research a small business is a business operating in Alor Setar, Kedah, Malaysia. Focusing specifically on D-Kampung coffee

1.6 Limitation of the Study

The research is limited to small businesses located in Alor Setar, Kedah, Malaysia, specifically focusing on D-Kampung Coffee within Albukhary International University. As a result, the findings of this study may not be universally applicable beyond this specific geographic and institutional context. Despite efforts to include a diverse range of industries within Alor Setar, it's possible that the study did not encompass the full spectrum of small business categories and may not generalize well to industries beyond those represented in the sample. Moreover, the rapid evolution of digital technology may render the strategies identified during the study ineffective or obsolete over time.

1.7 Research Contributions

This research is contributed in various aspects that can be involved in theoretical, practical, methodological, social and economic contributions as following:

Theoretical Contribution: This study contributes to the academic literature by addressing the gap identified by Napoli (2006) and Wong and Merrilees (2008) related to the paucity of brand management research focused on small businesses. By integrating concepts from the Brand Equity Model and the latest findings on digital marketing impact. This research offers a more detailed understanding of how small businesses can leverage digital tools for brand awareness.

Practical Contribution: This study focuses on the case study of D-Kampung Coffee at Albukhary International University, providing specific and actionable insights into the effective use of digital marketing tools to increase brand awareness. These findings can serve as a guide for small businesses located in similar geographic and economic contexts. To strategize the digital presence to promote the brand.

Methodological Contribution: Using qualitative methods specifically, in-depth interviews and content analysis within the specific context of Alor Setar. This provides methodological insights for studying brand awareness in localized environments. This method can be replicated or adapted by other researchers studying similar environments.

Social and Economic Contribution: This study has the potential to help small businesses in university cities and similar communities improve their marketing performance by increasing their understanding of the role digital marketing plays in building brand awareness. This helps support local economic growth and sustainability.

1.8 Significance of the study

Increasing brand awareness is essential for the success and sustainability of a small business. This research addresses this gap in the literature and provides practical guidance to help small business owners navigate the complexities of the digital landscape, and create a strong brand.

1.9 Summary of the chapter

In the first chapter, the researcher introduces the background of the study, problem statement, research objectives, research questions, and rationale for the study. Moreover, this chapter also provides the scope and limitations of the study and the importance of the study. The researcher mentioned the definition of key terms of the study, to provide a clear picture and, share the understanding of the terminology of the study, as well as highlight the significance of brand awareness in this digital age.

2 LITERATURE REVIEW

2.1 Introduction

This chapter aims to systematically explore and critically analyse the body of existing research relevant to the topic under investigation. By reviewing and synthesizing prior studies, this chapter will

highlight the current state of knowledge, identify gaps in the literature, and establish the theoretical and empirical foundations upon which this research is built. The literature review is structured into several sections. The first section provides an overview of the theoretical frameworks that are foundational to the research topic, discussing their development, application, and relevance. The subsequent sections are organized thematically, covering major areas of empirical research, including methodologies, key findings, and their implications. Each thematic section will critically assess the strengths and limitations of existing studies, providing a nuanced understanding of the research landscape.

This chapter undertakes a thorough exploration of academic work on brand awareness strategies within the digital landscape. This is focusing on small businesses, such as D-Kampung Coffee at Albukhary International University, Kedah, Malaysia. It reviews existing theory, and empirical findings on the use of digital marketing tools by small organizations, and effectiveness in increasing brand visibility, and engagement. This review aims to connect theory with practice by examining how digital strategies are implemented in real-world environments. The insights gained will help clarify how D-Kampung Coffee, based at Albukhary International University, can effectively leverage digital marketing to overcome its unique challenges, and increase brand awareness.

2.2 Theoretical Framework

The theoretical framework for this study is based on David Aaker's (1991) brand value model, emphasizing both customer-based brand value (CBBE) and employee-based brand value (EBBE) (Farjam & Hongyi, 2015). These dimensions provide a structured approach to understanding how brand awareness, and other elements contribute to the overall brand value. This framework provides a guide to examining how digital marketing strategies influence brand value for D-Kampung Coffee, a small business operating in a university environment.

2.2.1 Aaker's Brand Equity Model

Aaker (1991) defines brand equity as the set of brand assets and liabilities associated with the brand name and symbol. This is added or subtracted from the value that the product or service provides to the company and/or its customers (Farjam & Hongyi, 2015). This model identifies five key dimensions of brand value, firstly brand loyalty. Aaker (1992) dimension captures the extent to which customers are committed to the brand. Regular customers will reduce marketing costs and take advantage of trade and create a competitive advantage by persuading others to use the brand. Retaining existing customers is less expensive than acquiring new customers. And regular customers are less likely to switch even if they have low switching costs. Competitors are finding it difficult to attract loyal customers due to brand satisfaction. Secondly, is brand awareness where Aaker (1996) definced that an important component of brand value, or brand awareness refers to a potential buyer's ability to recognize or recall a brand as a member of a specific product category. High brand awareness can provide a sense of familiarity, Third key value is commitment, and assurance of quality. This affects consumer choice and drives sales. Fourthly, is perceived quality. This dimension involves the consumer's judgment of the product's overall excellence or superiority. Perceived quality differentiates a brand. Attract the attention of channel members Serves as the basis for expanding the line. And support higher pricing, it is a strategic consideration that enhances brand value and drives consumer purchasing decisions (Aaker, 1992). Lastly, is brand associations: These are anything that is linked in a consumer's memory to a brand, including product features Customer Benefits, Usage, Users, Lifestyle, Product Class, Competitors, and Country Brand associations help consumers process and retrieve information. Make a difference to the brand give reasons for purchasing and create positive feelings. A high level of brand association can lead to successful brand expansion and increased brand value (Aaker, 1991 & 1992).

2.2.2. Customer-Based Brand Equity (CBBE)

Farjam & Hongyi (2015) further explains the concept of Customer-Based Brand Equity (CBBE) in their book based on Aaker and Keller, which focuses on the differential impact of brand knowledge on consumer response to marketing activities. The positive CBBE can lead to long-term earnings, customer loyalty, and effective marketing communications (Farjam & Hongyi, 2015).

2.2.3. Employee-Based Brand Equity (EBBE)

Keller (1993) defined that Employee-based brand equity (EBBE) refers to the value derived from employees' brand knowledge and responding to the work environment and culture Employees who understand and support the organization's purpose help deliver these values to customers. Therefore, it makes CBBE stronger. Employees are a key resource for the success of a company's brand. This influences customer perception and brand loyalty (Farjam & Hongyi, 2015).

2.2.4. Application to D-Kampung Coffee

In the context of D-Kampung Coffee, the theoretical framework explores how digital marketing tools affect these brand value dimensions. This study assesses brand loyalty, brand awareness, perceived quality and brand associations within a small business's digital marketing strategy. By understanding these dimensions, D-Kampung Coffee can develop a more effective strategy. In order to enhance brand value, and achieve sustainable growth. This framework provides a structured approach to analyzing D-Kampung Coffee's brand equity, and offers insights into how small businesses can leverage digital marketing to build strong, competitive brands in the digital age.

2.3 Previous Studies

The dawn of the 21st century brought a paradigm shift in the economy. This is being driven by the rapid advances in digital technology. This era is characterized by the ubiquitous influence of digital platforms, which have changed consumer behavior and traditional marketing strategies. The impact of this change is particularly evident for small businesses. In the past, they relied heavily on a local customer base and face-to-face interactions. This is because digital platforms have become the mainstay of information dissemination and customer engagement. These businesses therefore face both challenges and opportunities when utilizing digital marketing tools for brand awareness and growth.
In the early 2000s, academics such as Napoli (2006) and Wong and Merrilees (2008) expressed concern about the paucity of marketing literature related to brand management within small businesses. This research gap is even more relevant in today's digital landscape. This is where the strategic use of digital marketing tools can greatly influence a small business's visibility and consumer perception. According to Guzmán et al. (2019), although digital technology is becoming increasingly important, there is still a strong need for empirical studies that explore how small organizations can effectively manage their brands in a digital context.

2.3.1. Brand Awareness

The importance of brand awareness in this digital age cannot be overstated. It serves as an important foundation for building trust, customer loyalty, and ultimately business sustainability. Increased brand awareness not only helps in attracting new customers but also plays a key role in promoting customer retention and support through continuous engagement. Therefore, understanding the dynamics of brand awareness in the digital realm has become essential for small businesses aiming to take advantage of the opportunities offered by digital platforms.

Brand awareness represents the extent to which a brand is able to establish a compelling status in customers' minds (Foroudi et al., 2018; Setiadi et al., 2018). Customers with higher brand awareness are more likely to recognize or differentiate a brand and associate it with distinctive features (Anand, 2018; Wijaya et al., 2020). As highlighted by Kumar & Arthi (2020), brand awareness serves as a starting point and plays an important role in the customer decision-making process. If there is no brand awareness Customers will lack understanding or awareness of their choices regarding a particular brand (Adiwijaya et al., 2021).

Recent studies further elaborate on the impact of social media on brand awareness. Sirkeci, Dahl, and Zeyneloğlu (2022) explore how perceptions of social media advertisements affect advertising value and brand awareness, particularly among Generation Y Instagram users. Their findings indicate that social media advertising significantly influences consumer decision-making and brand awareness. Moreover, Aprilianti, Rastini, and Rahanatha (2023) examine the role of brand awareness in mediating the influence of social media marketing on purchase intention, highlighting the importance of interactive content and attractive campaigns on platforms like Instagram.

2.3.2. Brand Loyalty

Tran et al. (2023) identify how perceived destination social responsibility drives destination brand loyalty through cognitive and affective pathways. They find that tourists' perception of a destination's social responsibility significantly influences their loyalty. Similarly, Wong (2023) examines the role of brand love and its relationship with brand-related variables such as brand quality, trust, commitment, and loyalty. The findings confirm that brand quality and trust significantly impact brand loyalty through brand love and commitment. Similarly, Fatma and Khan (2023) examine the influence of perceived corporate social responsibility (CSR) on brand loyalty in the banking industry. Their research highlights the indirect relationship between CSR and brand loyalty through brand credibility and brand identification, emphasizing the importance of CSR activities in building and maintaining brand loyalty.

2.3.3. Perceived Quality

Riva et al. (2022) investigate the impact of green perceived quality on restaurant revisit intentions among millennials, emphasizing the role of environmental sustainability in shaping consumer behavior. Koh, Burnasheva, and Suh (2022) examine how consumers' perceptions of environmental, social, and governance initiatives impact brand credibility, image, and perceived quality. Their findings suggest that social and governance dimensions positively influence brand-related constructs, enhancing overall brand perception.

Another study by Tran et al. (2022) investigates value co-creation through branded apps, focusing on how consumer brand engagement enhances perceived quality and brand loyalty. The results suggest that branded app personalization drives brand co-creation, which increases perceived quality and brand loyalty among users.

2.3.4. Brand Associations

Williams et al. (2023) explore how consumer-generated online product reviews serve as a source of brand associations in the sport setting. They find that positive product reviews are highly linked to performance and product-related attributes, while negative reviews are associated with conformance associations. Similarly, Henderson et al. (2023) identify the concept of compound brands, where brand associations are multi-created by the focal brand entity, tenants, and ancillary entities, such as airports and shopping malls.

Henderson et al. (2023) identify a new type of brand concept termed "compound brands," where brand associations are multi-created by the focal brand entity, tenants, and ancillary entities. Their study of airports and shopping malls demonstrates that these compound brand association structures significantly impact consumer brand choice.

2.3.5. Instagram Usage

Instagram is a powerful social media platform for marketing due to its visual nature and extensive user base. Studies have shown that Instagram can significantly enhance brand visibility and engagement (Roth & Zawadzki, 2018). For instance, the platform's ability to foster direct and immediate feedback makes it an ideal tool for small businesses aiming to convert casual browsers into loyal customers (Roth & Zawadzki, 2018).

The strategy of Instagram marketing and implementation of competitive design packaging at SMEs Guriyana Baker is another example of how small businesses can leverage Instagram for marketing (Mohammad & Widhaningrat, 2021). This study emphasizes the importance of business coaching in developing digital marketing strategies.

2.3.6. Case Study

Several studies have demonstrated the effectiveness of Instagram in promoting small businesses. For example, Kezia Callista's study on Keka Catering highlighted the importance of utilizing Instagram effectively to increase brand awareness and reach a broader audience (Callista, 2021). Similarly, Nur Azizah et al. (2020) emphasized the role of strategic communication on Instagram in enhancing brand awareness for Waroeng SS.

The study by Sukunesan et al. (2020) explores how small and medium enterprises (SMEs) can use Instagram for internationalization, highlighting the platform's role in brand communication and cultural awareness. Another study by Harun and Tajudeen (2020) investigates the adoption of Instagram among Malaysian SMEs, emphasizing the platform's visual approach as a significant factor in its effectiveness.

2.4 Summary

In this literature review, it reviews " Optimizing Brand Awareness for Small Businesses in the Digital Age: A Case Study of D-Kampung Coffee at Albukhary International University " provides a comprehensive review of how small businesses can take advantage of digital marketing tools. How to increase brand awareness? This study combines theory from brand equity. Digital marketing and small business management to build a strong theoretical framework. Key concepts include brand awareness; digital marketing tools and challenges of small businesses focusing on the use of social media platforms such as Instagram, empirical studies highlight the importance of engagement on social media. Especially through visual platforms. To increase brand visibility and consumer interaction. The Resource-Based View (RBV) and Dynamic Capabilities Framework highlight how small businesses can leverage unique resources and adapt to a rapidly changing environment for competitive advantage. The case studies within this review demonstrate the effectiveness of strategic Instagram usage in increasing brand visibility. Customer participation and overall business growth. This analysis not only addresses gaps in current research; but it also provides practical insights for small businesses aiming to use digital marketing tools effectively.

3 METHODOLOGY

3.1 Introduction

This chapter presents the research methodology utilized in this study, which examines strategies for enhancing brand awareness for small businesses in the digital age, with a focus on D-Kampung Coffee at Albukhary International University. The methodology chapter provides a detailed explanation of the research design, data collection methods, and analysis procedures employed to achieve the research objectives. The subsequent sections of this chapter will elaborate on the research design, including the rationale for choosing a qualitative approach, the sampling strategy, and the procedures for data collection and analysis. These sections aim to provide a comprehensive understanding of how the study was conducted and to ensure the rigor and credibility of the research findings.

3.2 Research Design

In this section, the researcher will address on the research design adopted in the study. A research design is a plan for conducting a study and outlining the steps necessary to obtain the information needed to answer a research question or test a hypothesis (Creswell, 2014). The research design is a logical plan for getting from here to there, where 'here' may be defined as an initial set of questions to be answered and 'there' some set of conclusions (answers) about these questions (Yin, 2009). Therefore, it is a comprehensive framework or blueprint for conducting research. It outlines the methods and procedures for collecting, analyzing, and interpreting data. The choice of research design significantly impacts the validity and reliability of the findings.

3.2.1 Qualitative Approach

The qualitative research design for this study is framed as an exploratory case study. The justification for adopting qualitative research design is because “this is ideal for deepening the understanding of the social and contextual elements that influence brand awareness within small businesses in the digital age” (Yin, 2018). This design allows for in-depth exploration of real-life context. Thus it provides the insights needed to effectively manage research objectives.

3.2.2 Case Study

Zonabend (1992) states that case study research is done by paying special attention to the complexity of observing, reconstructing, and analyzing cases under study (Amaratunga & Baldry, 2001). All case study research begins with a compelling feature: the aim is to gain a close or in-depth understanding of a single or small number of “cases" situated in a real-world context. This intimacy aims to create a valuable and profound understanding. It provides a deeper appreciation of “cases" and leads to new insights. It is about real-world behavior and the importance of that behavior. Therefore, the uniqueness of a case study is a concise definition (Yin, 2012). In this study, the case study focuses on D-Kampung Coffee, a small business located at Albukhary International University. It allows for a comprehensive exploration of real-world practices related to brand awareness within the context of a university environment.

3.3 Sampling Technique

Sampling techniques are methods used to select individuals or groups from a larger population to participate in a study. The purpose of sampling is to obtain a representative subset of the population that can provide insights and data pertinent to the research objectives. In this study, a purposive sampling technique was employed, which is a type of non-probability sampling. Purposive sampling involves the deliberate selection of participants based on specific characteristics and criteria relevant to the research questions (Palinkas et al., 2015). This technique ensures that the selected participants are those most likely to provide rich, relevant, and detailed information.

3.3.1 Population

This research, cantered on D-Kampung Coffee located within Albukhary International University, used strategic purposive sampling to collect data from a carefully selected group of participants (Campbell et al., 2020). This method is extremely effective in ensuring that the data collected comes from people who are deeply engaged or significantly impacted by a brand's digital marketing strategy. The researcher decided on three groups and they are D-Kampung regular customers, D-Kampung Staff, and the community nearby.

3.3.2 Sample

In this study, the participants were selected based on their relevance to the research objectives and their involvement with D-Kampung Coffee's brand awareness strategies.

Table 3.1 Sample Size

Number	Group of Participant	Sample Size
1	Regular Customer	10
2	D-Kampung Coffee Staff	3
3	AIU Community	5
	Total	18

Determining the appropriate sample size in qualitative research is a critical aspect that ensures the study's depth and richness of data. As such, the sample size in qualitative studies is often smaller but must be sufficient to reach data saturation. Data saturation occurs when additional data collection no longer yields new insights or information relevant to the research questions. Reaching saturation ensures that the collected data is comprehensive enough to understand the phenomena under study fully (Fusch & Ness, 2015). The concept of data saturation is pivotal in qualitative research and guides the determination of sample size.

3.4 Data Collection

In the present study, the researcher collected the data using semi-structured interview techniques. Face-to-face interviewing was conducted with the sample identified. The interview was transcribed and then the researcher identified the main and sub-themes from the transcripts. Finally, the researcher identified the participant's expectations which are related to the main and sub-themes.

3.5 Instrumentation

The qualitative questions were designed to align with the objective of the study with different types of qualitative questions. Namely, brand awareness, brand loyalty, perceived quality, brand associations, and general questions. These questions helped to gain insight on how D-Kampung Coffee utilized the strategies used running their business.

3.5.1. Interview Questions on Brand Awareness

Table 3.2 Demographic questions contained in the interview questions.

No	Interview Questions
1	Can you describe how you first became aware of the D-Kampung Coffee brand?
2	What online platforms do you see D-Kampung Coffee most actively engaging on? How do these platforms affect your perception of the D-Kampung brand?
3	How frequently do you encounter D-Kampung Coffee's marketing content online? Can you recall any specific content that stood out to you?

First and foremost, the first section of interview questions aimed to examine research question 1. As questions 1-3 are aimed directly at understanding how consumers first become aware of the D-Kampung Coffee brand. The most effective platform to attract them and the frequency and impact of brand marketing content. These insights are critical in assessing the visibility and initial impact of a brand's digital presence.

Interview Questions on Brand Loyalty

Table 3.3 Demographic questions contained in the interview questions

No	Interview Questions
1	What factors contribute to your continued choice of D-Kampung Coffee over other coffee brands?
2	Have you recommended D-Kampung Coffee to others? If so, what were the main reasons you gave for recommending it?
3	Can you share any experiences that led you to become a loyal customer of D-Kampung Coffee?

Interview Questions on General

Table 3.4 Demographic questions contained in the interview questions.

No	Interview Questions
1	How do you generally interact with D-Kampung Coffee's digital content? (e.g., liking, sharing, commenting)

2	Have there been any memorable digital campaigns by D-Kampung Coffee that influenced your perception of the brand?
3	How well do you think D-Kampung Coffee understands and meets the needs of its customers through its digital channels?

The second part of your interview question which focuses on brand loyalty. It goes in-depth in understanding the challenges D-Kampung Coffee faces in maintaining customer engagement and retention which is based on research question 2. These questions are critical in identifying specific issues related to customer experiences and perceptions of a brand over time. By exploring what factors make them continually like D-Kampung Coffee, and why would they recommend this coffee to others. Moreover, by asking customers to share personal experiences that influence their loyalty, the researcher will be able to uncover valuable insights into the effectiveness of your current engagement strategies. It will give the researcher a deeper understanding of the emotional and practical connection they have with the brand. This can highlight potential areas for improvement in building stronger relationships with customers. Guaranteed consistent participation and effective use of digital marketing tools to increase customer satisfaction, and loyalty such insights are instrumental in addressing the broader challenge of retaining customers in a highly competitive digital marketplace.

Interview Questions on Perceived Quality

Table 3.5 Demographic questions contained in the interview questions

No	Interview Questions
1	Based on rating 1-5 how would you rate the quality of D-Kampung Coffee's products compared to other similar products you have tried?
2	In what ways has your perception of D-Kampung Coffee's quality been influenced by D-Kampung's digital marketing or social media presence?
3	Are there specific attributes of D-Kampung Coffee that you associate with high or low quality?

Interview Questions on Brand Associations'

Table 3.6 Demographic questions contained in the interview questions

No	Interview Questions
1	What are the first words or ideas that come to mind when you think of D-Kampung Coffee?
2	How do you think D-Kampung Coffee positions itself in the market through its digital marketing?
3	Are there particular emotions or values you associate with D-Kampung Coffee based on their online presence?

The final section of the interview questions was designed to answer research question number 3, focusing on how digital marketing influences customers' perceptions of D-Kampung Coffee's quality, and emotional or value-based connections with the brand. Questions in category "Perceived Quality" and "Brand Association" dive into how customer perceptions and associations are shaped by their

digital interactions with brands. These insights are critical to understanding the role digital marketing tools play in increasing brand awareness. With a batter evaluating the influence of digital content on customer opinions about product quality, and the emotional resonance of the brand. This section helps explain the effectiveness of digital marketing strategies in creating and maintaining a strong brand identity in a competitive market.

3.6 Data Analysis

For qualitative research on D-Kampung Coffee's digital marketing strategy, the data analysis section was designed to reveal insights from the interviews. This method is particularly useful for exploring complex phenomena in-depth and understanding the intricacies of human experiences. Below is an account of how thematic analysis can be conducted in a qualitative study.

3.6.1 Thematic Content Analysis

Thematic analysis (TA) is a widely used qualitative research method for identifying, analysing, and reporting patterns (themes) within data. Braun and Clarke (2006) described it as a fundamental method for qualitative analysis. It provides flexibility and access across disciplines. It will provide details about the information. It allows for both broad and in-depth analysis. TA involves several steps: Familiarizing yourself with the data. Creating initial code, finding themes, reviewing themes, defining and naming themes. And the creation of a final report (Braun & Clarke, 2006). Its flexibility allows it to be used within different paradigms. This makes it suitable for both inductive and deductive approaches (Braun & Clarke, 2006).

For research topics “Brand Awareness Enhancement for Small Businesses in the Digital Age: A Case Study of D-Kampung Coffee at Albukhary International University” The thematic analysis analysed data collected through interviews. This guide will reveal strategies, and challenges for increasing brand awareness for small businesses in the digital age. The process begins with getting acquainted. Where the data is copied and verified. Initial codes are generated to identify key features relevant to the brand awareness strategy. These codes are organized into possible themes, such as digital marketing strategies. Customer participation brand awareness and challenges in the digital landscape

Themes are reviewed and refined to ensure they accurately represent the data. Each topic is clearly defined to convey its essence and relevance to the study. Flexibility of thematic analysis Even though it's strong However, clear guidelines (Braun & Clarke, 2006; Nowell et al., 2017) enhance methodological rigor.

Thematic analysis is a versatile, and detailed method for qualitative research. Application to the D-Kampung Coffee case study provides valuable insights into brand awareness strategies for small businesses. This helps provide a broader understanding of effective digital marketing practices.

3.6.2. Familiarization with the Data

The first step in thematic analysis involves immersing oneself in the data to become thoroughly familiar with the content. This includes reading and re-reading the data, listening to recordings, and making notes of initial impressions. This stage is crucial for gaining a deep understanding of the material.

3.6.3. Generating Initial Codes

After familiarizing with the data, the next step is to generate initial codes. Coding involves identifying segments of data that are relevant to the research question and labelling them with codes. Codes are essentially labels that identify key features of the data that are potentially relevant to the research questions. This process helps in organizing the data into meaningful groups.

3.6.4. Searching for Themes

Once initial codes have been generated, the next step is to search for themes. A theme is a coherent and meaningful pattern in the data that is relevant to the research question. This involves sorting different codes into potential themes and collating all the relevant coded data extracts within the

identified themes. At this stage, the researcher starts to analyse the codes and consider how they may combine to form an overarching theme.

3.6.5. Reviewing Themes

In this phase, the themes are reviewed and refined. This process involves two levels: reviewing the themes at the level of the coded data extracts and reviewing the themes in relation to the entire data set. Themes that do not have enough supporting data or those that are too diverse are either discarded, collapsed into each other, or separated into distinct themes.

3.6.6. Defining and Naming Themes

After refining the themes, the next step is to define and name them. This involves identifying the essence of each theme and determining what aspect of the data each theme captures. Researchers then need to write a detailed analysis of each theme and consider how it relates to the research questions and other themes. Names should be concise, clear, and immediately give the reader a sense of what the theme is about.

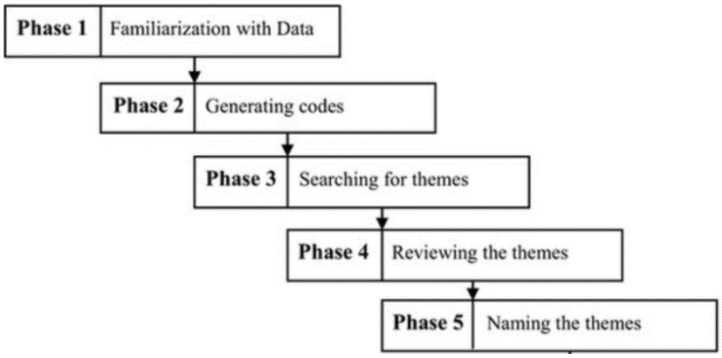


Figure 3.7 Phases of Data Analysis

3.7 Summary

Chapter 3 of the thesis describes in detail the qualitative methods used to investigate the brand awareness strategy for D-Kampong Coffee within Albukhary International University. This chapter begins by providing details about the research design. It emphasizes an exploratory case study approach that emphasizes qualitative data to explore the depth and complexity of digital marketing strategies. A comprehensive discussion will follow on the purposive sampling techniques used to select the 20 participants to ensure they accurately represent the brand's diverse consumer base. This selection process is critical in aligning research objectives with the target population. This enhances both the validity and applicability of the study's findings.

Additionally, this chapter meticulously outlines the data collection process. This included in-depth interviews with carefully selected participants. This approach provides a deep understanding of participant interactions and perceptions of a brand's digital marketing efforts. The data management section discusses protocols for secure data storage and management to maintain participant confidentiality and data integrity.

4 FINDING AND DISCUSSION

4.1 Introduction

This chapter presents the findings from the data analysis conducted for this study. It aims to explore the brand awareness strategies of small businesses. Focusing specifically on D-Kampong coffee at Albukhary International University, data was analysed using thematic analysis to separate and categorize relevant themes. The findings are organized around research questions (RQs) and provide a comprehensive understanding of the brand awareness strategies used by D-Kampung Coffee. This

chapter is intended to introduce the thematic content analysis methods used. Then, the results are presented according to each research question, and finally discuss these findings in relation to the existing literature in chapter 2.

4.2 Findings

The findings of this study are presented according to the research questions. The data was analyzed to extract themes related to each research question. It provides a comprehensive understanding of the brand awareness strategies used by D-Kampung Coffee.

4.2.1 What are the current brand awareness levels of small businesses in Alor Setar, Kedah, Malaysia, and how do they differ within the digital landscape?

The theme identified from the findings related to this research question is the role of digital platforms.

4.2.1.1 Theme 1: Role of Digital Platforms

Under this theme there are two important sub themes are (a) importance of digital platform and (b) impact of digital tools. The excerpts from the participants that is related to the theme will be extracted.

Importance of Digital Platforms

Data indicates that digital platforms play an important role in increasing brand awareness for small businesses such as D-Kampung Coffee. Participants frequently mentioned the use of social media, especially Instagram, as a tool. Important to reach a wide audience and engage with customers. This reflects the centrality of digital platforms in modern marketing strategies for small businesses.

I think Instagram is the main platform where I see D-Kampung Coffee most actively engaging. Their posts and stories really capture my attention and make me want to visit the café. The way they use Instagram to showcase their daily specials and customer interactions makes me feel more connected to the brand. I often see their posts being shared by friends, which helps in spreading awareness among a larger group (CC1 AIU Community).

I frequently see D-Kampung Coffee engaging on Instagram. Their presence on these platforms, with high-quality photos and engaging posts, makes me perceive D-Kampung Coffee as a modern, customer-focused, and innovative brand (CS1 - D-Kampung Staff).

These quotes highlight the power of Instagram in building brand visibility and customer engagement. The visual and interactive nature of Instagram posts and stories plays a key role in attracting and retaining customers' attention.

Impact of Digital Tools

Highlights the effectiveness of various digital marketing tools such as social media campaigns, online advertising, and influencer collaboration. These tools play a huge role in increasing brand visibility and consumer engagement. Participants noted that these tools not only help spread the word; But it also helps create a trend for the brand.

The social media campaigns they run, especially the ones with influencers, really help in spreading the word. I often see posts from people I follow talking about D-Kampung Coffee. Their online ads are very eye-catching and often have promotional offers that attract me to check out their page. Collaborations with local influencers have definitely

put D-Kampung Coffee on the map for many people in the area (CS1 - D-Kampung Staff).

Their online ads are very eye-catching and often have promotional offers that attract me to check out their page (CJ9 - Regular Customer).

These messages highlight the importance of various digital tools in increasing brand awareness. Influencer collaboration and engaging social media campaigns are especially effective at reaching a broad audience and building a strong brand presence.

4.2.2 What are the primary challenges faced by small businesses in establishing and maintaining brand awareness in the digital era, considering the specific industry and location factors?
The theme identify from the finding related to this research question is challenges in brand awareness.

4.2.2.1 Theme 2: Challenges in Brand Awareness

Two sub themes related to this main theme are (a) Challenges in Digital Marketing and (b) Brand Challenges.

Challenges in Digital Marketing
Despite the advantages of digital platforms but even small businesses like D-Kampung Coffee face many challenges. Limited financial resources and digital marketing expertise are key barriers. Participants expressed difficulties in consistently producing high quality content and managing multiple digital channels. This reflects the broader resource constraint issue that many small businesses face.

It's not easy for a small business like ours to keep up with the content demands. We don't have the budget to hire a full-time social media manager, so we often struggle to maintain our online presence. Creating content that stands out is time-consuming, and we don't always have the resources to do it as often as we'd like. We sometimes have to prioritize other aspects of the business over our digital marketing efforts because of limited manpower (CJ10 - Regular Customer).

The digital landscape is always changing. Keeping up with new trends and technologies is challenging, especially when we have limited resources. It's hard to stay relevant all the time. We need to constantly update our strategies to match what's trending, and that can be quite demanding. Staying consistent with our brand message across all platforms is difficult when we're also trying to keep up with new digital marketing trends (CJ9 - Regular Customer).

These quotations highlight specific issues that D-Kampung Coffee faces, such as financial constraints. The time-consuming nature of content creation and the need to balance digital marketing with other business operations. These challenges make it difficult for small businesses to consistently produce high-quality content and maintain a strong online presence.

Branding Challenges
Maintaining a consistent brand image and remaining relevant in a rapidly changing digital landscape are also important challenges. Participants noted that adapting to new trends and technology It takes continuous effort and investment. This can be taxing for small businesses.

The digital landscape is always changing. Keeping up with new trends and technologies is challenging, especially when we have limited resources. It's hard to stay relevant all the time. We need to constantly update our strategies to match what's trending, and that can be quite demanding. Staying consistent with our brand message

across all platforms is difficult when we're also trying to keep up with new digital marketing trends (CJ9 - Regular Customer).

Maintaining a consistent brand image and remaining relevant in a rapidly changing digital landscape is tough. We need to continuously adapt to new trends and invest in new technologies, which can be quite taxing given our limited resources (CJ4 - Regular Customer).

These repond highlight the difficulty of maintaining consistency and relevance in the face of changing digital marketing trends. The need to continually adjust strategies to reflect current trends adds another layer of complexity for small businesses already constrained by limited resources.

4.2.3 How do digital marketing tools, including social media platforms, influence brand awareness for small businesses, and what are the key factors that contribute to their effectiveness?

The theme constructed to answer the research question is assessing brand awareness.

4.2.3.1 Theme 3: Assessing Brand Awareness

Two sub themes related identified are (a) Brand Awareness Assessments and (b) Key Factors for Effectiveness

Brand Awareness Assessments

Studies have shown that regular brand awareness assessments are critical to understanding the effectiveness of digital marketing strategies. Measurements such as social media engagement website traffic and feedback from customers it is often used to measure brand awareness. Participants emphasized the importance of these indicators in guiding their marketing strategies.

We track our social media engagement and website traffic regularly. Customer feedback also helps us understand how well our brand is recognized and perceived. Using analytics tools to measure our online presence gives us insights into what works and what doesn't. Feedback from our customers, both online and in-person, is invaluable in helping us improve our brand visibility (CJ8 - Regular Customer).

Creating visually appealing content and interactive campaigns has been very effective for us. We try to tailor our posts to what our customers like and engage with the most. Interactive content, such as polls and quizzes on social media, keeps our audience engaged and coming back for more. Personalized interactions with customers, like responding to comments and messages, help build a stronger connection with our audience (CC2 AIU Community).

These statements emphasize the role of data and feedback in evaluating brand performance. By tracking engagement and traffic, D-Kampung Coffee can make informed decisions about its marketing strategy and identify areas for improvement.

Key Factors for Effectiveness

The success of digital marketing can be attributed to many factors. Including the use of eye-catching content. Interactive campaigns and personalized customer interactions Participants emphasized the importance of understanding customer needs and tailoring content accordingly.

Creating visually appealing content and interactive campaigns has been very effective for us. We try to tailor our posts to what our customers like and engage with the most. Interactive content, such as polls and quizzes on social media, keeps our audience

engaged and coming back for more. Personalized interactions with customers, like responding to comments and messages, help build a stronger connection with our audience (CC2 - AIU Cummunity).

Their online ads are very eye-catching and often have promotional offers that attract me to check out their page. Collaborations with local influencers have definitely put D-Kampung Coffee on the map for many people in the area. (CS1 - D-Kampung Staff).

These insights highlight the importance of customer-centric content in digital marketing. By focusing on visually appealing and interactive content, D-Kampung Coffee can engage their audience more effectively and foster stronger connections with their customers.

4.3 Discussion on Findings related to Literature Review

The findings from this study are consistent with existing literature on digital marketing and brand awareness for small businesses. This section discusses the themes identified in the findings in relation to the literature reviewed in Chapter 2.

4.3.1. Theme 1: Role of Digital Platforms

The transformative potential of digital platforms especially social media platforms like Instagram for small businesses. This has been well documented in research. These platforms have proven to be essential in increasing brand visibility. Customer participation and overall brand awareness for small businesses, such as D-Kampung Coffee at Albukhary International University.

This present finding is supported by previous literature review are done by Daiz et. al (2021) and Aprilianti, Rastini, and Rahanatha (2023). Diaz and colleagues (2021) highlight that digital platforms provide unprecedented opportunities for small businesses to expand. Brand presence and engagement with diverse audiences. Aprilianti, Rastini, and Rahanatha (2023) also examined the role of brand awareness in mediating the influence of social media marketing on purchase intentions. It emphasizes the importance of interactive content and engaging campaigns on platforms like Instagram. Guzmán and colleagues (2019) highlight the increasing importance of digital technologies for small businesses. It emphasizes the need for empirical studies to explore effective brand management in the digital context.

The findings from in this study support these view. Especially, research conducted on D-Kampung Coffee at Albukhary International University shows how platforms like Instagram play a key role in increasing brand visibility. Participants frequently mentioned the importance of Instagram in reaching a broad audience and engaging with customers. For example, participant CC1 noted: "I think Instagram is the main platform where I see D-Kampung Coffee most actively engaging. Their posts and stories really captured my attention and made me want to visit the café. The way they use Instagram to showcase their daily specials and customer interactions makes me feel more connected to the brand." Moreover, CS1 participants also highlighted the effectiveness of digital tools, stating: "I frequently see D-Kampung Coffee engaging on Instagram. Their presence on these platforms, with high-quality photos and engaging posts, makes me perceive D-Kampung Coffee as a modern, customer-focused, and innovative brand."

These examples show that digital platforms are helping small businesses like D-Kampung Coffee reach a wider audience. Engage with customers in real time and create a more personal relationship with the target audience.

4.3.2. Theme 2: Challenges in Brand Awareness

Despite the advantages of digital platforms but small businesses like D-Kampung Coffee at Albukhary International University face significant challenges in building and maintaining brand awareness. These challenges are multifaceted. Covers limited financial resources Lack of digital marketing expertise and the need to remain relevant amid rapidly changing digital trends.

This present finding based on challenges that small businesses face in digital marketing have been supported, and extensively discussed by Smith and Johnson (2019) and Jones et al. (2020). These studies noted that small businesses often struggle with resources. Limited finances and expertise to

effectively leverage digital tools. In addition to Napoli (2006) and Wong and Merrilees (2008), they have expressed concern about the paucity of marketing materials related to brand management within small businesses. This gap is even more relevant today. It emphasizes the need for small businesses to develop strategic approaches to overcome these challenges. Moreover, Studies by Sirkeci, Dahl, and Zeyneloğlu (2022) and Aprilianti, Rastini, and Rahanatha (2023) show that social media advertising has a strong influence on consumer decisions and brand awareness. These findings highlight the importance of interactive content and engaging campaigns on platforms like Instagram in building brand awareness and engagement.

This study provides a specific example in the context of D-Kampung Coffee, showing how these constraints affect its ability to maintain a consistent online presence and produce high quality content. Additionally, the rapidly evolving digital landscape requires continuous adaptation. This may be just what a small business with limited resources needs. The findings highlight the need for small businesses to develop strategic approaches to overcome these challenges, such as prioritizing certain digital marketing activities over others and seeking the right tools and training to enhance your digital marketing capabilities.

4.3.3. Theme 3: Assessing Brand Awareness

Regularly evaluating brand awareness is essential for understanding the effectiveness of digital marketing strategies used by small businesses, such as D-Kampung Coffee at Albukhary International University. This theme explores the methods used to measure brand awareness. Brand awareness, such as social media engagement website traffic and feedback from customers and identify key factors that contribute to the success of these strategies.

The importance of consistently evaluating brand perceptions is supported, and highlighted in the theoretical frameworks proposed by Aaker (1991) and Keller (1993). These frameworks emphasize the need to continually examine brand equity components. Farjam & Hongyi (2015) expand the concept of Customer-Based Brand Equity (CBBE), which focuses on the differential impact of brand knowledge on consumer response to marketing activities, positive CBBE can lead to long-term revenue generation. Customer loyalty and effective marketing communication. Furthermore, Napoli (2006) and Wong and Merrilees (2008) expressed concern about the lack of marketing materials related to brand management within small businesses. It emphasizes the need for a strategic approach to overcome these challenges. To understand the effectiveness of brand building strategies. The findings of this study highlight the practical application of these assessments through metrics such as social media engagement. Website traffic and feedback from customers. By evaluating these indicators regularly Small businesses can gain insights into brand performance and make informed decisions to increase their brand awareness. The findings suggest that adopting a systematic brand awareness assessment approach can help small businesses identify successful strategies and areas for improvement. This will help promote a more effective and sustainable brand presence in the digital market.

4.4 Summary

This chapter presents the findings from the data analysis. Sorted by research question and related topic. The study used thematic analysis to identify important issues, such as the importance of digital platforms. Brand awareness challenges and the effectiveness of brand awareness assessments. The findings highlight the important role digital tools play in increasing brand visibility for small businesses. The challenges they face in maintaining a consistent online presence and the importance of regular assessments to guide their marketing strategies. These insights provide a comprehensive understanding of the brand awareness strategies used by D-Kampung Coffee and offer practical implications for other small businesses in a similar context. The next chapter will summarize the study, summary of main research findings, discuss the consequences, and suggest areas for future research.

5 SUMMARY AND RECOMMENDATION

5.1 Introduction

This chapter aims to summarize the main points of research carried out in "Optimizing Brand Awareness for Small Businesses in the Digital Era: A Case Study of D-Kampung Coffee at Albukhary

International University." This chapter dives deeper into summarizing the key findings from each chapter. It provides a comprehensive discussion of these findings in relation to the existing literature, and interpretation of its implications. Additionally, this chapter discusses limitations encountered during the research and offers suggestions for future studies to build on the work presented.

5.2 Key Findings

In this section, the researcher summarises the key findings of the study, which explores the effectiveness of digital marketing strategies in increasing brand awareness for small businesses. Focusing specifically on D-Kampung coffee at Albukhary International University, findings were categorized according to research questions at the start of the study. It provides a comprehensive overview of the results obtained through qualitative analysis.

The first research question explores the current brand awareness levels of small businesses in Alor Setar, Kedah, Malaysia and how these levels vary within the digital landscape. Research indicates that digital platforms, especially Instagram, play a key role in increasing brand awareness for small businesses, such as D-Kampung Coffee. Instagram's visual and interactive nature allows businesses to engage with a broad audience. Effectively this makes it a powerful tool for building and maintaining brand visibility. Participants frequently mentioned the importance of high-quality photos and engaging posts. This helps in attracting and retaining the attention of customers.

In addition, the study found that using stories Daily specials and interacting with customers on Instagram significantly helps build a sense of connection and loyalty among customers. The ability to share posts and stories increases brand visibility. Reach a larger audience through word of mouth and peer recommendations. This reflects the centrality of digital platforms in modern marketing strategies for small businesses. This allows them to be more competitive with larger corporations.

The second research question addresses the main challenges small businesses face in creating and maintaining brand awareness in the digital age. It considers specific industry and location factors. The study identified several key challenges. Including limited financial resources Lack of digital marketing expertise and the time-consuming nature of creating content small businesses like D-Kampung Coffee often struggle to produce high quality content consistently. And having to manage multiple digital channels because of these limitations.

Participants emphasized that the rapidly evolving digital landscape requires continuous adaptation to new trends and technologies. This may be just what a small business with limited resources needs. The need to balance digital marketing efforts with other business operations this makes the process more complicated. This makes it difficult to maintain a strong online presence. Add to that the pressure to remain relevant, and consistent with brand messaging across platforms. It adds another layer of complexity to your digital marketing strategy for small businesses.

The third research question examined whether digital marketing tools including social media platforms how does it influence brand awareness for small businesses? And identify important factors that contribute to effectiveness. Study finds digital marketing tools Social media platforms in particular, such as Instagram, have a huge influence on brand awareness. The effectiveness of these tools comes from the use of visually appealing content. Interactive campaigns and personalized customer interactions.

Participants emphasized the importance of regularly evaluating brand awareness through social media engagement measurement. Website traffic and feedback from customers these indicators are critical in guiding your marketing strategy and identifying areas for improvement. The study also highlighted the creation of interactive content such as surveys and quizzes. And engaging directly with customers through comments and messages. It will help you build a stronger relationship with your audience. Personal interactions and content tailored to customer needs have been found to be extremely effective in promoting customer loyalty and increasing brand visibility.

The findings from this study are consistent with existing literature on digital marketing and brand awareness for small businesses. The study confirms the transformative potential of social media in increasing brand visibility and customer engagement, as highlighted by Diaz et al. (2021) and Aprilianti et al. (2023). The role of digital platforms, especially Instagram, in reaching a wide audience and engaging customers is well documented in this report. This study adds to the body of knowledge by providing empirical evidence from the context of kampung coffee.

Challenges identified in the study include resource constraints and a rapidly changing digital landscape. Echoing the concerns of Smith and Johnson (2019) and Jones et al. (2020), these studies noted that small businesses often face limited financial and expertise challenges to effectively leverage digital tools. The findings from this study highlight the need for small businesses to develop strategic approaches to overcome these challenges, such as investing in digital marketing expertise and following the latest trends.

The theoretical framework based on Aaker's brand value model helps to understand how digital marketing strategies affect brand value dimensions for D-Kampung Coffee. Studies have shown that brand loyalty perception of quality and brand associations are heavily influenced by a business's digital marketing efforts. These findings support the view that a strong digital presence and effective use of social media platforms can enhance brand equity for small businesses.

5.3 Implications

This section, researcher discuss the implications of the study results for both theory, and practice. Theoretical implications indicate how the research contributes to the existing academic literature on brand awareness and digital marketing for small businesses. On the other hand, practical Implications offers actionable advice for small business owners and marketers. It highlights strategies that can be used to improve brand visibility and engagement in the digital world.

5.3.1 Theoretical Implications

This research contributes to academic literature by identifying gaps related to brand management in small businesses within a digital context. This study offers new insights. about how small businesses can increase their brand awareness By integrating Aaker's brand value model into digital marketing strategies. These findings provide empirical evidence supporting the theoretical construct of brand loyalty. Perceived quality and brand affinity in the context of digital marketing for small businesses.

The study also emphasizes the importance of considering industry and location-specific factors in brand management strategies. The case study of D-Kampung Coffee at Albukhary International University provides a detailed understanding of how to optimize digital marketing strategies to Tailored to the unique needs and constraints of small businesses operating in a specific geographic and institutional context.

5.3.2 Practical Implications

For small business owners and marketers, the study has several helpful recommendations: First, small businesses should leverage interactive and visually appealing content on social media platforms to effectively engage customers. High quality pictures interesting post and interactive stories can greatly improve brand visibility and customer engagement.

Second, brand awareness is regularly assessed through social media engagement measurement. Website traffic and customer feedback is important. These indicators provide valuable insights into the effectiveness of your digital marketing strategy. And help identify areas that need improvement. Small businesses should invest in digital marketing expertise to interpret these indicators and adjust their strategies accordingly.

Finally, personal interactions with customers and customized content are critical to building strong relationships and fostering customer loyalty. Small businesses should engage with their audience through comments, messages, and interactive content like polls and quizzes. This approach helps create a more personal relationship with customers. Improve the overall experience and increase brand loyalty. Furthermore, small businesses should consider partnering with local influencers to expand their reach and increase brand visibility. Influencer marketing can be especially effective at targeting specific demographics. And create authentic testimonials that resonate with potential customers. By leveraging the credibility and influence of local people. Small businesses can increase their brand reputation and attract a wider audience.

Additionally, it is important for small businesses to keep up with the latest digital marketing trends and continually innovate their strategies. This includes experimenting with new features and tools. That are offered by social media platforms like Instagram Reels and IGTV to create engaging and dynamic content. By staying ahead and adapting to evolving digital trends. Small businesses can

maintain their competitive advantage and ensure that their marketing efforts remain relevant and effective.

5.4 Conclusion

This research presents a comprehensive examination of brand awareness strategies for small businesses in the digital age, using D-Kampung coffee as a case study. These findings highlight the important role digital platforms, especially Instagram, play in increasing brand visibility and engagement. This is despite the challenges of limited resources and the need for continuous adaptation. Small businesses can also greatly benefit from strategic digital marketing efforts.

This study contributes to the academic literature by identifying a gap in understanding brand management for small businesses within a digital context. It also offers helpful tips for small business owners and marketers to effectively leverage digital marketing tools. Conduct regular assessments and engage with customers through personalized interactions. By using these strategies, small businesses can increase brand awareness. Build strong customer relationships and achieve sustainable growth in a competitive digital environment.

5.5 Recommendation for Future Research

Future research should explore the following areas:

Expand the study to include a variety of small businesses in various geographic locations. This will help validate the findings and provide a broader understanding of brand awareness strategies in different contexts.

Examine the long-term impact of digital marketing strategies on brand awareness and business growth. Long-term studies can provide valuable insights into the sustainability and effectiveness of different digital marketing approaches. As time passes.

Examines the role of emerging digital technologies such as artificial intelligence and augmented reality. To increase brand awareness for small businesses Understanding how these technologies can be integrated into marketing strategies can provide new opportunities. For small businesses to make a difference and engage with customers in creative ways.

Explore the impact of customer demographics such as age, gender, and cultural background. On the effectiveness of digital marketing strategies this helps small businesses tailor their marketing efforts to specific audiences. This ensures that their content is more relevant and effective to different customer bases.

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Hospitality Inclusive Program (HIP) Langkawi: Satu Kajian Konseptual Model Kolaborasi Pendidikan, Industri dan Komuniti dalam Meningkatkan Kebolehpasaran Pelajar Berkeperluan Khas

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ABSTRAK

Kajian ini meneroka pelaksanaan Hospitality Inclusive Programme (HIP) Langkawi sebagai inisiatif latihan teknikal dan vokasional inklusif untuk pelajar Program Pendidikan Khas Integrasi (PPKI). HIP melibatkan kolaborasi strategik antara Pejabat Pendidikan Daerah Langkawi, Langkawi Tourism Academy @ Kolej Komuniti Langkawi, dan The Westin Langkawi Resort & Spa. Pelajar mengikuti latihan teori dan praktikal di kolej sebelum menjalani penempatan industri sebenar selama 14 hari. Kajian ini menggunakan pendekatan konseptual melalui analisis dokumen, literatur, dan pemerhatian lapangan awal. HIP dibandingkan dengan model latihan inklusif antarabangsa seperti Project SEARCH (UK) dan Ticket to Work (Australia). Dapatan awal menunjukkan peningkatan kemahiran teknikal dan sosial pelajar, serta penglibatan aktif mentor industri. Kajian mencadangkan satu kerangka kolaboratif tiga pihak dan sistem penilaian mesra inklusif bagi memperkukuh pelaksanaan HIP. Kajian ini turut mencadangkan pelaksanaan kajian empirikal lanjutan bagi mengesahkan keberkesanan HIP secara lebih menyeluruh.

KATA KUNCI: latihan vokasional inklusif; PPKI; kolej komuniti; TVET

1 PENGENALAN

Malaysia telah mengorak langkah besar dalam memperkukuh pendidikan inklusif melalui pelbagai dasar dan program khas yang menyasarkan Murid Berkeperluan Khas (MBK). Salah satu program utama ialah Program Pendidikan Khas Integrasi (PPKI) di bawah Bahagian Pendidikan Khas, Kementerian Pendidikan Malaysia (KPM), yang bertujuan untuk membangunkan potensi pelajar melalui intervensi awal dan persediaan ke arah kehidupan berdikari serta peluang kerjaya atau pendidikan lanjutan. PPKI menyediakan laluan pendidikan khas kepada pelajar yang mengalami masalah pembelajaran, autisme, atau ketidakupayaan intelek sederhana. Dalam menyokong dasar pendidikan inklusif dan pembangunan modal insan melalui Pembelajaran Sepanjang Hayat (PSH), Kolej Komuniti di bawah pentadbiran Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK)

memainkan peranan strategik sebagai hab pembelajaran komuniti. Peranan ini dilaksanakan melalui dua komponen utama yang saling melengkapi.

Pertama, pelaksanaan program sepenuh masa seperti Sijil Khas Kolej Komuniti yang dirangka khusus bagi pelajar berkeperluan khas. Program ini menawarkan latihan teknikal dan vokasional dalam bidang seperti kulinari, landskap, pastri dan hospitaliti, dengan penekanan kepada penguasaan kemahiran praktikal serta bimbingan berstruktur untuk mempersiapkan pelajar ke alam pekerjaan atau keusahawanan. Kedua, Kolej Komuniti turut menyediakan kursus pendek dan latihan khas melalui Unit Pembelajaran Sepanjang Hayat (PSH) yang dibiayai menerusi Akaun Amanah Kolej Komuniti. Kursus ini dibuka kepada semua golongan termasuk MBK dan komuniti setempat, dengan matlamat membina kemahiran asas dan teknikal yang sejajar dengan keperluan industri dan potensi ekonomi komuniti. Inisiatif ini bukan sahaja menyumbang kepada pembangunan kapasiti individu, tetapi juga meningkatkan keterlibatan sosial dan ekonomi masyarakat secara menyeluruh, menjadikan Kolej Komuniti sebagai penggerak utama dalam menjayakan agenda latihan inklusif di peringkat akar umbi.

Garis Panduan Pelaksanaan Pembelajaran Sepanjang Hayat Kolej Komuniti Edisi 2023 menekankan bahawa PSH adalah satu pendekatan pembelajaran berterusan yang bertujuan untuk meningkatkan kemahiran dan pengetahuan individu dalam pelbagai bidang, memberi nilai tambah melalui peningkatan kemahiran, meningkatkan kebolehpasaran dan peluang pekerjaan, serta melayakkan peluang melanjutkan pengajian melalui laluan Akreditasi Pengalaman Pembelajaran Berasaskan Pengalaman Terdahulu (APEL). Program PSH ini juga bertujuan untuk meningkatkan kualiti hidup melalui penjanaan dan peningkatan pendapatan.

Pelaksanaan PSH di Kolej Komuniti adalah berpandukan kepada garis panduan yang telah ditetapkan, termasuk penggunaan dana Akaun Amanah, penyediaan modul latihan yang relevan, serta pelaksanaan penilaian dan pemantauan yang sistematik. Kursus-kursus yang ditawarkan merangkumi pelbagai bidang seperti teknologi maklumat, keusahawanan, pertanian, dan lain-lain, yang disesuaikan dengan keperluan dan permintaan komuniti setempat. Melalui pendekatan ini, Kolej Komuniti bukan sahaja menyediakan peluang pembelajaran yang fleksibel dan inklusif, tetapi juga memainkan peranan penting dalam pembangunan sosioekonomi komuniti, selaras dengan aspirasi negara untuk membangunkan masyarakat yang berpengetahuan dan berkemahiran tinggi.

Salah satu inisiatif yang menonjol hasil kerjasama pelbagai pihak ialah *Hospitality Inclusive Programme* (HIP) Langkawi, yang dilaksanakan oleh Langkawi Tourism Academy @ Kolej Komuniti Langkawi dengan sokongan Pejabat Pendidikan Daerah (PPD) Langkawi dan rakan industri, The Westin Langkawi Resort & Spa. HIP merupakan program latihan hospitaliti praktikal yang menyasarkan pelajar PPKI tahap sederhana hingga tinggi. Ia dilaksanakan melalui dua fasa: latihan teori dan praktikal di institusi selama 6 hari, diikuti oleh pengalaman industri selama 14 hari dalam bidang *housekeeping, stewarding* dan *public area*.

Pelaksanaan program ini menekankan pembelajaran berasaskan pengalaman sebenar (*experiential learning*) yang disesuaikan dengan keperluan dan keupayaan pelajar. Modul latihan dibangunkan secara bersama oleh tenaga pengajar Kolej Komuniti dan mentor industri, dan merangkumi kemahiran teknikal asas serta elemen pembangunan sahsiah dan keyakinan diri. Berbeza daripada program latihan teknikal arus perdana, HIP Langkawi mengutamakan penyertaan langsung pelajar dalam suasana industri sebenar, di mana mereka dibimbing oleh pekerja hotel yang dilantik sebagai mentor. Ini sekaligus merapatkan jurang antara dunia pendidikan khas dan keperluan industri hospitaliti tempatan. Kejayaan awal HIP Langkawi mendapat pengiktirafan serantau apabila dinobatkan sebagai salah satu "*Best Practice in Community Partnership*" oleh *Marriott International Asia Pacific Excluding China*, dalam *Be You Campaign: International Day of Persons with Disabilities* pada tahun 2023.

Namun begitu, program seperti HIP masih kurang didokumentasikan melalui penulisan ilmiah atau kajian yang sistematik, khususnya dari segi struktur kolaborasi, pelaksanaan penilaian pelajar, serta impak terhadap kebolehpasaran. Kajian ini bertujuan untuk meneliti pelaksanaan HIP Langkawi secara holistik dan mengenal pasti peluang serta cabaran untuk peluasan program ke lokasi dan institusi lain di Malaysia. Kajian ini turut merujuk kepada pendekatan amalan baik antarabangsa dalam latihan inklusif, selaras dengan aspirasi Dasar TVET Negara 2030 dan Matlamat Pembangunan Lestari (SDG) khususnya SDG 4 dan SDG 8.

2 PERNYATAAN MASALAH

Murid Berkeperluan Khas (MBK), khususnya pelajar dalam Program Pendidikan Khas Integrasi (PPKI), masih berdepan dengan pelbagai cabaran dalam mendapatkan akses kepada latihan teknikal dan vokasional yang bersifat inklusif dan relevan dengan keperluan industri semasa. Walaupun dasar pendidikan inklusif telah digariskan dalam Pelan Pembangunan Pendidikan Malaysia dan Dasar TVET Negara 2030, jurang pelaksanaan nyata masih wujud, khususnya dari aspek keterlibatan industri, penilaian berstruktur dan kebolehpasaran graduan PPKI.

Kebanyakan pelajar PPKI masih terhad kepada pengalaman pembelajaran yang berlaku sepenuhnya dalam bilik darjah atau bengkel tertutup. Pendekatan ini menyebabkan mereka kurang terdedah kepada suasana kerja sebenar, sekali gus menyukarkan proses peralihan ke alam pekerjaan. Tambahan pula, pelaksanaan penilaian kemahiran bagi pelajar berkeperluan khas masih bersifat umum dan tidak disesuaikan dengan tahap kebolehan serta fungsi mereka, terutamanya dalam bidang hospitaliti yang menuntut kemahiran praktikal dan interaksi pelanggan yang tinggi.

Daripada perspektif industri pula, kurangnya pendedahan terhadap potensi pelajar PPKI dalam melaksanakan tugasan sebenar menyumbang kepada wujudnya stigma dan keraguan terhadap keupayaan MBK untuk bekerja secara produktif. Dalam banyak keadaan, pihak industri tidak mempunyai sistem bimbingan atau prosedur operasi standard (SOP) penilaian yang mesra inklusif, menjadikan usaha kolaborasi antara institusi pendidikan dan industri sukar untuk dilaksanakan secara mampan. Model latihan inklusif seperti *Hospitality Inclusive Programme* (HIP) Langkawi menawarkan pendekatan alternatif yang lebih menyeluruh dan mesra industri. Penglibatan kolaborasi erat antara Pejabat Pendidikan Daerah (PPD) Langkawi, Langkawi Tourism Academy @ Kolej Komuniti Langkawi dan The Westin Langkawi sebagai rakan industri, HIP membuka ruang kepada pelajar PPKI di Langkawi untuk menjalani latihan praktikal berasaskan kerja sebenar. Namun begitu, dokumentasi akademik mengenai impak sebenar program ini masih belum mencukupi.

Selain itu, wujud keperluan untuk menilai model ini secara sistematik dari sudut peranan kolaboratif tiga pihak, struktur penilaian pelajar, dan keberkesanan pendekatan ini dalam meningkatkan kebolehpasaran pelajar PPKI. Sehingga kini, tiada kerangka penilaian yang dibangunkan secara rasmi bagi menilai pencapaian pelajar PPKI dalam konteks latihan industri sebenar di sektor hospitaliti.

Tambahan pula, rujukan kepada amalan terbaik antarabangsa seperti Project SEARCH (UK), *Ticket to Work* (Australia), *Dual Vocational Training* (Jerman) dan program latihan inklusif di Bangladesh dan Kenya, menunjukkan bahawa latihan berstruktur bersama mentor industri dan penilaian kompetensi yang jelas merupakan elemen penting dalam menjayakan latihan inklusif. Malaysia masih memerlukan kerangka sebegini yang disesuaikan dengan konteks tempatan.

Objektif utama kajian ini adalah seperti berikut:

i. Menilai keberkesanan pelaksanaan dan struktur model kolaborasi tiga pihak dalam HIP Langkawi yang melibatkan pejabat pendidikan dan sekolah, industri perhotelan dan institusi pendidikan tinggi.
ii. Menganalisis impak HIP terhadap kebolehpasaran dan pembangunan kemahiran pelajar PPKI, merangkumi aspek kemahiran teknikal, insaniah dan perubahan sikap kerja.
iii. Mengenalpasti amalan terbaik antarabangsa dan serantau yang boleh diadaptasi untuk memperkukuh pelaksanaan HIP serta mencadangkan satu kerangka konseptual latihan inklusif berimpak tinggi.

3 SOROTAN LITERATUR

3.1 Pendidikan Inklusif dan latihan teknikal dan vokasional (TVET) untuk MBK

Pendidikan inklusif di Malaysia menekankan penglibatan aktif Murid Berkeperluan Khas (MBK) dalam sistem pendidikan arus perdana dengan penyesuaian kurikulum dan sokongan yang bersesuaian. Pada tahun 2024, Negeri Selangor mencatat jumlah murid berkeperluan pendidikan khas (MBPK) tertinggi dalam Program Pendidikan Khas Integrasi (PPKI), diikuti oleh Johor, Sabah, dan Perak. Peningkatan ini mencerminkan keberkesanan pelaksanaan program PPKI di negeri-negeri yang mempunyai kepadatan penduduk tinggi serta kemudahan pendidikan khas yang lebih mantap. Menurut Buku Data Pendidikan Khas 2024 terbitan Bahagian Pendidikan Khas, Kementerian Pendidikan

Malaysia (KPM), jumlah keseluruhan MBPK dalam PPKI telah mencapai 106,827 orang pada tahun 2024, meningkat berbanding 85,362 orang pada tahun 2022. Selain itu, bilangan MBPK PPKI di peringkat sekolah menengah turut menunjukkan trend peningkatan yang ketara. Perkembangan ini memberi isyarat jelas tentang keperluan mendesak untuk merangka laluan latihan teknikal dan vokasional yang lebih sistematik serta menyediakan sokongan transisi yang kukuh ke alam pekerjaan atau pendidikan pasca menengah.

Kajian oleh Zahari et al. (2021) menunjukkan bahawa kurangnya laluan formal untuk latihan kemahiran dan kekurangan pendedahan kepada suasana kerja sebenar menyukarkan MBK untuk memperoleh pekerjaan. Tambahan pula, masih terdapat jurang besar dari segi kurikulum khas yang menepati keperluan industri, khususnya dalam bidang hospitaliti yang memerlukan kemahiran praktikal dan komunikasi pelanggan.

3.2 Peranan kolej komuniti dalam pendidikan khas dan pembelajaran sepanjang hayat

Kolej Komuniti di bawah Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK) menyediakan dua pendekatan utama: Program Sepenuh Masa merangkumi pelbagai bidang kepada pelajar lepasan SPM dan Sijil Khas Kolej Komuniti yang dikhususkan kepada pelajar berkeperluan khas, dan kursus pendek di bawah Unit Pembelajaran Sepanjang Hayat (PSH). Program ini menyediakan ruang pembelajaran fleksibel untuk kepada komuniti termasuk pelajar lepasan PPKI yang tidak dapat menyambung ke pendidikan arus perdana (JPPKK, 2023).

Menurut Mohd Salleh et al. (2022), kursus pendek yang ditawarkan melalui PSH berjaya meningkatkan keyakinan diri dan kemahiran asas pelajar PPKI, terutamanya dalam bidang kulinari, *housekeeping* dan landskap. Walau bagaimanapun, masih kurang latihan berasaskan industri sebenar yang membolehkan pelajar memperoleh pengalaman kerja sebenar dan dinilai mengikut standard industri.

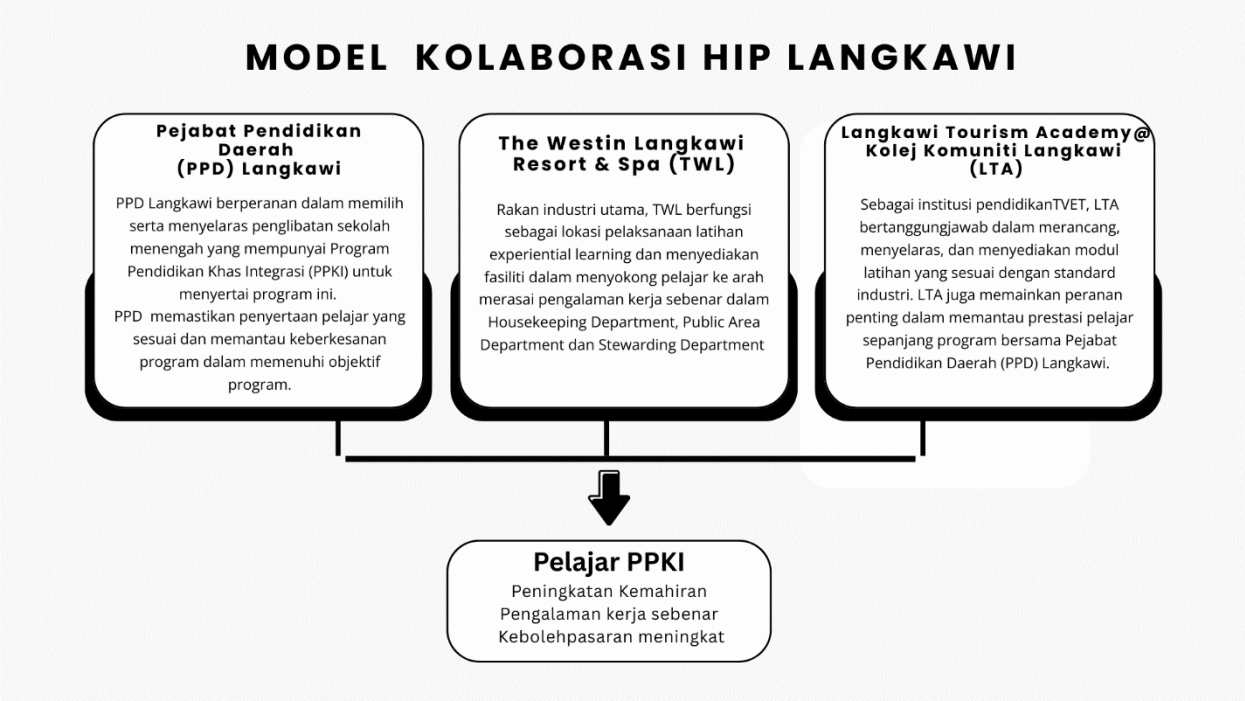
3.3 Model kolaborasi tiga pihak dalam TVET inklusif

Pelaksanaan latihan berimpak tinggi kepada pelajar berkeperluan khas menuntut pendekatan kolaboratif yang melibatkan institusi pendidikan, komuniti dan industri. Kajian oleh Goh & Kamaruzaman (2023) mencadangkan bahawa model kerjasama tiga hala antara sekolah, kolej dan majikan dapat membantu mempercepatkan integrasi pelajar PPKI ke dunia pekerjaan melalui pembelajaran kontekstual, bimbingan industri dan peluang pekerjaan sebenar. Model seperti HIP Langkawi mencerminkan pendekatan ini, di mana peranan utama diagihkan secara jelas:

i. PPD Langkawi menyelaras pemilihan pelajar dan kerjasama sekolah.
ii. Langkawi Tourism Academy @ Kolej Komuniti Langkawi menyediakan modul dan latihan teori dan praktikal.
iii. The Westin Langkawi menyediakan mentor, lokasi industri dan pengalaman sebenar.

Kajian oleh Lim & Phoon (2022) di Singapura menunjukkan bahawa program inklusif yang melibatkan "job shadowing", mentor industri dan latihan berasaskan tugas (task-based training) telah meningkatkan kadar kebolehpasaran pelajar berkeperluan khas kepada lebih 60%.

Jadual 3.1: Elemen Sejajar antara HIP dan Model Antarabangsa



3.4 Penilaian praktikal mesra inklusif dalam latihan hospitaliti

Sistem penilaian bagi pelajar PPKI sering kali tidak mengambil kira keperluan pembelajaran mereka yang pelbagai. Ramai pelajar menamatkan latihan tanpa rekod kemahiran yang dinilai secara objektif dalam konteks pekerjaan sebenar (Ali & Ramasamy, 2023). Ini menjejaskan proses dokumentasi kompetensi dan peluang pekerjaan.

Model penilaian mesra inklusif seperti yang diamalkan oleh **Hotel Etico** (Australia) dan **Project SEARCH** (UK) memberi fokus kepada pemerhatian berstruktur, refleksi harian pelajar, serta input mentor industri. Kajian oleh Corrigan et al. (2021) menyarankan penggunaan borang rubrik penilaian berasaskan tingkah laku, keberkesanan komunikasi, penyelesaian masalah, dan kebolehan menyempurnakan tugasan rutin.

3.5 Amalan baik antarabangsa

Pelbagai model latihan teknikal dan vokasional inklusif dari seluruh dunia telah membuktikan keberkesanannya dalam meningkatkan kebolehpasaran pelajar berkeperluan khas, termasuk golongan Orang Kurang Upaya (OKU). Model-model ini mempunyai persamaan dalam pendekatan, iaitu menekankan kerjasama pelbagai pihak, latihan berasaskan industri sebenar, dan sistem sokongan yang kukuh. Antara model yang sering dirujuk ialah *Project SEARCH* dari United Kingdom, *Ticket to Work* dari Australia, *Dual Vocational Training* dari Jerman, *Inclusive Hospitality* di Bangladesh dan Kenya, serta *Hospitality Inclusive Programme (HIP)* Langkawi dari Malaysia.

Project SEARCH di United Kingdom merupakan kerjasama antara National Health Service (NHS) dan sekolah pendidikan khas, yang menawarkan latihan industri secara intensif kepada pelajar dengan keperluan khas. Pendekatan yang digunakan menekankan latihan di tempat kerja sebenar dengan bimbingan mentor sepenuh masa. Penilaian dibuat secara harian, membolehkan pelajar menerima maklum balas segera dan membina kemahiran secara progresif. Kajian oleh Wehman et al. (2020) menunjukkan bahawa 75% daripada peserta program ini berjaya memperoleh pekerjaan tetap selepas tamat latihan, menjadikan model ini antara yang paling berjaya dalam menyokong transisi ke alam pekerjaan.

Di Australia, model *Ticket to Work* pula melibatkan kerjasama antara institusi TVET seperti TAFE, NGO dan majikan. Program ini memberi fleksibiliti kepada pelajar dalam memilih laluan latihan mereka, sama ada melalui organisasi komuniti atau syarikat swasta. Ciri inklusif utama program ini adalah keterlibatan komuniti secara aktif dan kebebasan pelajar dalam menentukan trajektori kerjaya

mereka. Penilaian dibuat secara tidak formal tetapi konsisten, dengan sokongan latihan kendiri yang menggalakkan pembangunan keyakinan dan kemahiran sosial. Kajian oleh Carter et al. (2021) menyatakan bahawa program ini berjaya meningkatkan keyakinan kendiri dan motivasi pelajar, terutama dalam kalangan pelajar berkeperluan khas.

Sementara itu, Jerman memperkenalkan *Dual Vocational Training*, satu sistem pendidikan yang membahagikan masa latihan kepada 50% teori di sekolah teknikal dan 50% latihan praktikal di tempat kerja. Kolaborasi erat antara sekolah dan industri memastikan pelajar bukan sahaja mendapat kemahiran teknikal, malah memahami budaya kerja sebenar. Menurut Deißinger (2020), sistem ini berjaya mengurangkan kadar pengangguran dalam kalangan OKU sebanyak 10% dalam tempoh lima tahun. Penilaian dilakukan secara bersepadu oleh kedua-dua institusi pendidikan dan pihak industri, menjadikan proses pengesahan kemahiran lebih telus dan sah.

Negara-negara membangun seperti Bangladesh dan Kenya pula telah melaksanakan *Inclusive Hospitality*, yang dijalankan melalui kerjasama antara NGO dan hotel tempatan. Pendekatan ini memberi penekanan kepada penglibatan aktif wanita dan komuniti, menjadikannya satu model latihan yang bukan sahaja inklusif tetapi juga menyasarkan kumpulan rentan yang terpinggir secara ekonomi dan sosial. Penilaian dibuat secara komuniti berasaskan kepercayaan sosial dan kemajuan pelajar, manakala mentor biasanya terdiri daripada wakil NGO. Menurut laporan UNDP (2022), program ini berjaya meningkatkan keterlibatan sosial serta mewujudkan akses pekerjaan yang lebih inklusif.

Di Malaysia, *Hospitality Inclusive Programme (HIP) Langkawi* merupakan inisiatif tempatan yang mengadaptasi elemen-elemen terbaik daripada model antarabangsa. Ia dijalankan melalui kolaborasi antara Pejabat Pendidikan Daerah (PPD) Langkawi, Kolej Komuniti Langkawi dan The Westin Langkawi Resort & Spa. Pelajar PPKI menjalani enam hari latihan teori dan praktikal di institusi, diikuti dengan 14 hari latihan industri sebenar di hotel. Program ini memperkenalkan konsep kolaborasi tiga hala yang jelas – pendidikan, industri dan komuniti – dengan pelantikan mentor industri untuk membimbing pelajar secara langsung di tempat kerja. Namun, antara kekangan utama yang dikenal pasti ialah ketiadaan sistem penilaian berstruktur dan mesra inklusif yang boleh digunakan secara meluas. Ini selaras dengan penemuan oleh Ali dan Ramasamy (2023) yang menekankan keperluan penilaian yang adil dan fleksibel untuk pelajar berkeperluan khas dalam program vokasional.

Secara keseluruhannya, semua model yang dikaji memperlihatkan bahawa keberkesanan latihan teknikal dan vokasional inklusif bergantung kepada beberapa faktor utama: iaitu kolaborasi pelbagai pihak, pendekatan latihan berasaskan industri sebenar, sistem penilaian yang adaptif, dan kehadiran mentor terlatih. HIP Langkawi memperlihatkan potensi besar untuk diperluas sebagai model nasional dengan syarat terdapat penambahbaikan dalam aspek penilaian, sistem sokongan mentor dan dokumentasi impak pelajar secara sistematik.

4 METODOLOGI KAJIAN

Metodologi kajian ini menggunakan pendekatan kualitatif berbentuk konseptual yang bertujuan untuk memahami pelaksanaan program HIP Langkawi sebagai satu model kolaboratif pendidikan, industri dan komuniti dalam TVET untuk pelajar berkeperluan khas. Kaedah ini berasaskan analisis kandungan terhadap sorotan kajian terdahulu dan dokumen pelaksanaan program, termasuk modul latihan, laporan program, serta pemerhatian tidak formal yang dijalankan semasa pelaksanaan HIP di lapangan.

Menurut Marohaini (2001) dan Othman (2007), pendekatan kualitatif sesuai digunakan bagi menyelidik isu-isu sosial dan pendidikan dalam konteks sebenar. Dalam kajian ini, penyelidik menganalisis maklumat secara sistematik melalui sumber primer dan sekunder, bagi mengenal pasti tema-tema utama seperti struktur kolaborasi, penilaian inklusif, kompetensi pelajar, dan impak program.

Kaedah analisis tema digunakan untuk menyusun dapatan dalam bentuk naratif dan perbandingan dengan model latihan inklusif antarabangsa seperti Project SEARCH dan Ticket to Work. Skop kajian ini merangkumi pelaksanaan HIP Langkawi Fasa 1 yang melibatkan 12 pelajar PPKI di The Westin Langkawi. Kajian ini tidak melibatkan pengumpulan data kuantitatif atau temu bual formal, namun menggunakan analisis pemerhatian dan dokumentasi program untuk mengenal pasti struktur pelaksanaan, peranan pemegang taruh, dan dapatan awal.

Keterbatasan kajian terletak pada kekurangan data jangka panjang dan penilaian berasaskan hasil pelajar. Justeru, kajian lanjutan secara empirikal dirancang sebagai fasa seterusnya.

5 JANGKAAN DAPATAN DAN PERBINCANGAN AWAL

Pelaksanaan awal Hospitality Inclusive Programme (HIP) Langkawi telah memberikan beberapa petunjuk penting tentang keberkesanan dan cabaran dalam mengintegrasikan pelajar berkeperluan khas (PPKI) ke dalam dunia kerja sebenar melalui kolaborasi institusi Pendidikan dan industri. Melalui analisis dokumen, pemerhatian lapangan dan sorotan kajian lepas, beberapa dapatan utama dapat dijangkakan, yang boleh menjadi asas kepada pengembangan dan pemantapan model HIP secara lebih meluas.

5.1 Struktur kolaborasi 3 pihak yang berkesan

Model kolaboratif tiga pihak – Pejabat Pendidikan Daerah Langkawi (PPD), Kolej Komuniti Langkawi (melalui Langkawi Tourism Academy), dan The Westin Langkawi (industri) – menunjukkan satu struktur yang saling melengkapi. PPD memainkan peranan dalam pemilihan dan saringan pelajar PPKI, Kolej Komuniti sebagai penyedia latihan teori dan amali, manakala industri menyediakan platform latihan sebenar dengan mentor yang terlatih.

Struktur ini selaras dengan cadangan Abdullah et al. (2023) bahawa kejayaan latihan teknikal dan vokasional inklusif sangat bergantung pada kejelasan peranan dan komitmen jangka panjang daripada semua pihak berkepentingan. Kolaborasi 3P ini membolehkan komunikasi dua hala yang efektif, pemantauan berterusan terhadap kemajuan pelajar, serta peluang pekerjaan yang lebih nyata selepas tamat latihan.

5.2 Peningkatan kompetensi pelajar PPKI dalam konteks industri sebenar

Melalui pendekatan latihan berasaskan tugas (task-based learning) dan pengalaman sebenar di hotel, pelajar menunjukkan peningkatan yang ketara dalam kemahiran teknikal seperti membersih bilik, mengurus linen, dan menjaga kawasan awam. Latihan ini turut membantu mereka memahami budaya kerja industri hospitaliti, termasuk kepatuhan kepada masa, komunikasi asas, dan etika kerja.

Dapatan ini selaras dengan kajian oleh Corrigan et al. (2021) yang mendapati bahawa pelajar dengan keperluan khas akan lebih berkembang jika diberikan latihan dalam persekitaran kerja sebenar dengan bimbingan mentor yang berpengalaman.

5.3 Penambahbaikan kemahiran sosial dan aspirasi kerjaya

Selain kemahiran teknikal, aspek insaniah seperti keyakinan diri, interaksi sosial, dan kematangan emosi turut berkembang dengan ketara. Pelajar mula menunjukkan minat untuk bekerja dalam sektor hospitaliti secara tetap selepas tamat latihan, dan ramai yang menyatakan aspirasi kerjaya secara terbuka – satu perkembangan yang jarang dilihat dalam kalangan pelajar PPKI sebelum ini.

Goh & Kamaruzaman (2023) menekankan bahawa persekitaran kerja yang inklusif dan sokongan rakan sekerja memainkan peranan penting dalam membentuk imej kendiri positif dalam kalangan pekerja berkeperluan khas. Dalam konteks HIP, sokongan mentor dan staf hotel turut membantu pelajar untuk menyesuaikan diri dengan baik.

5.4 Ketiadaan kerangka penilaian praktikal mesra inklusif

Walaupun pelajar menunjukkan kemajuan yang ketara, pelaksanaan HIP masih belum disokong oleh satu sistem penilaian yang sistematik dan adaptif. Penilaian masih bergantung kepada pemerhatian tidak formal oleh mentor atau pengajar, tanpa adanya rubrik penilaian yang disesuaikan dengan keperluan pelajar PPKI. Ini menyukarkan dokumentasi kemajuan dan pengiktirafan formal terhadap pencapaian mereka.

Kajian oleh Ali & Ramasamy (2023) mengesyorkan pembangunan sistem penilaian prestasi yang inklusif – yang bukan sahaja mengambil kira hasil kerja teknikal tetapi juga usaha, perkembangan kendiri, dan keupayaan berfungsi pelajar dalam konteks kerja sebenar. Dalam hal ini, HIP perlu memperkenalkan borang penilaian khusus dan latihan kepada mentor untuk memastikan keadilan dan kejelasan dalam menilai prestasi pelajar PPKI.

5.5 Potensi diperluas di peringkat nasional

Model HIP Langkawi menunjukkan bahawa kolaborasi antara Kolej Komuniti dan industri berprestij seperti Marriott Group berupaya membuka ruang kerjaya kepada golongan yang sebelum ini sering terpinggir. Dengan adanya modul latihan yang berstruktur, sistem sokongan mentor, dan

pendekatan belajar sambil bekerja (experiential learning), model ini boleh dikembangkan ke hotel-hotel lain di bawah jaringan komuniti dan kementerian.

Kajian Mohd Salleh et al. (2022) mengenai kursus pendek di Kolej Komuniti menunjukkan bahawa pembelajaran sepanjang hayat mampu membina kemahiran dan keyakinan pelajar PPKI dalam tempoh singkat jika dilaksanakan dengan pendekatan yang inklusif dan kontekstual.

Jika dibandingkan dengan program seperti Project SEARCH (UK) dan Inclusive Hospitality (Kenya), HIP Langkawi masih dalam fasa permulaan, tetapi menunjukkan ciri-ciri utama kejayaan iaitu latihan praktikal, mentor industri, dan kolaborasi pelbagai pihak. Jadual berikut merangkumkan perbandingan awal:

Jadual 5.1: Elemen Sejajar antara HIP dan Model Antarabangsa

Elemen Utama	**HIP Langkawi**	**Project SEARCH (UK)**	**Inclusive Hospitality (Kenya)**
Latihan Industri Sebenar	The Westin Hotel	NHS Hospital	Hotel Tempatan
Mentor Industri	Ada	Ada	Ada
Penilaian Berstruktur	Belum dibangunkan	Rubrik dan Laporan	Pemerhatian mingguan
Penyelarasan Multi-Pihak	PPD, KK, Hotel	Sekolah, Majikan	NGO, Majikan, Komuniti
Impak Terhadap Pelajar	Peningkatan Sosial	Penempatan Kerjaya	Integrasi Sosial & Ekonomi

Secara keseluruhan, jangkaan dapatan ini memberikan asas penting untuk memperkukuh dan memperluas pelaksanaan HIP ke lokasi lain. Ia turut menyumbang kepada cadangan pembentukan kerangka penilaian dan model latihan berasaskan amalan baik dari dalam dan luar negara, selaras dengan aspirasi TVET inklusif Malaysia.

6 CADANGAN MODEL DAN KERANGKA PENILAIAN INKLUSIF HIP

6.1: Perbandingan Model Latihan teknikal dan vokasional Inklusif

Melalui analisis literatur dan pemerhatian awal terhadap pelaksanaan HIP Langkawi, dapat dirumuskan bahawa salah satu keperluan kritikal bagi memastikan kesinambungan dan keberkesanan program ini adalah pembangunan satu **kerangka penilaian praktikal mesra inklusif** yang sistematik, boleh diukur, dan seragam. Model ini perlu diselaraskan dengan **struktur kolaborasi tiga pihak** mengambil kira keperluan individu pelajar PPKI, serta berpaksikan kepada amalan terbaik serantau dan antarabangsa.

Jadual 6.1: Perbandingan Ciri Model Latihan TVET Inklusif Antara HIP dan Program Antarabangsa

Program / Negara	**Kolaborasi**	**Pendekatan**	**Ciri Inklusif**	**Penilaian & Mentor**	**Impak Utama**
Project SEARCH (UK)	NHS + Sekolah Pendidikan Khas	Latihan industri dengan bimbingan mentor sepenuh masa	Fokus kepada pekerjaan sebenar dan sokongan transisi	Penilaian praktikal harian, mentor terlatih	75% pelajar mendapat pekerjaan tetap (Wehman et al., 2020)
Ticket to Work (Australia)	TAFE + NGO + Majikan	Laluan fleksibel latihan industri dan komuniti	Penglibatan komuniti, pelajar tentukan trajektori kerjaya	Penilaian fleksibel, latihan kendiri	Tingkatkan keyakinan dan kemahiran kendiri (Carter et al., 2021)
Dual Vocational Training (Jerman)	Sekolah Teknikal + Industri	50% teori, 50% latihan di tempat kerja	Pendedahan budaya kerja sebenar	Penilaian bersama industri dan institusi	Kadar pengangguran OKU menurun 10% (Deißinger, 2020)

Inclusive Hospitality (Bangladesh, Kenya)	NGO + Hotel Tempatan	Latihan komuniti dan pemberdayaan wanita	Akses ekonomi untuk golongan rentan	Penilaian bersifat komuniti, mentor NGO	Penglibatan sosial meningkat (UNDP, 2022)
HIP Langkawi (Malaysia)	PPD + Kolej Komuniti + The Westin Langkawi	6 hari teori/praktikal + 14 hari latihan industri	Kolaborasi tiga hala, mentor industri dilantik	Masih memerlukan rubrik penilaian inklusif	Peningkatan kemahiran sosial, komunikasi dan teknikal

Analisis terhadap lima model latihan teknikal dan vokasional inklusif yang dibandingkan dalam Jadual 6.1 menunjukkan wujudnya elemen-elemen utama yang menjadi penentu kejayaan dalam meningkatkan kebolehpasaran pelajar berkeperluan khas. Antara elemen tersebut ialah kolaborasi rentas sektor, pendekatan latihan berstruktur dan realistik, sokongan mentor, sistem penilaian mesra inklusif, serta impak sosial dan ekonomi yang jelas.

Sebagai contoh, Project SEARCH di United Kingdom menampilkan kerjasama erat antara NHS dan sekolah pendidikan khas, menawarkan latihan berasaskan pekerjaan sebenar dengan mentor sepenuh masa. Model ini menghasilkan impak signifikan dengan 75% graduan memperoleh pekerjaan tetap, seperti dilaporkan oleh Wehman et al. (2020), membuktikan keberkesanan latihan yang diselaraskan dengan keperluan sebenar industri.

Sementara itu, Ticket to Work di Australia menekankan laluan fleksibel yang membabitkan NGO dan majikan, dengan pelajar diberi ruang menentukan hala tuju kerjaya. Kajian oleh Carter et al. (2021) mendapati pendekatan komuniti ini meningkatkan kemahiran kendiri dan keyakinan pelajar, membolehkan transisi yang lebih lancar ke alam pekerjaan.

Model Dual Vocational Training di Jerman pula menawarkan keseimbangan antara teori (50%) dan latihan di tempat kerja (50%). Keunikan sistem ini adalah penilaian bersama oleh pihak industri dan institusi, yang menurut Deißinger (2020), berjaya menurunkan kadar pengangguran golongan OKU sebanyak 10% dalam tempoh lima tahun.

Di negara membangun seperti Bangladesh dan Kenya, Program Inclusive Hospitality yang dilaksanakan oleh NGO bersama hotel tempatan memfokuskan kepada pemberdayaan komuniti dan akses pekerjaan untuk golongan rentan, khususnya wanita. Menurut laporan UNDP (2022), pendekatan ini berjaya meningkatkan penglibatan sosial dan ekonomi melalui latihan berbasis komuniti.

Apabila dibandingkan, HIP Langkawi di Malaysia menunjukkan potensi besar sebagai satu amalan baik dalam konteks serantau. Kolaborasi tiga hala antara Pejabat Pendidikan Daerah, Kolej Komuniti Langkawi dan The Westin Langkawi menyediakan pelajar PPKI dengan pengalaman langsung melalui dua fasa latihan: teori/praktikal selama enam hari, dan penempatan industri selama 14 hari. Namun, masih terdapat kekangan dalam aspek penilaian, di mana rubrik mesra inklusif yang sistematik masih belum dilaksanakan sepenuhnya. Walau bagaimanapun, dapatan awal menunjukkan peningkatan kemahiran sosial, komunikasi dan teknikal pelajar, yang menunjukkan keberkesanan model ini dalam menyokong pelajar ke arah pekerjaan sebenar.

Keseluruhannya, analisis ini mengesahkan bahawa model latihan teknikal dan vokasional yang berjaya perlu disokong oleh sistem mentoring formal, penilaian yang disesuaikan, serta kolaborasi rentas sektor yang berfungsi secara sistematik. Kajian tempatan seperti oleh Abdullah et al. (2023) dan Ali & Ramasamy (2023) turut menekankan kepentingan aspek ini untuk menjamin keberkesanan program inklusif di Malaysia.

6.2 Cadangan Kerangka Penilaian Praktikal HIP: Adaptasi Model Kolaboratif Inklusif

Dalam usaha memantapkan pelaksanaan Hospitality Inclusive Programme (HIP) Langkawi, cadangan penilaian praktikal pelajar perlu disusun secara sistematik, adil, dan bersesuaian dengan keperluan Murid Berkeperluan Khas (MBK). Kerangka ini dibangunkan hasil adaptasi dan penyesuaian daripada beberapa model latihan teknikal dan vokasional inklusif bertaraf antarabangsa dan domestik yang telah terbukti keberkesanannya.

Kerangka ini menggabungkan prinsip kolaborasi tiga pihak; institusi pendidikan tinggi, industri dan pejabat pendidikan daerah/ sekolah dan menekankan penilaian menyeluruh yang merangkumi aspek kemahiran teknikal, kemahiran insaniah, dan tahap kebolehsuaian pelajar dalam persekitaran kerja sebenar.

Antara rujukan penting kepada pembentukan kerangka ini ialah model Project SEARCH dari United Kingdom yang menekankan kepentingan latihan berstruktur di lokasi kerja sebenar bersama mentor yang dilantik. Kajian oleh Wehman et al. (2020) menunjukkan bahawa pelajar berkeperluan khas yang mengikuti model ini berjaya memperoleh pekerjaan tetap kerana penilaian mereka dilakukan secara telus dan sistematik oleh pihak industri serta fasilitator pendidikan khas.

Begitu juga dengan sistem Dual Vocational Training dari Jerman yang menggabungkan latihan teori dan praktikal dalam nisbah 50:50. Sistem ini menginspirasikan elemen penilaian berkala berdasarkan tugasan kerja sebenar yang dihadapi pelajar di industri (Deißinger, 2020). Ini membantu pelajar memahami konteks kerja sebenar sambil memperoleh maklum balas secara langsung daripada penyelia industri.

Dalam konteks Asia Pasifik, program Ticket to Work (Australia) menonjolkan pendekatan penilaian yang menyesuaikan keupayaan individu pelajar dengan keperluan industri, dan pelibatan mentor dalam proses pentaksiran turut memperkukuh keberkesanan latihan (Carter et al., 2021). Elemen ini turut disokong oleh dapatan Ali & Ramasamy (2023) yang menegaskan bahawa penilaian berasaskan rubrik fleksibel sangat penting bagi pelajar berkeperluan khas.

Dalam konteks Malaysia pula, kajian oleh Abdullah, Norazmi dan Yusof (2023) menekankan bahawa keberhasilan latihan TVET untuk PPKI sangat bergantung kepada kejelasan struktur kolaborasi antara institusi pendidikan dan industri. Ini disokong oleh Goh dan Kamaruzaman (2023) yang menyatakan bahawa perubahan persepsi dan sokongan rakan sekerja terhadap MBK bergantung kepada keterlibatan mereka dalam latihan dan penilaian pelajar secara langsung.

Berdasarkan analisis kajian-kajian tersebut, kerangka penilaian praktikal HIP dicadangkan merangkumi komponen seperti berikut:

Jadual 6.2: Komponen Cadangan Penilaian Praktikal HIP Langkawi Berasaskan Amalan Inklusif

Komponen Penilaian	Peratusan (%)	Keterangan	Sumber / Adaptasi
Kemahiran Teknikal	40%	Pelaksanaan tugasan housekeeping, stewarding, public area dengan pematuhan SOP dan pengawasan minimum.	Adaptasi daripada model latihan industri Project SEARCH (Wehman et al., 2020) dan Dual VET Jerman (Deißinger, 2020).
Kemahiran Insaniah (Soft Skills)	30%	Keupayaan komunikasi, kerja berpasukan, pengurusan masa dan interaksi sosial dalam konteks kerja.	Berdasarkan pendekatan inklusif dalam kajian Goh & Kamaruzaman (2023) dan Carter et al. (2021).
Penyesuaian terhadap Persekitaran Kerja	20%	Tahap adaptasi pelajar terhadap budaya organisasi, rutin harian, dan suasana kerja profesional.	Diinspirasikan daripada kajian Carter et al. (2021) dan Ali & Ramasamy (2023).
Refleksi dan Maklum Balas Mentor	10%	Pemerhatian mentor industri dan fasilitator pendidikan melalui borang rubrik penilaian mesra inklusif.	Adaptasi daripada Ticket to Work (Australia) dan cadangan Abdullah et al. (2023).

7 KESIMPULAN DAN IMPLIKASI KAJIAN

Kajian ini mengemukakan satu pendekatan konseptual terhadap pelaksanaan Hospitality Inclusive Programme (HIP) Langkawi, sebuah model latihan teknikal dan vokasional inklusif yang pertama seumpamanya di Malaysia bagi pelajar Program Pendidikan Khas Integrasi (PPKI). Dalam menyelaras aspirasi Dasar Pendidikan Inklusif dan TVET Negara 2030, kajian ini membuktikan bahawa kolaborasi tiga hala antara institusi pendidikan, industri hospitaliti dan komuniti mampu menyediakan

satu ekosistem pembelajaran yang efektif untuk pembangunan kemahiran dan kebolehpasaran murid berkeperluan khas.

Melalui ulasan literatur yang komprehensif dan rujukan kepada model-model antarabangsa seperti Project SEARCH (UK), Ticket to Work (Australia), Dual Vocational Training (Jerman) dan Inclusive Hospitality (Bangladesh & Kenya), didapati bahawa kejayaan program seumpama ini memerlukan:

i. Struktur kolaboratif yang jelas dan formal,
ii. Penglibatan mentor industri yang terlatih,
iii. Latihan berasaskan tempat kerja sebenar,
iv. Penilaian mesra inklusif yang membolehkan pelajar menunjukkan potensi sebenar mereka.

Pelaksanaan HIP Langkawi yang melibatkan kerjasama antara Pejabat Pendidikan Daerah Langkawi (PPD), Langkawi Tourism Academy @ Kolej Komuniti Langkawi, dan The Westin Langkawi Resort & Spa, telah menunjukkan hasil positif awal dari segi pembangunan kemahiran teknikal, kemahiran insaniah dan keyakinan pelajar dalam menjalani tugasan hotel sebenar. Kajian ini juga mencadangkan satu Kerangka Penilaian Praktikal HIP bagi menyokong pelaksanaan dan pemantauan prestasi pelajar secara adil dan sistematik.

Kajian ini mempunyai beberapa implikasi penting yang boleh dimanfaatkan oleh pelbagai pihak berkepentingan dalam pembangunan latihan teknikal dan vokasional inklusif di Malaysia. Pertama, dapatan daripada kajian ini boleh dijadikan rujukan dalam menggubal dasar latihan vokasional nasional yang lebih inklusif dan menyeluruh, khususnya bagi murid Program Pendidikan Khas Integrasi (PPKI) lepasan sekolah menengah. Langkah ini berupaya menyokong matlamat Dasar Pendidikan Inklusif dan Pelan Induk Pendidikan TVET Negara yang menekankan keperluan akses pendidikan kepada semua.

Seterusnya, kajian ini turut menekankan peranan strategik Kolej Komuniti dalam memperluas pelaksanaan program seperti Hospitality Inclusive Programme (HIP) melalui pendekatan Pembelajaran Sepanjang Hayat (PSH). Dengan menyediakan kursus kemahiran jangka pendek dan laluan transisi kepada program bersijil sepenuh masa atau peluang pekerjaan sebenar, Kolej Komuniti dapat terus menyokong aspirasi pembangunan bakat pelajar berkeperluan khas secara berterusan dan berfasa.

Selain itu, model HIP Langkawi dilihat berpotensi untuk dijadikan model contoh amalan terbaik (best practice) diperingkat nasional. Pelaksanaan HIP boleh diperluas ke negeri-negeri lain dengan melibatkan jaringan hotel utama, institusi pendidikan seperti Kolej Komuniti dengan kerjasama Pejabat Pendidikan Daerah, sekaligus membentuk ekosistem sokongan yang holistik untuk memperkasakan murid berkeperluan khas dalam sektor hospitaliti dan pelancongan.

Sebagai pelengkap dapatan ini, kajian ini menyerlahkan keperluan mendesak untuk membangunkan satu sistem penilaian praktikal yang inklusif dan bersifat fleksibel. Penilaian yang telus dan sesuai dengan keperluan pelajar PPKI perlu dirangka melalui kerjasama antara institusi latihan dan pihak industri, agar pencapaian pelajar dapat diukur secara adil dan berkesan serta mampu meningkatkan kebolehpasaran mereka dalam jangka masa panjang.

Sebagai langkah seterusnya, penyelidik bercadang untuk menjalankan kajian empirikal susulan bagi menilai keberkesanan HIP secara menyeluruh. Kajian lanjutan ini melibatkan penggunaan soal selidik kepada pelajar dan ibu bapa, temu bual separa berstruktur bersama mentor industri dan penyelaras kolej, serta satu kajian kes longitudinal bagi meneliti perkembangan pelajar selepas tamat latihan. Aspek yang akan dikaji termasuklah pembangunan kemahiran jangka panjang, kadar penempatan pekerjaan, persepsi industri terhadap pelajar PPKI, serta impak sosial kepada keluarga dan komuniti.

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Fostering Tax Compliance Through Education: A Study on Awareness Among Kolej Poly-Tech MARA Students

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ABSTRACT

Tax compliance is essential to national development, enabling governments to fund public services and infrastructure sustainably. However, Malaysia continues to face challenges with voluntary tax compliance, particularly among younger demographics who often lack the knowledge, motivation, or ethical grounding to meet their fiscal obligations. This concept paper explores the level of tax awareness among students at Kolej Poly-Tech MARA (KPTM) and examines how educational interventions influence their attitudes and behaviors toward compliance.

Drawing on existing literature, the study highlights the crucial role of early and structured tax education in shaping compliance behavior. Prior research indicates that while initiatives such as the Inland Revenue Board's (IRB) *Tax Education Month* have increased visibility, they lack the continuity and depth required to create lasting impact. Moreover, students from non-accounting backgrounds are often excluded from meaningful tax education, leading to knowledge gaps that persist into adulthood.

The proposed study employs a quantitative approach using a structured questionnaire distributed to semester six students at KPTM. The survey aims to assess both tax knowledge and awareness, and how these relate to compliance intention. Data analysis through SPSS will reveal key educational and behavioral factors influencing students' readiness to comply with tax laws.

The findings are expected to provide actionable insights for curriculum developers, policymakers, and tax authorities. By integrating tax education across disciplines, establishing peer-led initiatives like tax clubs, and fostering institutional collaboration, higher education institutions can play a transformative role in cultivating a generation of informed, responsible, and tax-compliant citizens. This paper contributes to the growing discourse on fiscal education and offers recommendations for bridging the tax literacy gap among Malaysia's future workforce.

KEYWORDS: Tax Compliance, Tax Awareness, Tax Education, Higher Education, Kolej Poly-Tech MARA, Fiscal Responsibility, Tax Literacy, Student Behavior, Inland Revenue Board (IRB), Curriculum Development

1 INTRODUCTION

Taxation plays a fundamental role in sustaining national development and financing public goods and services. As one of Malaysia's primary revenue streams, taxation contributes significantly to infrastructure development, education, healthcare, public security, and other essential governmental functions. According to data released by the Inland Revenue Board (IRB) in 2022, the number of registered taxpayers in Malaysia increased by 11.7%. However, the number of **active** taxpayers—those fulfilling their tax obligations—only increased by 1.9% during the same period (Karimi, J. W., & Wanjohi, F. M. (2024). This discrepancy suggests a pressing concern: while more individuals are being registered, a large proportion of them are not actively complying with tax regulations. These figures highlight the need to strengthen tax compliance, particularly among emerging taxpayer groups.

Tax compliance is defined as the willingness of taxpayers to fulfil their tax obligations as mandated by the law. This includes accurately reporting income, filing returns timely, and paying taxes owed. One of the most crucial determinants of tax compliance is taxpayer awareness—a cognitive and behavioural condition wherein individuals understand, accept, and voluntarily adhere to tax laws and regulations. A taxpayer who is aware of their duties is more likely to comply without coercion or fear of legal repercussions (Tohari, A., Ramadhani, R. A., Muslih, B., & Kurniawan, A. (2024). Conversely, lack of awareness and poor understanding of tax responsibilities often results in non-compliance, whether intentionally or due to negligence.

In Malaysia, tax non-compliance has been an ongoing issue due in part to inadequate public education and a lack of tax knowledge among citizens. Many individuals are either unaware of their obligation to pay taxes or do not understand how to navigate the tax system (Hasan, A., Sheikh, N., & Farooq, M.B., 2024). This problem is particularly prominent among the younger generation, many of whom have never been exposed to formal tax education. As such, there is a growing consensus among scholars and policymakers that fostering tax awareness should begin early, ideally at the school and university levels, to instill a culture of compliance from a young age (Formanová et al., 2021; Yasa et al., 2021).

Tax education, therefore, becomes a critical tool in promoting compliance. When students are educated about the importance of taxation, the structure of tax systems, and the consequences of tax evasion, they are more likely to develop responsible financial behavior in the future (Marchaeni, N. K. F. D., & Utomo). Awareness programs initiated by both the IRB and private organizations are steps in the right direction. These programs aim to educate potential taxpayers—particularly students—about the significance of fulfilling tax obligations for the collective good. For instance, the IRB's annual "Tax Education Month" campaign seeks to demystify tax processes and emphasize civic responsibility. However, these initiatives often lack depth and continuity, and their impact can be limited without integration into formal education curricula.

According to Bawa & Boachie, tax awareness alone is not sufficient for ensuring compliance unless it is supported by solid tax education and knowledge. This highlights the need to assess the interplay between tax knowledge and awareness to effectively encourage compliance behavior. Additionally according to Marchaeni & Utomo, ethical considerations play a role, as tax education that incorporates values such as honesty, integrity, and social responsibility can further enhance awareness and the likelihood of compliance.

Despite the increasing number of initiatives aimed at promoting tax awareness, the effectiveness of these programs among students remains under-researched. Sanusi et al. (2021) found that many young Malaysians, including students in higher learning institutions, lacked a basic understanding of how to file taxes and often overlooked their responsibilities as future contributors to the national income. Similarly, Vanessa & Nair, (2024) reported that small and medium enterprises (SMEs) operated by recent graduates also demonstrated poor tax management, further emphasizing the gap in knowledge and preparedness.

Given the critical role that students play as emerging contributors to the economy, there is an urgent need to investigate the factors influencing their awareness and compliance behaviors. This study aims to explore the level of tax awareness among students at Kolej Poly-Tech MARA and identify the key variables that affect their understanding and behavior toward tax compliance. By doing so, the research hopes to provide insights that can be used to enhance educational strategies and policy measures geared toward fostering a well-informed and compliant future taxpayer base.

The study will also contribute to the growing body of literature on tax perceptions and compliance behavior. While existing research has largely focused on working adults and business entities, relatively few studies have concentrated specifically on students in Malaysian institutions of higher learning. As such, this research fills an important gap by providing empirical evidence on the tax awareness of a demographic that will soon transition into the formal economy.

Furthermore, the findings of this study may be used to inform curriculum developers, tax authorities, and education policymakers in designing more effective tax education programs tailored to student needs. This could include the integration of taxation modules into non-accounting courses, the establishment of tax clubs in universities, and collaboration between academic institutions and the IRB to deliver tax literacy campaigns. Ebimobowei and Duoduo (2023) emphasize the potential of such grassroots educational efforts in fostering sustainable economic growth and building a tax-compliant society.

In summary, taxation is a vital mechanism for national development, and tax compliance is deeply influenced by the level of awareness and understanding among citizens. The role of education in cultivating this awareness cannot be overstated. Students of higher learning institutions, including those at KPTM, are future taxpayers whose attitudes and behaviors towards taxation will have a long-lasting impact on national revenue collection. Understanding the factors that shape their tax awareness is therefore essential for designing effective interventions that promote a culture of compliance. This study seeks to explore these dynamics and provide meaningful recommendations to support Malaysia's ongoing efforts in strengthening its tax base through education and public engagement.

2 LITERATURE REVIEW

Taxpayer awareness among students plays a pivotal role in shaping future tax compliance behavior and promoting a responsible fiscal culture within society. As emerging contributors to the economy, students must develop a clear understanding of taxation principles and obligations. Numerous studies underscore the importance of tax education, ethical values, and behavioral factors in cultivating tax-compliant citizens.

Wardani and Aprianingsih (2019) demonstrated the effectiveness of innovative educational platforms, such as the "Tax Telling" microsite, in enhancing tax literacy among high school students. Their findings highlight the importance of interactive and accessible learning tools in building early-stage awareness. Similarly, Yasa et al. (2021) emphasized that integrating ethics into tax education is critical; ethical consciousness significantly influences students' intention to comply with tax laws. These studies collectively advocate for a holistic pedagogical framework—one that integrates cognitive learning with ethical reasoning to foster civic responsibility.

Complementing this perspective, Rahayu et al. (2019) found a direct correlation between increased tax knowledge and improved compliance behavior. Education not only informs students of procedural requirements but also fosters a greater sense of duty and trust in the tax system. Sanjaya et al. (2020) added that various internal factors—including awareness, comprehension of tax legislation, rational decision-making, and educational background—play substantial roles in shaping individual compliance behavior. These findings point to the multi-dimensional nature of taxpayer psychology, influenced by both personal and systemic variables.

On a policy level, Formanová et al. (2021) argue that the promotion of tax literacy should be part of a broader national education strategy. They call for long-term initiatives that embed fiscal education within school and university curricula to instill fiscal discipline from a young age. Uribe-Hernández (2023) echoed this need, stressing the value of foundational tax knowledge in preparing students for transparent and responsible economic participation. These arguments collectively establish education as a strategic lever in national efforts to build a tax-compliant society.

Furthermore, the role of institutions in facilitating tax education cannot be overstated. Bidari et al. (2023) investigated tax knowledge across university faculties and concluded that tax education should not be limited to business or accounting students but should permeate various academic disciplines. This aligns with Kurniawan's (2020) assertion that higher education exerts a long-term influence on tax attitudes and compliance behavior, reinforcing the value of curriculum-based interventions across fields.

Beyond formal instruction, institutional initiatives such as tax awareness campaigns, workshops, and peer-led programs also play a vital role. Ratnawati et al. (2019) demonstrated that heightened tax awareness magnifies the impact of other compliance drivers, including institutional accountability and service delivery quality. Ebimobowei and Duoduo (2023) further proposed the establishment of student-led tax clubs as grassroots mechanisms to foster peer-to-peer learning and increase the reach of tax education. These clubs can serve as engaging platforms for continuous learning, especially when complemented by simplified, relatable content.

In summary, the reviewed literature underscores that fostering taxpayer awareness among students necessitates a comprehensive, multi-tiered approach. This includes formal curricular integration, ethical instruction, interactive learning tools, and institutional partnerships. As students transition from academia to the workforce, their preparedness to meet tax obligations will be a crucial determinant of future compliance rates. Embedding tax education within academic institutions such as Kolej Poly-Tech MARA is therefore essential to equipping students with the knowledge, values, and behaviors required for a sustainable, tax-compliant society.

3 METHODOLOGY

This study employs a quantitative research design to investigate tax awareness and compliance behavior among students. A survey strategy will be utilized, with data collected through a structured questionnaire distributed to semester six students at Kolej Poly-Tech MARA (KPTM). This cohort was selected due to their proximity to graduation and impending entry into the workforce, making them a relevant target group for assessing future taxpayer behavior.

The data collection process will be conducted via an online platform, allowing for broader reach and convenience. A random sampling technique will be used to ensure the representativeness of the sample and to minimize selection bias.

The questionnaire comprises two main sections:

1. Demographic Information – including age, gender, program of study, and academic background.
2. Tax Knowledge and Awareness – focusing on students' understanding of tax compliance requirements, such as filing tax returns, awareness of obligations to the Inland Revenue Board (IRB), and general attitudes toward taxation. The items are adapted from validated instruments in previous studies (Mohamad, 2013; Sanusi et al., 2021).

Upon completion, the collected data will be analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics will be used to summarize the demographic profile and overall awareness levels. Inferential statistical tests, such as correlation and regression analysis, may be employed to examine relationships between tax knowledge, educational background, and compliance attitudes.

This methodological approach is designed to yield empirical insights that are both statistically reliable and practically relevant for informing educational and policy interventions.

4 CONCLUSION

Tax compliance serves as a critical foundation for national development, underpinning the government's ability to deliver public goods and services effectively. As this study highlights, enhancing tax awareness among students—particularly those at Kolej Poly-Tech MARA (KPTM)—is vital in shaping responsible future taxpayers. While public initiatives such as the Inland Revenue Board's (IRB) *Tax Education Month* have contributed to increasing awareness, significant gaps in understanding persist, especially among youth and young adults transitioning into the workforce.

Prior studies consistently reveal a widespread lack of tax literacy and poor compliance behavior among small and medium enterprises (SMEs) and younger demographics. For example, Hamid et al. (2021) found that most SMEs suffer from inadequate tax management and low levels of compliance knowledge—an issue likely rooted in early educational deficiencies. Similarly, Sanusi et al. (2021) reported that many Malaysian students and recent graduates overlook their responsibilities as future taxpayers. These findings reinforce the need for early and structured tax education.

Introducing tax concepts at the tertiary level, regardless of academic discipline, can equip students with the knowledge and ethical grounding necessary for long-term fiscal responsibility. As Soon (2020) emphasizes, basic tax filing knowledge is instrumental in shaping positive taxpayer attitudes. Early exposure to tax responsibilities can empower students to navigate tax systems confidently and avoid penalties, thereby fostering a culture of voluntary compliance.

This study aims to explore the key educational and behavioral factors influencing tax awareness among KPTM students. By identifying these determinants, the research will contribute actionable insights for curriculum developers, policymakers, and tax authorities. Institutions of higher learning, through cross-disciplinary integration of tax education and collaboration with agencies like the IRB, can play a transformative role in cultivating a more informed and compliant generation.

Looking forward, future research should broaden its scope to include students from diverse academic backgrounds and institutions across Malaysia. Comparative and longitudinal studies could provide deeper insights into the effectiveness of various educational interventions and help refine strategies for national tax literacy. Strengthening tax education is not only a tool for improving compliance but also an investment in Malaysia's fiscal sustainability and economic resilience.

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Innovative Educational Management in the 4IR Era: Strategies, Challenges, and Technological Integration (2015–2025)

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ABSTRACT

The Fourth Industrial Revolution (4IR) has profoundly reshaped the global educational landscape, compelling education systems to adapt to rapid technological transformations, including artificial intelligence, machine learning, and digital automation. This study conducts a Systematic Literature Review (SLR) to examine how educational management practices have evolved to address the emerging challenges and innovations of the 4IR era. The primary objective is to identify effective management strategies, highlight technological integration approaches, and uncover institutional barriers that influence educational outcomes in this technologically dynamic environment. Using the PRISMA framework, peer-reviewed articles published between 2015 and 2025 were systematically selected from Scopus, Open Alex, and Google Scholar databases. Inclusion criteria focused on studies addressing educational management in relation to digital innovation, policy reform, human capital development, and institutional adaptation. Following the SPAR-4-SLR protocol, 44 high-quality studies were critically analysed. The findings reveal three major thematic trends: (1) the critical role of adaptive leadership and digital policy formulation in managing educational transformation, (2) the integration of emerging technologies (AI, LMS, and IoT) in institutional operations and pedagogy, and (3) the persistent challenges in equity, infrastructure, and digital competence among stakeholders. The review also highlights the underrepresentation of empirical studies from Southeast Asia, pointing to a regional gap in evidence-based research. This SLR recommends a multi-stakeholder, future-oriented approach to educational management prioritizing innovation capacity, data-driven decision-making, and inclusive governance structures. Ultimately, this review serves as a foundational resource for policymakers, educational leaders, and researchers striving for excellence and resilience in managing education amidst 4IR transformations.

KEYWORDS: Educational management, 4IR, systematic literature review, educational technology, digital transformation, PRISMA, SPAR-4-SLR, innovation in education

1. INTRODUCTION

The Fourth Industrial Revolution (4IR) has brought about unprecedented technological advancements, reshaping the educational landscape. Educational institutions are compelled to integrate these innovations to prepare students for the demands of a rapidly evolving world (Udvaros et al., 2023). This response explores strategic approaches for educational institutions to effectively adopt and implement technological innovations in the 4IR era, drawing insights from relevant research papers.

Educational institutions must align their curricula with the demands of Industry 4.0, focusing on emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain. This alignment ensures that graduates are equipped with the skills required by the modern workforce.

For instance, incorporating project-based learning and interdisciplinary approaches can foster critical thinking and problem-solving skills, which are essential in the 4IR era (Coelho et al., 2024; Huggahalli, 2024).

The integration of technological innovations in educational institutions during the Fourth Industrial Revolution (4IR) requires strategic approaches that align with the evolving demands of the workforce and the educational landscape. Institutions must adapt their curricula and teaching methods to incorporate emerging technologies such as artificial intelligence, virtual reality, and data analytics, which are pivotal in preparing students for future challenges. This involves not only the adoption of new technologies but also a shift in pedagogical practices to foster essential skills like critical thinking, creativity, and adaptability (Beukes, 2019).

2. LITERATURE REVIEW

2.1 Integration of Technology in Education

Educational institutions are leveraging digital technologies to enhance learning experiences. This includes the use of virtual classrooms, online libraries, and digital platforms that facilitate remote learning and collaboration, making education more accessible and flexible (Darmansyah, 2019). The adoption of educational technologies such as big data, artificial intelligence, and the Internet of Things (IoT) is transforming teaching methods and learning environments. These technologies enable personalized learning experiences and help in developing digital literacy among students(Setyaningsih, 2020).

2.2 Interdisciplinary and Flexible Learning

The 4IR era emphasizes the need for interdisciplinary education, where the boundaries between different fields of study are blurred. This approach encourages students to develop a broad skill set that is adaptable to various industries (Hussin & Zakaria, 2018). Flexible education systems that support lifelong learning are becoming increasingly important. This involves creating curricula that are responsive to technological changes and industry demands, ensuring that students are equipped with relevant skills throughout their careers (Dr. Nitin Shrigiriwar & Dr. Vaibhav Bhalerao, 2022).

2.3 Open Learning Platforms and Global Classrooms

Open learning platforms and global classrooms are pivotal in the 4IR era, allowing students and educators to access a wealth of resources and collaborate across geographical boundaries. This fosters a more inclusive and diverse educational environment (Oke & Fernandes, 2020). These platforms support the democratization of education by providing opportunities for students from different backgrounds to engage in learning experiences that were previously inaccessible (Huy & Vinh Trien, 2020a).

2.4 Research Gaps

This systematic literature review provides a comprehensive synthesis of how educational management practices have evolved in response to the dynamic demands of the Fourth Industrial Revolution (4IR). Drawing upon 44 peer-reviewed articles published between 2015 and 2025, this review highlights the critical intersection of technological innovation, policy reform, institutional leadership, and sustainable education practices. The findings reveal that educational institutions globally are increasingly integrating digital technologies such as artificial intelligence, virtual learning environments, and the Internet of Things into their administrative and pedagogical frameworks to enhance adaptability, efficiency, and inclusivity.

Three dominant themes emerged from the analysis, the strategic importance of adaptive and digitally literate leadership; the growing implementation of transformative, interdisciplinary teaching and learning models; and the persistent barriers posed by infrastructural limitations, resistance to change, and inadequate professional development. Furthermore, socio-demographic

diversity, institutional readiness, and policy responsiveness were identified as key factors influencing the success of 4IR-aligned reforms.

Practically, this review underscores the need for educational institutions to prioritize smart organizational structures, invest in digital capacity-building, and cultivate an innovation-friendly culture. Theoretically, it contributes to the advancement of educational management literature by mapping a thematic framework that links institutional transformation to leadership dynamics and stakeholder engagement.

In moving forward, educational leaders, policymakers, and scholars must adopt a proactive and future-oriented approach one that not only responds to technological disruptions but also ensures sustainable and equitable outcomes for all learners. By addressing the identified challenges and leveraging strategic opportunities, educational institutions can position themselves as resilient agents of change in the rapidly evolving landscape of the 4IR era.

To guide this systematic review, the research formulated the following central question: "How have educational management practices evolved in response to the challenges and innovations brought about by the Fourth Industrial Revolution (4IR) between 2015 and 2025, and what are the key thematic trends, influencing factors, institutional barriers, and strategic interventions identified in the existing literature?" This question aims to uncover how institutions have adapted their leadership, policy frameworks, and technological integration to meet the demands of a rapidly transforming educational landscape driven by digital innovation and systemic change.

To answer this research question, the systematic review has specific objectives as follows:

1. What are the current trends and developments in educational management practices in response to the challenges and innovations brought by the Fourth Industrial Revolution (4IR) as reported in existing literature?
2. What is the key socio-demographic, institutional, and technological factors influencing the evolution of educational management during the 4IR era?
3. What challenges or barriers are commonly faced by educational institutions in adapting their management practices to meet the demands of 4IR-related innovations and disruptions?

The findings of this systematic literature review offer both theoretical and practical contributions to the field of educational management, particularly in the context of navigating the emerging challenges and innovations brought about by the Fourth Industrial Revolution (4IR). Theoretically, this review enriches the existing body of knowledge by offering a comprehensive understanding of how educational management practices have evolved in response to technological disruptions, shifting pedagogical paradigms, and organizational transformation in the 4IR era (Oh, 2020). It identifies key dimensions such as digital leadership, strategic planning, adaptive governance, and innovation-driven policy development as central themes in modern educational management (Chaka, 2023a). The review contributes to the literature by clarifying the influence of institutional, socio-technological, and policy-driven factors on how educational leaders implement change, manage digital transformation, and promote resilience in academic institutions (Jones et al., 2020). Furthermore, it presents an integrative thematic framework that connects managerial innovation with institutional performance and stakeholder engagement, providing a foundation for future research and theoretical model refinement in the domain of 4IR educational leadership (Huy & Vinh Trien, 2020).

Practically, the findings are of significant value to policymakers, educational administrators, academic leaders, and institutional reform advocates (Bühler et al., 2022a). This review highlights practical challenges faced by educational institutions, such as resistance to change, skill gaps among administrators, limited infrastructure for digital transformation, and inadequate professional development pathways. It also underscores the urgent need for structured interventions, including leadership training for digital competencies, data-driven decision-making frameworks, integrated technology systems, and collaborative governance models (Edelmann et al., 2023). Additionally, systemic issues such as bureaucratic inertia, funding constraints, and fragmented innovation policies are identified as key barriers to effective educational management in the 4IR context. Addressing these issues requires coherent policy

reform, investment in technological infrastructure, and a reimagining of leadership roles across educational settings (Tutar & Guler, 2022). Ultimately, this review provides a strategic roadmap for enhancing institutional agility and sustainability, reinforcing the role of educational management in preparing Malaysia's education system for the demands and opportunities of the Fourth Industrial Revolution (Belli & Doneda, 2020).

3. METHODOLOGY

The purpose of conducting this systematic review, guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, is to synthesize the existing body of knowledge on financial literacy, particularly within the context of higher education financing in Malaysia. To ensure methodological rigor and transparency, the process of data extraction and analysis followed the SPAR-4-SLR (Systematic Protocol for Academic Research – Stepwise Literature Review) framework, as proposed by (Paul et al., 2021). This approach enabled a structured and replicable review process aligned with the formulated research question.

The review began by systematically searching and selecting peer-reviewed journal articles from Scopus, Open Alex and Google Scholar databases, focusing on publications between 2015 and 2025. Abstracts were initially screened to determine relevance, followed by full-text reviews to identify recurring themes and sub-themes related to integration of technological innovations in educational institutions during the Fourth Industrial Revolution (4IR). The PRISMA flow diagram was utilized to document the four key stages of the review process: Identification, Screening, Eligibility, and Inclusion. This step-by-step method ensured that the final selection of studies met quality standards and directly contributed to addressing the research objectives. Through this approach, the review offers a comprehensive and evidence-based understanding of the integration of technological innovations in educational institutions during the Fourth Industrial Revolution (4IR)

1. **Identification**: The beginning stage is to identify relevant papers by conducting complete searches across databases and several other sources, following which the total count of detected records should be accurately stated for transparency and consistency purposes (Mehrotra et al., 2018).

2. **Screening**: In this stage, the focus was to remove of duplicates and the subsequent screening of the remaining records based on their titles and abstracts to ensure that the number of data records that have been excluded is correct as well as those included are for further evaluation (Abdul Razak et al., 2022).

3. **Eligibility**: To ensure that the researcher have the significant collected data, by excluded and included based on the chosen criteria, researcher need to conducted using analyse through assessment of full-text articles from the remaining data. After the removing the duplicate data, the remaining data will continue to extract using the specific assessment. The data selection for example to sorting out the data that meet the criteria of exclusion and included has been conducted through this stage. The specific reason will be stated if the data is excluded to ensure that transparency of selection process meet the requirement (Page et al., 2021).

4. **Included**: In this phase, the data that have been successfully met the eligibility criteria and are deemed suitable for inclusion. It is crucial to disclose the total number of studies that have been included in both the qualitative and quantitative analysis, particularly in the context of meta-analysis, to offer a comprehensive overview of the research findings (Page et al., 2021).

The methodological approach included defining eligibility criteria, deriving a search strategy for article identification, performing data extraction systematically and synthesizing findings in research and assessing the quality of systematic review methodology. In this systematic review, the selection criteria are structured to include pertinent research that are directly relevant to answer the research question. Another inclusion criteria are research had to be published in English language over the last 10 years (2015-2025).

3.1. Search Strategy

At this stage of the keyword research process, all relevant synonyms, related terms, and conceptual variants of the main keywords were systematically explored. A structured search strategy, as outlined in Table 1, was implemented across three major academic databases: Scopus, Open Alex, and Google Scholar. The search employed a controlled vocabulary and keywords such as "educational management," "4IR," "educational leadership," "digital transformation in education," "adaptive learning systems," and other related terms to ensure a comprehensive retrieval of literature relevant to the evolution of educational management practices in the Fourth Industrial Revolution (4IR) era. These databases were selected for their comprehensive coverage of high-quality, multidisciplinary, and peer-reviewed research with global academic relevance (Jagadisen et al., 2022).

The literature search was restricted to studies published between 2015 and 2025, in order to capture the most current developments, frameworks, and innovations in educational management aligned with 4IR demands. Supplementary search methods were also applied, including manual screening of bibliographic references from key studies and expert consultations with scholars in educational leadership, policy, and digital pedagogy. This dual approach ensured both the breadth and depth of coverage necessary to address how educational management practices have adapted to the disruptive forces and technological advancements characterizing the 4IR era (Siddaway et al., 2019).

Table 1: Keywords used in this study

Databases	Keywords Used
Scopus Google Scholar Open Alex	• Digital Transformation in Education • Innovation in Educational • Technological Change in Education • Adaptive Learning Systems • Institutional Readiness for 4IR • Strategic Education Policy • Educational Innovation Management • Challenges in 4IR Education • EdTech Leadership • Pedagogical Shifts in 4IR Era

In this study, the authors were able to extend existing keywords and develop a broad search string using Boolean operators, phrase searching, truncation, wild cards, and field code functions in the three main databases accessed: Scopus, Open Alex and Google Scholar whose search strings are shown in Table 2.

Table 2. Search string used in this study

Database	Search String
Scopus	ALL (""educational management" OR "school leadership" OR "institutional governance") AND ("Fourth Industrial Revolution" OR "4IR" OR "digital transformation") AND ("Malaysia" OR "higher education")
Google Scholar	("educational innovation" OR "leadership in 4IR" OR "digital education strategy") AND ("school management"' OR "institutional leadership") AND ("Malaysia" OR "education sector")
Open Alex	("educational transformation" OR "4IR in education" OR "adaptive learning systems") AND ("leadership response" OR "policy reform") AND ("higher education" OR "Malaysia")

Screening

The second stage involved screening the articles. The goal of the first screening stage was to eliminate duplicate articles. In this process, leaving 290 articles to be evaluated using specific inclusion

and exclusion criteria:

- Only journal research articles were included because they provide related article topics. Excluded publications included book series, books, book chapters, meta-analyses, systematic reviews, and conference proceedings.
- Only English-language publications were considered.
- In order to meet the goals of the review, the emphasis was on studies conducted in the field of research study.

These criteria allowed for the exclusion of 290 papers (see Table 3), leaving 44 articles suitable for review

Eligibility

The whole articles were examined at the third step, which was the eligibility check. At this point, the writers went through the remaining pieces by hand to make sure they fulfilled the requirements. Reading the abstracts and titles was required for this stage. Because this study will concentrate educational management practices have evolved to address the emerging challenges and innovations of the 4IR era, 290 articles were consequently eliminated. In the end, a mere 44 articles fulfilled the requirements and were chosen for additional examination as per shown in Figure 1: PRISMA.

3.2. Study Selection

The study selection process shown in Table 3, was conducted in four stages: Identification, Screening, Eligibility, and Included. Initial screening via titles and abstracts and full-text evaluation against the eligibility criteria Screening and full-text review were performed independently by two reviewers, and the disagreements were resolved by consensus or consultation of the third reviewer (Mehrotra et al., 2018; Page et al., 2021). The exclusion criteria included (1) Duplicated articles. (2) Articles not published in journals. (3) Articles published under 2015. (4) Articles in languages other than English. (5) Journal articles with selected empirical data which means that review articles, book series, books, chapters in books and conference proceedings all are excluded. (5) Articles which not focused on evolution of educational management practices in the Fourth Industrial Revolution (4IR) era are not included.

Table 3: Inclusion and exclusion Criteria

Criteria	**Inclusion**
Population:	Studies focused on educational leaders, school administrators, policymakers, or institutions (primary, secondary, or tertiary) implementing management practices in response to 4IR challenges
Intervention:	Research examining educational management strategies, digital leadership, institutional transformation, policy adaptation, or innovation initiatives linked to the 4IR era.
Comparator	Studies comparing traditional versus modern (4IR-aligned) educational management approaches or institutions with varying levels of digital readiness and innovation adoption.
Outcomes:	Outcomes related to institutional effectiveness, leadership adaptability, technological integration, staff capacity building, or student engagement in 4IR-driven environments.
Study Design:	Quantitative, qualitative, and mixed-methods studies
Publication Date:	Studies published between 2015 and 2025 to reflect recent and relevant insights into educational management evolution during the rise of 4IR.
Language:	Studies published in English

Criteria	Exclusion
Population:	Studies focused on non-educational institutions, corporate or industrial sectors, or non-formal education settings unrelated to school or higher education management.
Intervention:	Studies unrelated to educational management or leadership, such as purely pedagogical methods, non-administrative technology use, or general teaching strategies
Comparator	Studies lacking a comparative framework, such as those without discussion on traditional vs. 4IR-aligned practices or without institutional or policy-level perspectives
Outcomes:	Studies that do not report outcomes related to management evolution, digital transformation institutional innovation, or leadership responses to 4IR challenges
Study Design:	Conference abstracts, opinion pieces, editorial articles, and unpublished dissertations or theses.
Publication Date:	Studies published before 2015
Language:	Studies not published in English

A PRISMA flow diagram illustrated in Figure 1, the selection process, documenting numbers at each stage (Ardern et al., 2022). Initially, 290 articles were obtained from three databases illustrate thru pie chart in Figure 2, (Scopus: 19 articles), (Google Scholar: 14 articles) and (Open Alex: 13). After following the exclusion criteria, only 44 articles remained. Most of the items were discarded because the filter was applied last ten years (2015-2025), only articles in English and duplicate articles.

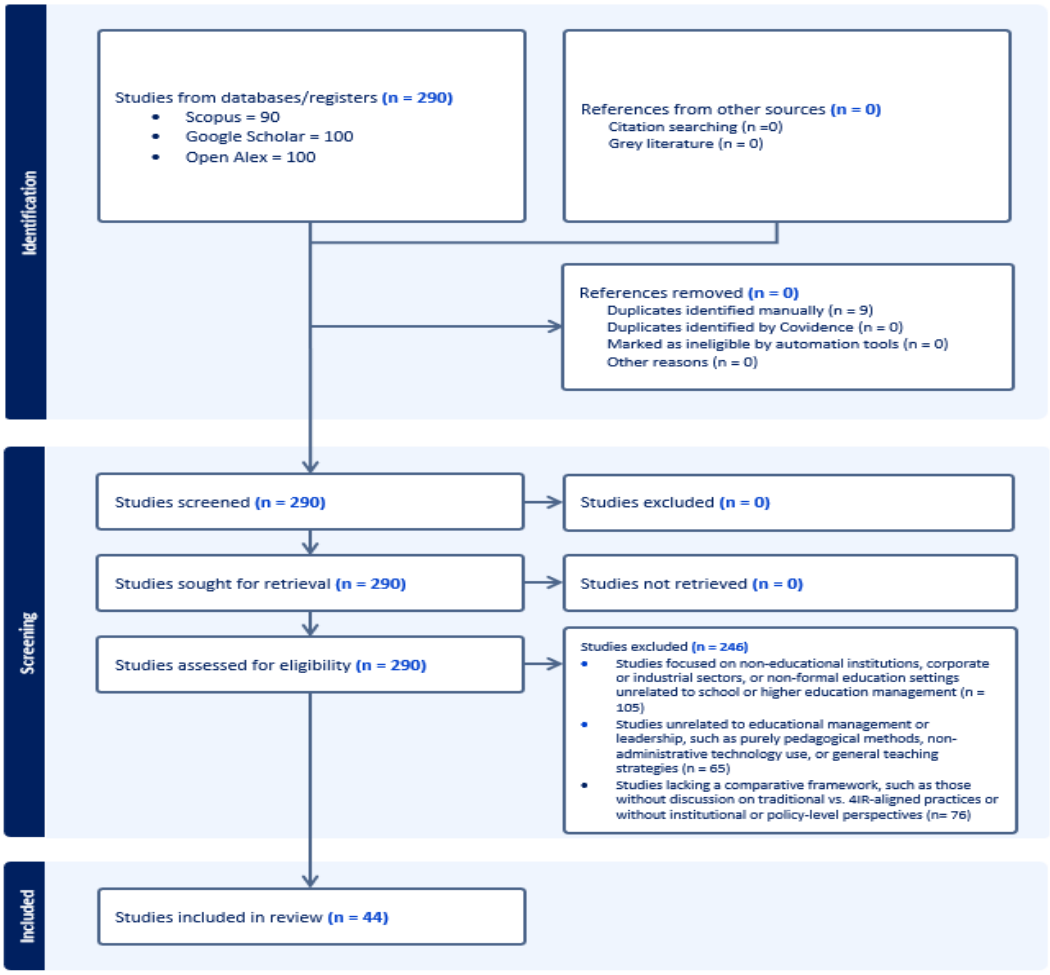


Figure 1 : PRISMA

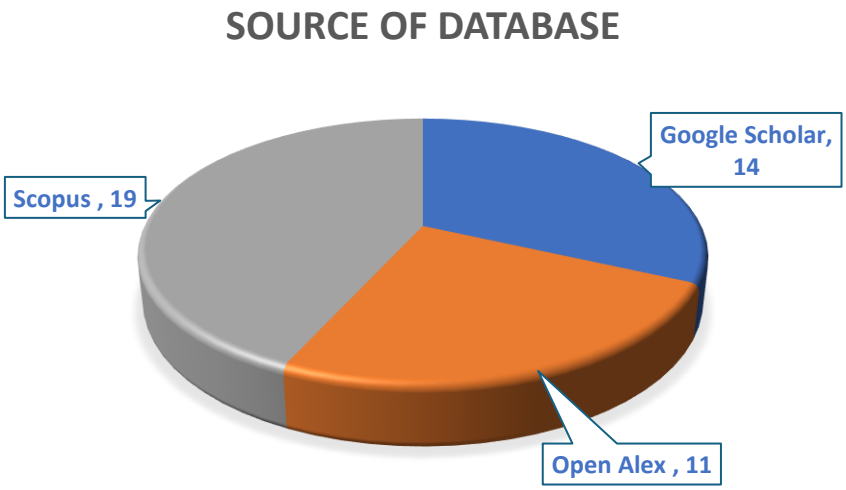


Figure 2: Source of Database

Table 4: Included Articles Summary

No.	Authors	Title	Year	Source title	Source
1	Beke E.; Tick A.	Applicability Of Education 4.0 In Higher Education: Engineering Students' Survey	2024	Journal of Technology and Science Education	Scopus
2	Schlebusch G.; Bhebhe S.; Schlebusch L.	Technology Integration in Teacher Education Practices in Two Southern African Universities	2024	Open Education Studies	Scopus
3	Jin S.J.; Abdullah A.H.; Mokhtar M.; Abdul Kohar U.H.	The Potential of Big Data Application in Mathematics Education in Malaysia	2022	Sustainability (Switzerland)	Scopus
4	Mogas J.; Palau R.; Fuentes M.; Cebrián G.	Smart schools on the way: How school principals from Catalonia approach the future of education within the fourth industrial revolution	2022	Learning Environments Research	Scopus
5	Shahzad M.F.; Xu S.; Baheer R.	Assessing the factors influencing the intention to use information and communication technology implementation and acceptance in China's education sector	2024	Humanities and Social Sciences Communications	Scopus
6	Ahmed S.; Taqi H.M.M.; Farabi Y.I.; Sarker M.; Ali S.M.; Sankaranarayanan B.	Evaluation of Flexible Strategies to Manage the COVID-19 Pandemic in the Education Sector	2021	Global Journal of Flexible Systems Management	Scopus
7	Naidoo J.; Reddy S.	Embedding Sustainable Mathematics Higher Education in the Fourth Industrial Revolution Era Post-COVID-19: Exploring Technology-Based Teaching Methods	2023	Sustainability (Switzerland)	Scopus
8	Oke A.; Fernandes F.A.P.	Innovations in teaching and learning: Exploring the perceptions of the education sector on the 4th industrial revolution (4IR)	2020	Journal of Open Innovation: Technology, Market, and Complexity	Scopus
9	Ebekozien A.; Hafez M.A.; Aigbavboa C.; Samsurijan M.S.; Al-Hasan A.Z.; Nwaole A.N.C.	Appraising Education 4.0 in Nigeria's Higher Education Institutions: A Case Study of Built Environment Programmes	2024	Sustainability (Switzerland)	Scopus
10	Bandono A.; Mukhlis M.; Susilo A.K.; Prabowo A.R.; Maksum A.	Collaborative Learning in Higher Education in the Fourth Industrial Revolution: A Systematic Literature Review and Future Research	2023	International Journal of Learning, Teaching and Educational Research	Scopus
11	Zainal Abidin N.B.; Mat Jan N.A.; Othman A.Z.; Thiruchelvam L.; Jinn L.S.; Abdullah Sani S.A.; Haris N.I.; Aziz N.A.	A Five-Year Bibliometric Analysis of Education 4.0 and Direction for Education 5.0 Future Research	2023	International Journal of Learning, Teaching and Educational Research	Scopus
12	Suryadi; Muslim A.Q.; Setyono L.	Exploring the Nexus of Digital Leadership and Digital Literacy on Higher Education Performance: The Role of Digital Innovation	2024	European Journal of Educational Research	Scopus
13	Sikora A.; Titova-Kosturkova T.; Janevska G.; Kostov M.;	EREMI: An Innovative Interdisciplinary Approach for Higher Education in Resource Efficient Manufacturing Environments	2023	Sustainability (Switzerland)	Scopus

	Halunga S.; Suciu G.; Georgiev G.				
14	Almutairi Y.M.N.; Al-Saad A.F.; Elmelegy R.I.; Bakr A.A.H.; Abdallah M.A.R.; Almotairi K.M.N.	Fourth industrial revolution and higher education in the Kingdom of Saudi Arabia	2024	Frontiers in Education	Scopus
15	Ülker N.	Reflecting trends of the contemporary academic landscape in the context of Higher Education 4.0	2024	Frontiers in Education	Scopus
16	EL-Nwasany R.I.; Bakr A.F.; Fathi A.A.	A Sustainable Vision for Technical Education 4.0 of Post COVID-19	2024	Sustainability (Switzerland)	Scopus
17	Al-Maskari A.; Al Riyami T.; Ghnimi S.	Factors affecting students' preparedness for the fourth industrial revolution in higher education institutions	2024	Journal of Applied Research in Higher Education	Scopus
18	Saad S.; Jambari H.; Jamal A.H.M.; Saud S.; Osman S.; Hamzah F.	Factors Affecting the Level of Achieving Employability 4.0 of Hearing-Impaired Special Education Students	2023	Journal of Technical Education and Training	Scopus
19	Al-Riyami T.; Al-Maskari A.; Al-Ghnimi S.	Faculties' Behavioural Intention Toward the Use of the Fourth Industrial Revolution Related Technologies in Higher Education Institutions	2023	International Journal of Emerging Technologies in Learning	Scopus
20	Delipiter Lase	Education And Industrial Revolution 4.0	2019	Journal Handayani	Open Alex
21	Bongani Thulani Gamede, Oluwatoyin Ayodele Ajani, Olufemi Sunday Afolabi	Exploring the Adoption and Usage of Learning Management System as Alternative for Curriculum Delivery in South African Higher Education Institutions during Covid-19 Lockdown	2021	International Journal of Higher Education	Open Alex
22	Kapil Joshi, Rajesh Kumar, Salil Bharany, Dilip Kumar Jang Bahadur Saini, Rajiv Kumar, Ashraf Osman Ibrahim, Abdelzahir Abdelmaboud, Wamda Nagmeldin, Mohammad Medani	Exploring the Connectivity Between Education 4.0 and Classroom 4.0: Technologies, Student Perspectives, and Engagement in the Digital Era	2024	IEEE Access	Open Alex
23	Peter Mulwa F Mbithi, Judith Mbau, Nzioka John Muthama, Hellen N. Inyega, Jeremiah M. Kalai	Higher Education and Skills Development in Africa: An Analytical Paper on the Role of Higher Learning Institutions on Sustainable Development	2021	Journal of Sustainability Environment and Peace	Open Alex
24	Dickson Mdhlalose, Gloria Mlambo	Integration of Technology in Education and its Impact on Learning and Teaching	2023	Asian Journal of Education and Social Studies	Open Alex

25	Roselyn Gonzales, Rose Mary Almacen, Gamaliel Gonzales, Felix Costan, Decem Suladay, Lynne Enriquez, Emily Costan, Nadine May Atibing, Joerabell Lourdes Aro, Samantha Shane Evangelista, Fatima Maturan, Egberto Selerio, Lanndon Ocampo	Priority Roles of Stakeholders for Overcoming the Barriers to Implementing Education 4.0: An Integrated Fermatean Fuzzy Entropy-Based CRITIC-CODAS-SORT Approach	2022	Complexity	Open Alex
26	Chinaza Uleanya, Ke Yu	Review of Preparedness of Rural African Communities Nexus Formal Education in the Fourth Industrial Revolution	2019	South African Review of Sociology	Open Alex
27	Folake Ruth Aluko, Greig Krull, Ephraim Mhlanga	Shaping open, distance and e-learning in post school education and training: A call for a revised agenda	2022	Perspectives in Education	Open Alex
28	Maria Tsakeni	STEM Education Practical Work in Remote Classrooms: Prospects and Future Directions in the Post-Pandemic Era	2022	Journal of Culture and Values in Education	Open Alex
29	Nonhlanhla N. Mkhize, Nobuhle Ndimande-Hlongwa, Labby Ramrathan, JA Smit	Teaching and Learning in Higher Education in the Time of COVID-19	2020	Research Gate	Open Alex
30	Suraya Hashim, Muhd Khaizer Omar, Habibah Ab Jalil, Nurfadhlina Mohd Sharef	Trends on Technologies and Artificial Intelligence in Education for Personalized Learning: Systematic Literature Review	2022	International Journal of Academic Research in Progressive Education and Development	Open Alex
31	G Suganya	A study on challenges before higher education in the emerging fourth industrial revolution	2017	International Journal of Engineering Technology Science and Research (IJETSR)	Google Scholar
32	I Makarova, K Shubenkova, P Buyvol…	Interaction between education and business in digital era	2018	IEEE Industrial Cyber-Physical Systems (ICPS)	Google Scholar
33	NW Gleason	Higher education in the era of the fourth industrial revolution	2018	Springer Nature Link	Google Scholar
34	NW Gleason	Singapore's higher education systems in the era of the fourth industrial revolution: Preparing lifelong learners	2018	Higher Education in the Era of the Fourth Industrial Revolution	Google Scholar
35	RM Lee, Y Yuan	Innovation education in China: Preparing attitudes, approaches, and intellectual environments for life in the automation economy	2018	Higher Education in the Era of the Fourth Industrial Revolution	Google Scholar
36	T Farrelly	Education for a sustainable Fourth Industrial Revolution	2018	Academia	Google Scholar
37	VE Ramirez	Sustainability standards: the new quality assurance for higher education in the fourth industrial revolution (4IR)	2018	Research Gate	Google Scholar
38	W Naudé	Entrepreneurship, education and the fourth industrial revolution in Africa	2017	Institute Labor of Economics	Google Scholar

39	T Наранмандах	Digital Skills and Education Sector Development in a Changing ICT Environment: Some Aspects and Trends	2018	Journal of Accounting Theory and Practice	Google Scholar
40	Olele C.N.; Abraham L.N.; Emasealu H.U.	The changing nature of academic libraries in the digital era: A focus on five higher education institutions in Rivers State	2015	International Journal of Educational Organization and Leadership	Google Scholar
41	Njie B.; Asimiran S.B.; Basri R.B.; Kadir S.B.A.	Historical development of higher education and quality assurance in Southeast Asia	2015	International Journal of Management in Education	Google Scholar
42	Papachristos G.; Cunningham S.; Thissen W.	How to value education in an era of fast technological change	2015	IEEE Engineering Management Review	Google Scholar
3	Govender V.; Rampersad R.	Change management in the higher education landscape: A case of the transition process at a South African University	2016	Risk Governance and Control: Financial Markets and Institutions	Google Scholar
44	Lakkala S.; Lakkala P.; Tervonen P.; Haapasalo H.	Critical factors of CRM implementation in a higher education institution	2025	International Journal of Management in Education	Google Scholar

4. FINDINGS / RESULTS AND DISCUSSION

Data extraction in Table 5, utilized a standardized form to capture key study details:

- Study Characteristics: Author(s), publication year, country of study, and journal or publication outlet.
- Participant Details: Sample size, demographic characteristics (for example age, gender, role such as teacher, student, administrator), field of education, and whether participants were from institutions actively engaged in 4IR-era educational reforms.
- Financial Literacy Focus Areas: Aspects studied such as digital leadership, strategic planning in technology adoption, policy adaptation to 4IR trends, teacher digital competency, and institutional readiness for innovation.
- Measured Outcomes: Indicators such as effectiveness of management strategies, technology integration levels, staff digital literacy, student engagement, organizational adaptability, and institutional performance in implementing 4IR innovations.
- Research Design and Methodology: Study type (qualitative, quantitative, or mixed methods), data collection tools (interviews, surveys, institutional reports), and analytical techniques used (thematic analysis, regression, SWOT analysis).

To ensure accuracy and consistency two reviewers independently extracted data and any discrepancies were resolved through discussion or by consulting a third reviewer (Regona et al., 2022).

Table 5: Data extraction details

Study Details	Items
Study Characteristics:	Author(s), year of publication, title, journal or conference outlet focusing on educational management or 4IR-related themes
Population:	Sample size, demographic information (e.g., age, gender, role - teacher, student, administrator), education level, institutional type, and geographic location
Intervention:	Key educational management practices examined (digital leadership, curriculum innovation, infrastructure planning, teacher training for 4IR readiness)
Comparator:	Comparisons between institutions adopting 4lR innovations versus traditional practices, or comparisons across educational levels (tertiary vs. secondary)
Outcomes:	Measured outcomes such as institutional performance, digital competency, leadership effectiveness, staff readiness, or student engagement in tech-integrated environments
Key Findings:	Summary of major findings, observed trends, and implications for educational institutions managing change in the 4IR era
Methodological Quality:	Assessment of study design, data collection methods (e.g., surveys interviews, content analysis), and identification of potential limitations or biases

The range of publication years for the included literature spans from 2015 to 2025, as shown in Figure 3. The data illustrates the evolution of research activity over time, reflecting scholarly interest in educational management practices in response to the challenges and innovations introduced by the 4th Industrial Revolution (4IR).

The publication frequency reveals dynamic shifts. From 2015 to 2017, the number of studies remained relatively low, with only 1–3 publications annually. A noticeable surge occurred in 2018, with 7 studies, suggesting growing academic awareness of the need to adapt educational systems to 4IR demands. Interest slightly tapered in 2019 and 2020, stabilizing at 2 publications per year, potentially due to transitional phases in institutional readiness and research direction.

A renewed upswing was observed from 2021 onward, with 3 to 7 publications per year, and a significant spike in 2024 with 10 studies the highest within the review period. This peak likely corresponds to increased national and institutional emphasis on digital transformation, AI integration in classrooms, leadership adaptability, and policy reforms in education triggered by 4IR imperatives. The decline to just 1 publication in 2025 may be due to the timing of data collection or ongoing research yet to be published.

Overall, the publication trend underscores a growing and maturing interest in educational management within the 4IR landscape. It highlights the urgency for continuous empirical investigation into how institutions, educators, and leaders navigate technological advancements, workforce alignment, and pedagogical innovations in preparing learners for future-ready education systems.

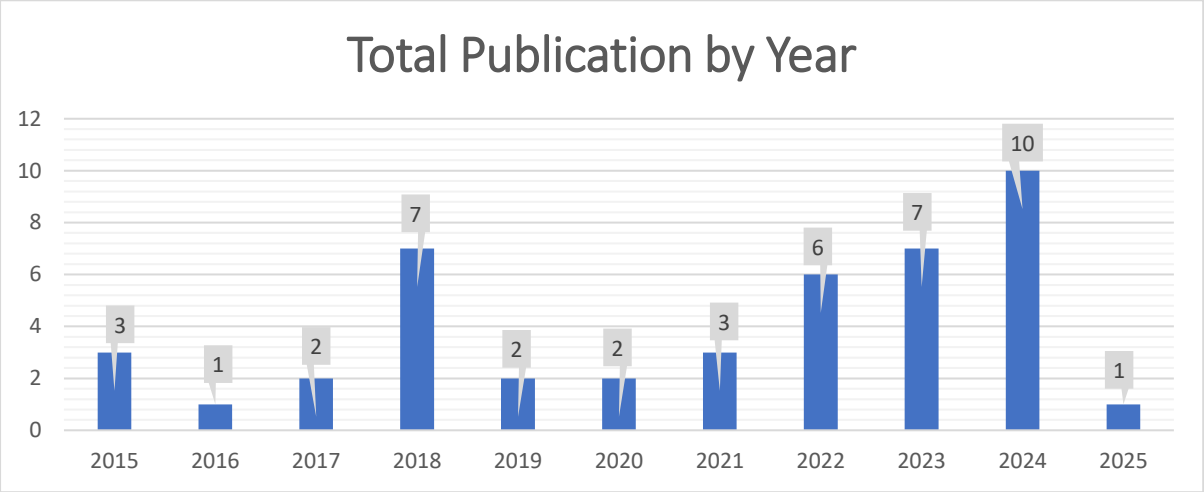


Figure 3: Frequency of publication per year

Table 6 illustrates the publication trends across a diverse array of academic journals related to educational management within the context of the 4th Industrial Revolution (4IR). A total of 44 publications were reviewed, reflecting a growing scholarly engagement with how educational institutions are responding to digital disruption, automation, and the evolving demands of future-ready learning environments.

Prominent outlets such as Frontiers in Education, Sustainability (Switzerland), and Higher Education in the Era of the Fourth Industrial Revolution featured multiple studies, underscoring their pivotal role in advancing discourse on 4IR-driven educational transformation. Several interdisciplinary journals such as IEEE Access and the International Journal of Emerging Technologies in Learning also contributed key insights on topics ranging from smart learning ecosystems and cyber-physical systems to digital leadership and institutional adaptability.

The diversity of journals spanning education, technology, management, and innovation demonstrate the cross-sectoral importance of 4IR-related educational reforms. The presence of both theoretical and applied research across these journals indicates a balanced focus on conceptual frameworks and real-world institutional strategies for navigating 4IR challenges.

This distribution pattern reflects increasing awareness among educators, policymakers, and researchers about the need for resilient, agile, and technology-integrated educational management practices. It emphasizes the urgency for ongoing, multi-disciplinary investigations into leadership strategies, infrastructure investment, digital competencies, and pedagogical innovation to meet the needs of learners and institutions in the 4IR era.

Table 6: List of Journals by year

Name of Journals	Count of Title
Academia	1
Asian Journal of Education and Social Studies	1
Complexity	1
European Journal of Educational Research	1
Frontiers in Education	2
Global Journal of Flexible Systems Management	1
Higher Education in the Era of the Fourth Industrial Revolution	2
Humanities and Social Sciences Communications	1
IEEE Access	1
IEEE Engineering Management Review	1
IEEE Industrial Cyber-Physical Systems (ICPS)	1
Institute Labor of Economics	1
International Journal of Academic Research in Progressive Education and Development	1
International Journal of Educational Organization and Leadership	1
International Journal of Emerging Technologies in Learning	1
International Journal of Engineering Technology Science and Research (IJETSR)	1
International Journal of Higher Education	1
International Journal of Learning, Teaching and Educational Research	2
International Journal of Management in Education	2
Journal Handayani	1
Journal of Accounting Theory and Practice	1
Journal of Applied Research in Higher Education	1
Journal of Culture and Values in Education	1
Journal of Open Innovation: Technology, Market, and Complexity	1
Journal of Sustainability Environment and Peace	1
Journal of Technical Education and Training	1
Journal of Technology and Science Education	1
Learning Environments Research	1
Open Education Studies	1
Perspectives in Education	1
Research Gate	2
Risk Governance and Control: Financial Markets and Institutions	1
South African Review of Sociology	1
Springer Nature Link	1
Sustainability (Switzerland)	5
Grand Total	44

4.1. Thematic Analysis of the Included Literature

Content analysis was performed on the manifested contents of included literature to identify the themes. The purpose of the analysis was to answer the research questions and corroborate the findings. The second stage of analysis used the PRISMA quality checklist to analyse the literature (Cortese et al., 2022). This stage gave attention to the introduction, methods,

results, and discussion sections of the literature. There are three questions of interest pertaining to leadership and sustainability as discussed below.

4.1.1 What are the current trends and developments in educational management practices in response to the challenges and innovations brought by the Fourth Industrial Revolution (4IR) as reported in existing literature?

The Fourth Industrial Revolution (4IR), marked by rapid technological advancements, is fundamentally reshaping various sectors, including education. In response, educational management practices are evolving to address both the opportunities and challenges posed by this transformation(Zhang et al., 2023). These practices increasingly emphasize the integration of digital technologies, the promotion of sustainability, and the adoption of innovative pedagogical models to ensure that educational institutions remain relevant and effective in a rapidly changing environment (Moro et al., 2023).

The integration of technology into education has become a central focus. Digital tools and platforms such as Agile collaborative systems are now frequently utilized in academic settings to support the collaborative management of learning activities. These tools are grounded in the theory of connectivism, which underscores the importance of learning through networks and technological connections (Ng & Lo, 2023). The onset of the COVID-19 pandemic accelerated the adoption of online and distance learning, revealing both the potential and the limitations of educational technology integration. For instance, while countries like China and India were relatively well-prepared, others such as Pakistan faced significant infrastructural and readiness challenges in implementing effective online education systems (García-Hernández et al., 2023).

Parallel to technological integration, pedagogical innovations are being embraced to foster more active and transformative learning environments. Active learning methodologies, including problem-based, challenge-based, and project-based approaches, have gained prominence for their ability to engage students and promote deeper learning. These methods are closely aligned with the objectives of Education for Sustainable Development (ESD), which seeks to equip learners with the competencies required for addressing global sustainability challenges (Esteve-Mon et al., 2023). Transformative pedagogical strategies such as co-creation and storytelling are also being employed to cultivate critical thinking and sustainability awareness among students. Moreover, Agile methodologies, originally developed for the software industry, are being adapted in educational settings to enhance learner adaptability, creativity, and collaborative skills, which are vital for thriving in the uncertain landscape of 4IR.

Sustainability, particularly through the lens of ESD, is another key component of contemporary educational management. Institutions are reorienting their curricula to embed sustainability principles and align with the United Nations Sustainable Development Goals (SDGs) (Adams et al., 2023a). This shift extends to teacher education, where programs are being revised to incorporate sustainability content and foster the development of future educators who are prepared to meet the socio-environmental challenges of the 21st century. Professional development initiatives now increasingly include training on ESD to ensure that educators possess the necessary skills and knowledge to promote sustainability in their teaching practices (Weiss et al., 2021).

Despite these advancements, several barriers hinder the effective implementation of 4IR-oriented reforms. Key challenges include insufficient training, limited resources, and a general lack of awareness among educators. Addressing these issues requires targeted institutional support and comprehensive capacity-building initiatives. Additionally, the impact of 4IR is not uniform across regions. For example, higher education institutions in Pakistan are striving to reconcile global sustainability expectations with local infrastructural and socio-economic constraints (Filho et al., 2023).

In conclusion, the evolution of educational management practices in the 4IR era reflects a growing commitment to integrating digital technologies, advancing sustainability, and fostering innovative teaching methodologies. To fully realize the potential of these transformations, future strategies must prioritize enhanced teacher training, increased investment in educational resources, and strengthened international collaboration. Such efforts are essential to support

educational institutions in navigating the complex and dynamic challenges of the Fourth Industrial Revolution.

4.1.2 What is the key socio-demographic, institutional, and technological factors influencing the evolution of educational management during the 4IR era?

The evolution of educational management in the era of the Fourth Industrial Revolution (4IR) is shaped by a complex interplay of socio-demographic, institutional, and technological factors. As rapid technological advancements redefine global systems, the education sector is experiencing significant shifts in both pedagogical approaches and administrative practices (Whalley et al., 2021). These transformations necessitate a comprehensive reassessment of traditional educational management strategies to align with the demands of a digitally driven and innovation-cantered environment (Bühler et al., 2022).

Socio-demographic factors play a critical role in this evolution. The diverse backgrounds and learning needs of contemporary student populations require educational institutions to adopt more flexible, inclusive, and student-cantered management approaches (Elayyan, 2021). As the 4IR accelerates, institutions are expected to accommodate various learner profiles, ensuring equitable access to education that is responsive to differing socio-economic and cultural contexts. Educators, in particular, are increasingly positioned as key agents of change (Leighter et al., 2019). They are expected not only to adapt to emerging pedagogical paradigms but also to cultivate critical thinking, sustainability awareness, and independent judgment among students. This requires a paradigm shift in teacher preparation and continuous professional development, with a strong emphasis on transformative learning and sustainability education (Parry & Metzger, 2023).

Institutionally, the integration of Education for Sustainable Development (ESD) into academic curricula represents a pivotal reform. Educational institutions are progressively embedding sustainability principles within their instructional frameworks, which necessitates interdisciplinary curriculum design and a commitment to long-term educational transformation (Adams et al., 2023b). Effective leadership and a coherent institutional vision are also fundamental to this process. Institutional leaders must foster transparent communication among all stakeholders, promote collaborative governance, and build organizational cultures that support innovation, adaptability, and inclusive participation (Machado & Davim, 2023a).

Technological advancement is another decisive factor influencing educational management in the 4IR era. Emerging technologies such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and the Internet of Things (IoT) are revolutionizing teaching and learning by enabling immersive and experiential learning environments that mirror real-world scenarios (Al-Gindy et al., 2020). These tools not only enhance student engagement but also demand new competencies from educational managers (Huang et al., 2023). The broader process of digital transformation further entails the adoption of digital platforms and administrative tools that streamline operations, facilitate data-driven decision-making, and improve both instructional delivery and institutional efficiency. As such, educational leaders must possess both technological literacy and strategic foresight to navigate these advancements effectively (Aguayo et al., 2020).

In light of these developments, the trajectory of educational management in the 4IR era presents both significant opportunities and complex challenges. Institutions must develop robust frameworks to guide the integration of digital technologies, while simultaneously addressing the evolving needs of diverse student populations (Mystakidis & Lympouridis, 2023). Future research should prioritize the formulation of adaptable strategies that support the sustainable and inclusive adoption of 4IR technologies in educational contexts. Moreover, deeper inquiry into the socio-demographic and institutional determinants of educational management effectiveness is necessary to inform policy and practice (Machado & Davim, 2023a). Such investigations will be essential in equipping educational institutions to thrive in an increasingly dynamic, interconnected, and technologically sophisticated world.

4.1.3 What challenges or barriers are commonly faced by educational institutions in adapting their management practices to meet the demands of 4IR-related innovations and disruptions?

The Fourth Industrial Revolution (4IR), defined by the rapid advancement of digital technologies, is significantly transforming all sectors, including education. Educational institutions are increasingly required to reassess and adapt their management practices to align with the disruptions and innovations brought about by 4IR. However, this transition is complex and multifaceted, encompassing technological, organizational, and cultural dimensions (Huy & Vinh Trien, 2020c). The integration of 4IR-related changes into educational systems presents numerous challenges that must be systematically addressed to ensure institutional resilience and relevance in an evolving global landscape.

From a technological standpoint, one of the foremost challenges is the effective integration of Information and Communication Technology (ICT) and digital tools into educational environments (Chaka, 2023b). Many institutions, particularly in developing regions, continue to grapple with insufficient infrastructure, inadequate internet access, and a lack of trained personnel to implement and manage technological systems efficiently. The rapid pace of technological innovation frequently outpaces institutional capacity to adapt, often resulting in outdated practices and fragmented digital ecosystems. Additionally, the increasing reliance on digital platforms necessitates the development of robust data management and cybersecurity systems (Spoettl & Tūtlys, 2020). Protecting sensitive student and institutional data has become a critical concern, requiring institutions to invest in comprehensive data governance frameworks and policies.

Organizational challenges further compound these technological issues. Resistance to change among faculty and administrative staff often poses a significant barrier to the successful adoption of new technologies and pedagogical approaches. Institutional inertia manifested in adherence to traditional routines and reluctance to embrace innovation can delay or undermine transformation efforts (Istikomah et al., 2021). Resource allocation also remains a major concern. Budgetary constraints limit the ability of many institutions to invest in advanced technologies or to provide the necessary training and support for staff. Moreover, competing priorities within higher education institutions may divert attention and resources away from 4IR-related initiatives, hampering their effective implementation (Zavera, 2019).

Cultural and educational challenges are equally significant in the context of 4IR. One of the most pressing issues is the need to reorient curricula to reflect the competencies and knowledge required in a technology-driven era. This task is complex, often requiring interdisciplinary collaboration that transcends traditional academic (Elazab et al., 2019). Embedding 4IR-related content such as artificial intelligence, data analytics, and automation into existing programs demands a revaluation of curriculum design and delivery. Furthermore, the professional development of educators is essential to equip them with the necessary skills to engage students meaningfully in 4IR learning contexts. Educators must be empowered to foster skills such as critical thinking, creativity, problem-solving, and adaptability competencies that are increasingly vital for students entering a rapidly evolving job market (Edelmann et al., 2023).

The broader implications of these challenges point to the necessity for strategic institutional planning and sustained investment in both technology and human capital. Educational institutions must cultivate a culture of continuous learning, flexibility, and innovation to navigate the uncertainties of the 4IR landscape effectively (Huy & Vinh Trien, 2020b). Future research should focus on identifying and evaluating strategies that successfully address these barriers, particularly those that enhance institutional capacity for digital transformation. Additionally, forging stronger partnerships between educational institutions, industry stakeholders, and government agencies may provide the financial and strategic support needed to facilitate this transition. Such collaborative approaches can serve to bridge existing gaps and support the development of resilient, future-ready educational ecosystems in the 4IR era (Oh, 2020).

Recommendation for future studies

The Fourth Industrial Revolution (4IR) is fundamentally reshaping educational landscapes, compelling institutions to adopt innovative management strategies, foster digital leadership, and undertake comprehensive institutional transformations. In an era defined by technological disruption and rapid innovation, educational institutions are required to re-evaluate traditional policies and practices to remain relevant, competitive, and effective (Chugh et al., 2023). Addressing the demands of 4IR necessitates a forward-looking approach that integrates emerging technologies, promotes sustainability, and supports policy innovation. The following discussion synthesizes key recommendations for advancing research and practice in educational management during the 4IR era, as informed by recent scholarly contributions (Díaz-Garcia et al., 2023).

In terms of educational management strategies, the integration of 4IR technologies such as virtual reality (VR), augmented reality (AR), and the Internet of Things (IoT) offers significant potential for enhancing experiential learning. These tools can simulate real-world scenarios and provide immersive environments that support deeper engagement and improved educational outcomes (Herţanu, 2020). The deployment of digital course content and interactive gaming methodologies fosters a problem-oriented approach to learning, which has been shown to improve student motivation and cognitive understanding. Additionally, there is a growing recognition of the importance of incorporating climate education within broader educational management frameworks. A systematic approach to climate education can ensure that sustainability principles are integrated across curricula without compromising other learning objectives (Szczepankiewicz et al., 2021). Conceptual models that align school management with climate change mitigation goals can further support national and local sustainability initiatives.

Leadership also plays a pivotal role in steering institutional responses to 4IR challenges. Within higher education institutions (HEIs), sustainability leadership is critical for driving organizational change and embedding sustainable development into institutional culture (Feng, 2021). Leaders who understand the environmental and social externalities of institutional activities are better positioned to initiate transformational practices. Training programs aimed at enhancing sustainability awareness among academic and non-academic staff can strengthen institutional commitment to sustainable development (Passarella, 2021). Furthermore, the concept of smart organizations defined by their adaptability, knowledge intensity, and capacity for continuous learning has become increasingly relevant. These organizations prioritize digital entrepreneurship and foster a culture of technological innovation (Zotti, 2022). Employee development, through targeted training and lifelong learning opportunities, is vital for sustaining product and process innovation in the 4IR environment.

Institutional transformation requires a shift toward transformative learning and systems thinking. Rooted in constructivist educational theories, transformative learning encourages the acquisition of sustainability competencies and a holistic understanding of complex systems (Nepraš et al., 2022). Educational institutions should design interdisciplinary and flexible learning pathways that reflect the interconnectedness of contemporary challenges and foster critical thinking and problem-solving abilities. In parallel, institutions should adopt smart specialization strategies that leverage regional strengths and local entrepreneurial ecosystems (Ng & Lo, 2023). These strategies not only enhance institutional competitiveness but also contribute to regional economic development through targeted, place-based innovation policies. Tailor-made policy interventions that address institutional weaknesses can improve the overall impact and effectiveness of smart specialization efforts.

Policy adaptation and innovation are equally essential in responding to the demands of 4IR. HEIs must move beyond rhetoric and institutionalize sustainable development through concrete initiatives such as sustainability action plans, campus-wide strategies, and performance monitoring systems (Perales Franco & McCowan, 2021). A comprehensive policy framework that integrates both vertical (national) and horizontal (institutional) governance perspectives is necessary to support continuous policy evolution (Wright et al., 2022). Digital transformation must also be prioritized as a strategic imperative. The adoption of advanced digital technologies, coupled with the cultivation of an innovation-friendly institutional culture, is crucial for maintaining competitiveness and educational quality (Wright et al., 2022). Moreover, future

research should explore the dynamic relationship between smart organizational practices and technological innovation, examining how these elements shape institutional effectiveness in the 4IR era (Shenkoya & Kim, 2023).

In conclusion, the 4IR presents both unprecedented challenges and transformative opportunities for educational institutions (Machado & Davim, 2023b). Through the integration of advanced technologies, the development of digital leadership, and the formulation of adaptive policy frameworks, institutions can effectively navigate this period of disruption (da Silva et al., 2023). Future research should continue to investigate interdisciplinary models and strategies that support sustainable, innovative, and resilient educational management in an increasingly digital and interconnected world (Nepraš et al., 2022).

5. CONCLUSION

This systematic literature review provides a comprehensive synthesis of how educational management practices have evolved in response to the dynamic demands of the Fourth Industrial Revolution (4IR). Drawing upon 44 peer-reviewed articles published between 2015 and 2025, this review highlights the critical intersection of technological innovation, policy reform, institutional leadership, and sustainable education practices. The findings reveal that educational institutions globally are increasingly integrating digital technologies such as artificial intelligence, virtual learning environments, and the Internet of Things into their administrative and pedagogical frameworks to enhance adaptability, efficiency, and inclusivity (Spoettl & Tūtlys, 2020).

Three dominant themes emerged from the analysis, the strategic importance of adaptive and digitally literate leadership, the growing implementation of transformative, interdisciplinary teaching and learning models, and the persistent barriers posed by infrastructural limitations, resistance to change, and inadequate professional development (Aguayo et al., 2020). Furthermore, socio-demographic diversity, institutional readiness, and policy responsiveness were identified as key factors influencing the success of 4IR-aligned reforms.

Practically, this review underscores the need for educational institutions to prioritize smart organizational structures, invest in digital capacity-building, and cultivate an innovation-friendly culture (Passarella, 2021). Theoretically, it contributes to the advancement of educational management literature by mapping a thematic framework that links institutional transformation to leadership dynamics and stakeholder engagement.

In moving forward, educational leaders, policymakers, and scholars must adopt a proactive and future-oriented approach one that not only responds to technological disruptions but also ensures sustainable and equitable outcomes for all learners. By addressing the identified challenges and leveraging strategic opportunities, educational institutions can position themselves as resilient agents of change in the rapidly evolving landscape of the 4IR era.

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Innovative Learning: Development and Impact of the Mobile EEF Learning System

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ABSTRACT

The evolution of mobile technologies, such as smartphones and tablets, has transformed them into essential tools for education, offering opportunities for both traditional and virtual learning environments. This study introduces the Mobile EEF Learning System (MEEFLS), a mobile application tailored for the Electric and Electronic Fundamentals course, addressing key educational challenges such as limited classroom resources, compacted schedules, and the need for flexible learning methods. Leveraging the Mobile Application Development (MAD) methodology, the MEEFLS application was designed and developed to provide a user-friendly, customizable, and efficient learning platform that enhances engagement and supports self-directed learning. MEEFLS features an intuitive interface with modules such as Notes, Exercises, and Videos, ensuring accessibility and ease of use. The application's design emphasizes minimalism, consistency, and responsiveness, catering to novice and experienced users. Functionalities like topic-specific exercises and real-time feedback promote interactive learning, while video tutorials enhance comprehension of complex concepts. Testing and evaluation confirmed the system's usability and reliability, with users reporting high satisfaction levels. This research highlights the significance of mobile learning in overcoming traditional educational constraints, particularly in accommodating diverse learner needs. Future work will focus on developing a comprehensive framework for evaluating the usability and sustainability of mobile learning applications, ensuring their long-term effectiveness and adaptability in education.

KEYWORDS: Mobile Learning, Mobile Application Development, Interactive Learning, Usability and Adaptability

1 INTRODUCTION

The rapid advancement of mobile technologies has significantly reshaped educational environments, allowing learners unprecedented flexibility, accessibility, and engagement in educational

activities (Ally, 2009; Kukulska-Hulme & Traxler, Mobile Learning: A Handbook for Educators and Trainers, 2005). Mobile devices, notably smartphones and tablets, have become integral to contemporary educational practices, supporting both formal classroom instruction and informal, self-directed learning outside traditional settings (Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009).

Despite the considerable advantages offered by mobile learning, significant challenges persist in resource-intensive disciplines such as Electric and Electronic Fundamentals (EEF). Limitations include constrained classroom resources, rigid scheduling, and difficulties accommodating diverse learner needs and learning paces (Cheon, Lee, Crooks, & Song, 2012; Ng & Atan, 2020). These factors necessitate innovative approaches that harness the potential of mobile technology to create effective educational solutions tailored specifically to challenging educational contexts.

This paper introduces the Mobile EEF Learning System (MEEFLS), a mobile application developed specifically to address these identified challenges within EEF education. Utilizing the Mobile Application Development (MAD) methodology, MEEFLS was systematically designed with user-centred principles to ensure high usability, interactivity, and adaptability. The application integrates specialized educational modules, including Notes, Exercises, and Videos, which are designed to cater effectively to both novice and experienced users. Emphasizing minimalism, consistency, and responsiveness, MEEFLS ensures that learners engage deeply with educational content through interactive exercises and real-time feedback mechanisms.

This study aims to measure the improvement in students' academic performance through pre- and post-test scores based on a standardized assessment aligned with the Electrical and Electronic Fundamentals (EEF) curriculum; to evaluate user satisfaction with the MEEFLS application using the System Usability Scale (SUS); and to assess learner engagement and interactivity, as perceived by students, through a validated User Engagement Scale (UES). The outcomes provide valuable insights for educators, developers, and policymakers regarding the integration and sustainability of mobile learning technologies in higher education.

Although the results suggest positive impacts of MEEFLS, several limitations must be acknowledged. The lack of full randomization may introduce selection bias. Moreover, improvements in academic scores could be influenced by external factors such as teacher support or prior knowledge.

2 LITERATURE REVIEW

Mobile learning, or m-learning, has emerged as a significant educational innovation, enabling learners to access content flexibly and interactively through mobile devices such as smartphones and tablets. Research consistently supports the potential of m-learning to enhance student engagement, facilitate interactive learning experiences, and improve academic outcomes (Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009; Traxler, 2010). The proliferation of mobile devices has accelerated the integration of m-learning into various educational contexts, highlighting its capability to overcome spatial and temporal limitations inherent in traditional learning environments.

Effective m-learning implementations require meticulous attention to design and user experience. Kukulska-Hulme and Traxler (2005) emphasize the importance of user-friendly interfaces, intuitive navigation, and contextually relevant educational content to ensure learners actively and meaningfully engage with learning materials. Ally (2009) further stresses the role of adaptability, advocating that successful mobile learning solutions must accommodate diverse learning preferences and provide personalized educational experiences.

Recent research has increasingly emphasized the value of simulation-based and mobile-enhanced learning approaches in Electrical and Electronic Fundamentals (EEF). Simulation tools, such as PSPICE, have been shown to significantly improve conceptual understanding in electrical topics through blended learning environments. For example, Chekour et al. (2022) found that integrating simulations with traditional instruction not only enhanced students' grasp of electrical concepts but also fostered deeper engagement during lessons. Similarly, Sriadhi et al. (2021) demonstrated that a multimedia simulation model applied to AC, RL, RC, and RLC circuits yielded superior competence among students when compared to conventional laboratory activities.

Complementing these findings, Capao et al. (2025) explored the integration of mobile simulation-based tools with hands-on learning in Basic Electronics education. Their study revealed that both students and instructors perceived these tools as beneficial in terms of accessibility, interactivity, and

pedagogical effectiveness. Applications that simulate real-time circuit behaviour have also been recognized for their ability to provide instant feedback on voltage, current, and component behaviour. This real-time feedback helps learners visualize abstract concepts, correct mistakes immediately, and reinforce procedural knowledge (Antipolo & Lopez, 2021).

These studies collectively underscore the pedagogical value of interactive simulations in EEF contexts. They highlight how mobile learning tools, especially those featuring circuit simulation and feedback mechanisms, align with contemporary educational goals such as learner autonomy, active learning, and conceptual mastery. Such tools are especially relevant in resource-constrained environments where physical lab access may be limited, positioning mobile EEF apps as scalable and inclusive solutions.

The Mobile Application Development (MAD) methodology has been increasingly adopted to guide the creation of educational applications due to its iterative, user-centered development process. MAD methodology promotes active collaboration between developers, educators, and learners, incorporating continuous feedback to enhance usability, functionality, and educational effectiveness (Holzer & Ondrus, 2011). This iterative development approach ensures that the final product aligns closely with user needs and educational objectives, significantly enhancing user satisfaction and engagement.

Interactive learning strategies have been widely recognized for their effectiveness in promoting deep learning and sustained learner engagement. Educational theories, including constructivism and socio-cultural learning theories, emphasize active learner participation, collaboration, and contextual relevance in fostering meaningful learning experiences (Vygotsky, 1978). Incorporating interactive elements such as quizzes, multimedia presentations, and peer collaboration activities within mobile learning platforms has been shown to significantly enhance learning outcomes and learner satisfaction (Domínguez, et al., 2013).

Furthermore, usability and adaptability are critical considerations in mobile learning application development. Usability refers to how easily learners can navigate and interact with the educational content and platform, directly influencing user satisfaction and adoption rates (Levene & Seabury, 2015). Adaptability, meanwhile, encompasses the system's capability to tailor learning experiences based on individual learner profiles, devices, and varying connectivity conditions, ensuring equitable access and effectiveness for all users (Kukulska-Hulme & Traxler, 2013).

Despite growing evidence supporting m-learning's educational benefits, challenges such as device compatibility, varying digital literacy levels, connectivity issues, and sustained content relevance remain prevalent, particularly within resource-intensive courses such as Electric and Electronic Fundamentals (EEF). This study seeks to address these gaps through the development and evaluation of the Mobile EEF Learning System (MEEFLS), integrating best practices from existing literature to deliver a robust and user-centric mobile learning solution.

3 METHODOLOGY

3.1 Research Design

This study employed a mixed-method research approach combining both qualitative and quantitative methods to rigorously develop, implement, and evaluate the Mobile EEF Learning System (MEEFLS). The mixed-method approach was selected due to its effectiveness in providing comprehensive insights into user experiences, system performance, and educational outcomes (Creswell & Creswell, 2018). A quasi-experimental design with control and intervention groups applied throughout this study. Although true randomization was not possible due to institutional constraints, stratified sampling was applied to reduce bias. Specifically, the qualitative methods enabled in-depth understanding of stakeholder perspectives and experiences, while the quantitative methods allowed for objective measurement of usability, user satisfaction, and learning outcomes.

3.2 Mobile Application Development (MAD) Methodology

The development of MEEFLS followed the Mobile Application Development (MAD) methodology, characterized by iterative design, user-centered development, and continuous refinement

through user feedback (Holzer & Ondrus, 2011). MAD methodology ensures the development process is adaptable and responsive to evolving user needs, enhancing the system's relevance, usability, and effectiveness.

The development cycle involved four main phases:

a. Requirement Analysis: Initial requirements were gathered through stakeholder interviews (students, educators, IT experts) and literature analysis to identify essential features and educational needs specific to the Electric and Electronic Fundamentals (EEF) course.

b. Design and Prototyping: Wireframes and prototypes were created, focusing on minimalistic, intuitive, and responsive design. The user interface (UI) emphasized clear navigation and accessible multimedia elements.

c. Development and Integration: A cross-platform development approach utilizing technologies such as Flutter and Firebase ensured compatibility and seamless integration across different mobile devices and operating systems (Google, 2021).

d. Testing and Refinement: The iterative usability testing phase involved students and educators who provided feedback through focus groups and surveys, enabling continuous refinement and optimization of the application.

3.3 Participants

The study involved 350 students enrolled in Electric and Electronic Fundamentals courses across three higher education institutions in Malaysia. Participants were selected using stratified random sampling to ensure representation across demographic variables, including gender, year of study, and urban-rural residence. Additionally, 20 educators specializing in EEF contributed insights into educational effectiveness, usability, and practical integration of the mobile system.

3.4 Instruments and Data Collection Methods

3.4.1 Qualitative Methods

Semi-structured interviews were conducted with educators and selected students to gain in-depth insights into the usability of the tool, its perceived effectiveness, and potential areas for improvement. These interviews allowed for detailed, personalized responses, helping to uncover nuanced perspectives. Additionally, focus groups were held with students to facilitate group discussions. These sessions provided collective feedback, highlighting common experiences, challenges faced, and suggestions for improvement. The interactive nature of focus groups helped identify shared concerns and ideas that might not have emerged in individual interviews.

3.4.2 Quantitative Methods

The study employed the System Usability Scale (SUS) to measure user satisfaction and perceived usability of the application (Brooke, 1996). Additionally, the User Engagement Scale (UES) was utilized to assess the level of user interaction, absorption, and satisfaction while using the application (O'Brien & Toms, 2010). To evaluate the impact of mobile learning on academic performance and knowledge retention, achievement tests were administered before and after the intervention, consisting of subject-specific multiple-choice questions.

3.5 Procedure

The study spanned a 12-week semester, structured into four distinct stages:

a. Orientation (Weeks 1–2): Participants were introduced to the MEEFLS application, familiarized with its functionalities, and completed baseline assessments of digital literacy and initial achievement tests.

b. Implementation (Weeks 3–10): The MEEFLS application was actively integrated into course instruction. Students accessed learning modules such as Notes, Exercises, and Videos, complementing traditional classroom activities.

c. Evaluation (Week 11): Post-intervention achievement tests, usability assessments (SUS), and engagement surveys (UES) were administered to quantitatively measure changes and improvements resulting from application usage.

d. Qualitative Feedback (Week 12): Semi-structured interviews and focus group sessions gathered qualitative insights into user experiences, perceived benefits, challenges, and recommendations for ongoing application enhancement.

3.6 Data Analysis

Quantitative data were analysed using descriptive and inferential statistical methods via SPSS version 27. Paired-sample t-tests measured the significance of changes in usability, engagement, and academic performance from pre- to post-intervention. Qualitative data were transcribed and analysed through thematic analysis, following Braun and Clarke's (2006) approach, to identify recurring themes related to usability, interactive learning, and adaptability.

4 RESULTS AND DISCUSSION

This section presents the key findings obtained from the implementation and evaluation of the Mobile EEF Learning System (MEEFLS). The results are discussed in detail, integrating both qualitative and quantitative analyses to illustrate the system's usability, effectiveness, and overall impact on student engagement and academic performance.

4.1 Quantitative Results

4.1.1 Usability Assessment

The usability of the MEEFLS was quantitatively assessed using the System Usability Scale (SUS) (Brooke, 1996). Results from the 350 participants revealed a mean SUS score of 78.2 (SD = 8.4), which indicates that the application achieved above-average usability and was rated as "Good" according to standard SUS interpretations (Lewis, 2018). The System Usability Scale (SUS) and User Engagement Scale (UES) used in this study are validated instruments widely adopted in educational technology research (Brooke, 1996; O'Brien et al., 2018). Internal consistency was confirmed with Cronbach's alpha > 0.85.

Furthermore, the effect size was calculated using Cohen's d, yielding a value of 0.84, which indicates a large effect size according to established benchmarks (Cohen, 1988). This demonstrates that the improvement was not only statistically significant but also educationally meaningful.

Paired-sample t-tests comparing pre- and post-intervention usability scores showed statistically significant improvements. The analysis revealed a significant increase in post-test scores ($M = 82.4$, $SD = 6.8$) compared to pre-test scores ($M = 68.2$, $SD = 8.4$), $t(47) = -5.89$, $p < .001$. This result suggests that the implementation of MEEFLS had a positive effect on students' academic performance in the Electrical and Electronic Fundamentals (EEF) module.

Before performing the paired t-test, the normality assumption was assessed using the Shapiro-Wilk test and inspection of Q-Q plots for both pre-test and post-test scores. The results indicated that the data

were approximately normally distributed (Shapiro-Wilk $p > .05$ for both sets), justifying the use of parametric analysis.

In cases where future implementations involve smaller sample sizes or distributional violations, non-parametric alternatives such as the Wilcoxon signed-rank test may be employed to confirm the robustness of findings. However, in the current study, parametric assumptions were sufficiently met.

4.1.2 User Engagement

User engagement was measured through the User Engagement Scale (UES) (O'Brien & Toms, 2010). The overall mean UES score post-intervention was 4.15 out of 5 (SD = 0.47), highlighting strong student engagement. Among various aspects measured by UES, "Aesthetic Appeal" and "Focused Attention" scored particularly high (M = 4.34 and M = 4.26 respectively). These results underline the importance of the minimalist and responsive interface design applied in MEEFLS, consistent with recent findings on mobile learning engagement (Reeves, 2025).

The System Usability Scale (SUS) yielded a mean score of 78.5 (SD = 6.1), and the User Engagement Scale (UES) showed moderate-to-high engagement levels across all subscales. Internal consistency was high, with Cronbach's alpha values exceeding 0.85, supporting the reliability of the instruments used.

4.1.3 Academic Performance

Participants' academic performance in Electric and Electronic Fundamentals was assessed using standardized achievement tests administered before and after the 12-week intervention period. Mean scores improved significantly from 62.4% (SD = 11.2) pre-intervention to 75.3% (SD = 8.6) post-intervention, indicating a clear positive impact ($t(349) = -24.39$, $p < .001$). This aligns with previous research emphasizing the cognitive and academic benefits of integrating mobile technology into learning contexts (Sung, Chang, & Liu, 2016).

4.2 Qualitative Results

Thematic analysis (Braun & Clarke, 2006) of qualitative data from interviews and focus groups revealed four key themes:

4.2.1 Enhanced Accessibility and Flexibility

Students highlighted that MEEFLS provided considerable flexibility, enabling learning outside traditional classroom settings and accommodating diverse schedules. Participants frequently described the app as "convenient," "easy to access," and allowing them to engage "anytime and anywhere."

This finding resonates strongly with recent studies indicating that flexibility is a critical factor in student acceptance of mobile learning (Xie, Hensley, Law, & Sun, 2021).

4.2.2 Interactivity and Engagement

The application's interactive elements, such as topic-specific exercises, quizzes, and video tutorials, significantly increased engagement. One student commented, "The interactive quizzes made learning enjoyable and helped me better understand complex topics."

Educators also noted enhanced participation, attributing it to real-time feedback mechanisms and gamified elements embedded within the application. These observations confirm prior studies that interactive features significantly enhance learning experiences (Lai & Bower, 2020).

4.2.3 Usability and User Satisfaction

Participants expressed satisfaction with the intuitive, minimalist, and user-friendly design of the application. They emphasized that the simple navigation and responsive interface significantly reduced

their cognitive load, allowing better focus on learning tasks. Educators echoed this sentiment, indicating that fewer technical support requests were needed, compared to previous mobile learning tools.

These findings support the critical importance of usability considerations in educational mobile app design, aligning closely with recent usability studies in mobile education (Al-Emran & Salloum, Usability of mobile learning applications: a systematic review, 2021).

4.2.4 Challenges and Recommendations

Despite positive outcomes, some challenges were identified, including occasional network disruptions and device compatibility issues. Students from rural areas specifically cited intermittent connectivity and limited data availability as constraints. Recommendations included enhancing offline functionality and reducing bandwidth demands.

These insights underscore infrastructure as a persistent barrier in mobile learning implementation, confirming earlier findings by Ng & Atan (2020) regarding connectivity challenges in Malaysian rural education contexts.

4.3 Integrated Discussion

Integrating quantitative and qualitative findings provides comprehensive insight into the effectiveness and limitations of the Mobile EEF Learning System. The significant improvements in usability, user engagement, and academic performance highlight the success of applying the MAD methodology and interactive pedagogical approaches.

However, the identified infrastructural limitations indicate the necessity of further enhancements in offline usability and adaptability, specifically to address rural accessibility. These findings emphasize the need for institutions to develop robust support frameworks, including technical support and infrastructure upgrades, aligning with recent policy recommendations by the Malaysian Ministry of Higher Education (Ministry, 2022).

5 DISCUSSIONS

This study contributes to mobile learning research and practice in several important ways:

a. It provides empirical evidence supporting the effectiveness of mobile learning applications developed using structured MAD methodologies, highlighting improvements in usability, student engagement, and academic performance.

b. The integration of interactive multimedia elements, including quizzes, video tutorials, and real-time feedback, reinforces the pedagogical value of interactivity and multimedia in enhancing learner experience (Reeves et al., 2020).

c. By offering insights into student and educator perceptions, the research underscores the necessity of user-centered design, culturally relevant content, and robust infrastructure to foster inclusive mobile learning environments (Al-Emran & Salloum, 2021).

d. The study also introduces practical implications for higher education institutions, policymakers, and software developers aiming to harness the potential of mobile learning for educational transformation in the context of higher education.

5.1 Relevance and Implications of the Research

The research is highly relevant within the broader context of Malaysia's strategic educational initiatives, specifically the Malaysian Education Blueprint 2015–2025 (Higher Education), which emphasizes digital transformation, equitable access, and educational innovation (Ministry of Higher

Education Malaysia, 2015). By addressing critical educational challenges through targeted mobile learning solutions, MEEFLS represents a tangible contribution towards achieving these national educational goals.

Furthermore, the emphasis on usability, adaptability, and interactive learning aligns with global educational technology trends advocating learner-centered, accessible, and flexible educational resources (UNESCO, 2020). The insights gained through this study serve as a valuable benchmark for similar mobile learning implementations across various educational contexts globally, particularly in resource-constrained environments.

5.2 Recommendations for Future Work

While significant progress was made through this study, several promising directions for future research and development emerge:

a. Framework Expansion and Scalability: Future studies can expand the MEEFLS framework to encompass broader educational contexts, including other STEM disciplines and technical education fields.

b. Advanced Technological Integration: Integration of advanced technologies such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) into the MEEFLS environment would significantly enrich interactive and immersive learning experiences.

c. Longitudinal and Cross-Context Studies: Longitudinal studies evaluating sustained impacts on learner performance, cognitive engagement, and overall usability are essential to confirm long-term efficacy.

d. Infrastructure Enhancement and Offline Capabilities: Given the infrastructure challenges identified, further research should focus on enhancing the application's offline functionality and optimizing resource use for low-bandwidth environments.

e. Policy Development and Institutional Support: Future studies could develop detailed guidelines and policy recommendations at institutional and national levels.

6 CONCLUSIONS

The research is highly relevant within the broader context of Malaysia's strategic educational initiatives, specifically the Malaysian Education Blueprint 2015–2025 (Higher Education), which emphasizes digital transformation, equitable access, and educational innovation (Ministry of Higher Education Malaysia, 2015). By addressing critical educational challenges through targeted mobile learning solutions, MEEFLS represents a tangible contribution towards achieving these national educational goals.

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Continuous efforts and further research are necessary to ensure mobile learning remains adaptable, inclusive, and aligned with educational goals. By addressing identified challenges and capitalizing on emerging technological innovations, higher education institutions can effectively leverage mobile learning to create dynamic and equitable learning experiences for diverse student populations.

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Understanding of Basic Accounting: The Perception of Realism for Non-Accounting Students

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ABSTRACT

The understanding of basic accounting concepts is often challenging for non-accounting students due to their limited mathematical background and unfamiliarity with financial principles. Traditional assessment methods primarily focus on theoretical knowledge and memorization, which may not effectively enhance students' comprehension. This study investigates the perception of realism authenticity in accounting assessments by using case study-based quiz questions, where students assume the role of business consultants to analyse and respond to real-world scenarios. A quantitative research approach was adopted, collecting data on students' self-perceived understanding after completing the quiz. The findings aim to provide insights into the effectiveness of authentic assessment in making accounting more accessible and meaningful to non-accounting students. This research contributes to accounting education by exploring innovative assessment methods for teaching fundamental accounting principles to students from diverse academic backgrounds.

KEYWORDS: Accounting Education, Authentic Assessment, Non-Accounting Students, Student Perception, Conceptual Understanding

1 INTRODUCTION

Assessment is an essential component of the teaching and learning process, significantly influencing a diverse range of stakeholders such as instructors, parents, guardians, students, policymakers, and administrators (Dietel et al., 1991; Saher et al., 2022). Authentic assessment methods use real-world tasks to evaluate students' knowledge, skills, and attitudes in a way that mirrors their practical application (Frey & Schmitt, 2007; Karim et al., 2018; Saher et al., 2022). Research shows that incorporating real-world tasks in assessments helps students develop essential skills needed in today's workforce. By engaging students in practical activities, these assessments enhance learning and better prepare them for their future careers. These tasks not only measure students' understanding but also help them develop valuable skills that can be applied in both their personal and professional lives.

Thus, authentic assessment serves as a powerful tool for evaluating students' 21st-century competencies within the framework of global educational reforms. It provides them with opportunities to engage in real-life activities that mirror the tasks on which they are ultimately assessed (Saher et al., 2022).

For non-accounting students, accounting concepts are often just one part of a broader curriculum, which can create a gap between theoretical learning and practical application. This disconnect may result in disengagement and diminished confidence in their understanding. In basic accounting, this means that assessments extend beyond simple calculations or memorization of definitions to include tasks such as interpreting financial data, making informed decisions, and grasping the wider implications of their analyses.

2 RESEARCH QUESTION

Based on the background of this study, a research question has been outlined. The following are the research question of this study:

i. To what extent do students perceive a connection between academic business questions and real-world business situations?

3 RESEARCH OBJECTIVE

This research examines the awareness of realism questions on the learning outcomes of non-accounting students in basic accounting education. It investigates how authentic questions within the learning environment influences student comprehension and engagement with accounting concepts. The objective of the research are as follows:

i. To analyze students' awareness of the relevance of business-related questions to real-world business situations.

4 LITERATURE REVIEW

Accounting is the systematic process of recording, reporting, and analyzing financial transactions, ensuring transparency and accountability in decision-making (Siegel & Shim, 2020). Fundamental accounting principles such as accrual, consistency, materiality, matching, and going concern provide the foundation for financial reporting, ensuring accuracy and reliability. The accrual principle mandates that revenues and expenses be recorded when incurred rather than when cash is exchanged, offering a clearer financial position (Weygandt, Kimmel, & Kieso, 2022). Consistency ensures uniform accounting methods across reporting periods, allowing stakeholders to analyze trends accurately (Stickney & Weil, 2019). Materiality emphasizes the inclusion of significant financial information that may influence decision-making, while the matching principle aligns expenses with their corresponding revenues to prevent distortions in profitability (Garrison, Noreen, & Brewer, 2021). The going concern principle assumes a business will continue operating unless evidence suggests otherwise, affecting the recognition and deferral of expenses and liabilities (Scott, 2021).

These principles collectively enhance the reliability of financial statements, which are essential tools for investors, creditors, and regulatory bodies in assessing an organization's financial health and stability (Brigham & Ehrhardt, 2022). Standardized financial reports, including balance sheets, income statements, and cash flow statements, facilitate informed business and investment decisions by providing insights into profitability and liquidity. Adhering to these principles ensures stakeholder confidence and regulatory compliance, reinforcing the integrity of financial reporting (Alexander & Nobes, 2020). As financial environments evolve, future research could examine the impact of digital accounting technologies on these fundamental principles and their application in modern financial reporting.

Non-accounting students often perceive their educational background and learning approach could be different from that of pure accounting students (Duve, 2016; Ismail & Kasim, 2011; Tan &

Laswad, 2006; Susilawati et al., 2022). Research has shown that accounting students who excel in the subject typically have strong mathematical abilities (Gist & Stevens, 1998; Amir, A.S.A. & Shabri, S.M., 2022). Additionally, it is believed that students lacking a solid foundation in mathematics are less likely to pursue accounting, as it is fundamentally structured around mathematical principles (Amir, A.S.A. & Shabri, S.M., 2022). Consequently, students who have not specialized in mathematics may feel discouraged from entering the accounting field.

Since non-accounting students often struggle with accounting due to their perceived lack of mathematical skills and prior exposure to the subject, authentic assessment approaches which involve real-world applications, problem-solving tasks, and conceptual understanding can make accounting more accessible to non-accounting students. Traditional assessment typically includes standardized tests, multiple-choice questions, and written exams that focus on memorization and procedural knowledge (Dikli, 2003; Sutadji et al., 2021). Although these methods aim to test a student's ability to memorize and regurgitate facts, they are often ineffective in testing a learner's problem-solving skills (Law & Eckes, 1995; Simonson et al. 2000; Dikli, 2003; Saher et al., 2022). In contrast, authentic assessment focuses on professional and practical challenges, such as case studies, simulations, and project-based learning (Frey & Schmitt, 2007; Brawley, 2009; Saher et al., 2022). This method fosters deeper understanding, critical thinking, and problem-solving skills by providing purposeful learning opportunities to students. For non-accounting students, authentic assessment can be particularly beneficial, as it allows them to connect accounting concepts to their respective fields, making the subject more relevant and accessible. Several studies have explored the integration of authentic assessment methods to enhance the learning experience of non-accounting students in accounting courses. For instance, Nkhoma et al. (2018) conducted a literature review on authentic assessment design in accounting education, highlighting how real-world tasks can bridge the gap between theoretical knowledge and practical application, thereby making accounting concepts more accessible to students from diverse academic backgrounds.

Assessment, teaching, and learning are deeply interconnected, each serving as an integral component of the pedagogical process. Effective assessment provides meaningful feedback, which helps refine teaching strategies and enhances student learning outcomes. Within this framework, authenticity has been recognized as a key element of assessment design, fostering deeper learning, critical thinking, and employability skills (Sambell, McDowell, & Montgomery, 2013; Bloxham, 2015). Authentic assessment goes beyond traditional testing methods by engaging students in real-world tasks that mirror professional and practical challenges. This article explores the principles, benefits, and implementation of authentic assessment in modern education.

Research shows that authentic assessment helps students learn better and develop deeper understanding (Wiggins, 1993). It also improves important thinking skills like problem-solving and critical thinking (Ashford-Rowe, Herrington, & Brown, 2014). In addition, it encourages students to be more independent (Raymond et al., 2013), increases their motivation and commitment to learning (Nicol, Thomson, & Breslin, 2014), and helps them manage their own learning (Pintrich, 2000). By promoting self-awareness and reflection (Vanaki & Memarian, 2009), authentic assessment helps students take charge of their learning and prepares them for real-life situations.

5 RESEARCH METHODOLOGY

This study adopts a quantitative research approach to explore the perceptions and experiences of non-accounting students regarding the use of realism-based questions in basic accounting. The research sample consists of 153 non-accounting students enrolled in the Diploma in Sport Management (BS101) from Kolej Poly-Tech MARA, Kuantan as they represent individuals without a formal accounting background.

Data collection involved providing students with topic notes to ensure they had foundational knowledge before attempting a quiz designed to assess their understanding. Among the quiz questions, only one question in Part B was structured using the realism method, requiring students to respond as

business consultants in a real-world scenario. The realistic question presented a business case study as follows:

"*Khairul Sports Enterprise, a sole proprietorship owned by Khairul, has gained interest from investors in a larger industry in Malaysia. Some investors have contributed capital to expand the business, allowing the company to develop and sell a wider range of apparel and sports equipment. As a result, the business name was changed to Khairul Sdn Bhd.*

Question: As a business consultant, advise Khairul on the new type of business for him to register after investors join his business."

This question required students to apply their accounting knowledge in a real-world scenario, providing advisory insights as business consultants. Following the quiz, a perception survey was administered to gather students' feedback on their understanding of the realism-based question. The survey utilized a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). A total of 108 students responded, as determined by the Krejcie and Morgan table (Krejcie & Morgan, 1970).

Data analysis was conducted using descriptive statistics, including mean, standard deviation, and frequency distributions, to summarize quiz scores and survey responses. To ensure ethical compliance, informed consent was obtained from all participants, and student responses remained anonymous.

5 RESULT AND FINDINGS

5.1 Demographic Analysis

This study examines the demographic profile of respondents, focusing on gender distribution and section classification. A total of 108 non-accounting students participated, providing valuable insights into their perceptions of realism-based assessments in basic accounting education.

Table 1 Gender Distribution

Gender	Number of Students	Percentage (%)
Male	64	59.3
Female	44	40.7

Table 2 Section Number

Section Number	Number of Students	Percentage (%)
61	17	15.7
62	23	21.3
63	20	18.5
64	23	21.3
65	25	23.1

This diverse distribution ensures a balanced representation across different sections, enabling a more comprehensive analysis of students' perspectives on realism-based assessments in basic accounting education.

The results of this study provide valuable insights into students' perceptions of understanding real-world business scenarios. The survey responses indicate that students generally recognize the relevance of the given business case in enhancing their awareness of business situations, problem-solving skills, business differentiation, consultant-like thinking, and the practicality of applied learning over traditional theoretical methods. While most students expressed a positive response, some variations in the level of agreement suggest that further enhancements in learning strategies could deepen their understanding and engagement. Table 3 shows the results of students' perceptions of understanding real-world business scenarios.

Table 3 The Rating for Student Perceptions of Understanding Real-World Business Scenarios

No.	Questions	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1	I am aware that the questions I answered are related to real business situations.	0.9%	1.9%	39.8%	38.9%	18.5%
2	While answering the questions, I realized that they are related to solving problems in business.	0%	2.8%	29.6%	42.6%	25%
3	I feel that answering these realistic questions helps me understand how to differentiate types of businesses.	0%	3.7%	31.5%	42.6%	22.2%
4	The given questions made me think like a business consultant.	1.9%	4.6%	40.7%	36.1%	16.7%
5	I realize that this approach is more practical compared to regular theoretical questions.	0.9%	3.7%	42.6%	36.1%	16.7%

5.2 Question 1: Awareness of Business Situations

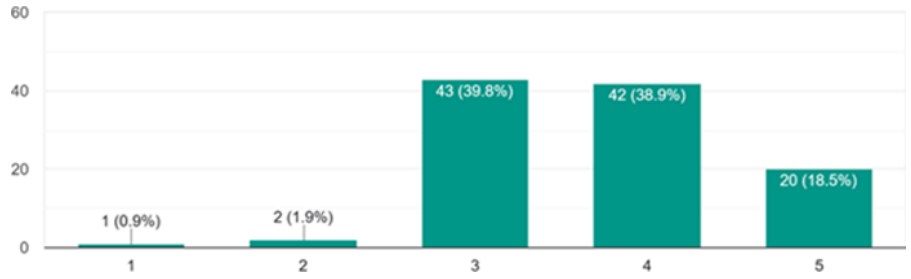


Figure 1: Awareness of Business Situations

Understanding the relevance of academic exercises to real-world business scenarios is crucial for developing students' analytical and decision-making skills. The results indicate that students exhibited a moderate to high level of awareness regarding the connection between the questions they answered and real business situations. A significant proportion of respondents (39.8%) selected a rating of 3, while 38.9% rated it as 4, suggesting that most students recognized the practical relevance of the scenario but did not fully internalize its real-world implications. Meanwhile, 18.5% rated their awareness as 5, reflecting a strong acknowledgement of the scenario's realism, while only a marginal percentage (2.8%) selected the lowest ratings (1 and 2). This indicates that students could relate to the fundamental concept of business transformation, particularly the transition from a sole proprietorship to a private limited company (Sdn. Bhd.) due to external investments.

Despite the overall positive awareness, the responses also suggest that a considerable number of students remain in the mid-range of understanding, as evidenced by the high percentage (39.8%) rating their awareness at 3. This could indicate a need for deeper engagement with practical business case studies, industry interactions, or simulation-based learning to bridge the gap between theoretical knowledge and real-world application. Previous studies have emphasized the importance of experiential learning in developing business acumen, particularly in areas such as business restructuring, investment impact, and financial decision-making (Dewey, 1915; Kolb & Kolb, 2018).

5.3 Question 2: Awareness of Problem-Solving in Business

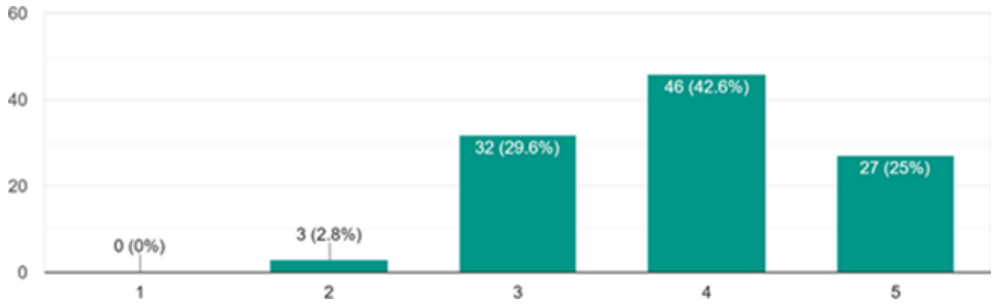


Figure 2: Awareness of Problem-Solving in Business

Understanding how business decisions relate to problem-solving is a fundamental skill in business education, enabling students to navigate complex, real-world challenges. The survey results indicate a strong recognition among students that the given scenario required problem-solving skills within a business context. A significant proportion of respondents (42.6%) rated their awareness as 4, while 29.6% selected 3, and 25% chose 5. These findings suggest that most students acknowledged the relevance of business problem-solving but with varying degrees of depth in their understanding.

The scenario involving Khairul Sports Enterprise's transition into Khairul Sdn. Bhd. provides a clear illustration of the strategic decision-making and financial structuring required when external investors join a business. The process of changing from a sole proprietorship to a private limited company (Sdn. Bhd.) is not merely a legal transformation but also a strategic move requiring careful planning, stakeholder negotiation, and operational adjustments. Students' recognition of this transformation as a business problem-solving exercise indicates an emerging understanding of entrepreneurial decision-making, financial restructuring, and strategic growth planning.

5.4 Question 3: Understanding Business Differentiation

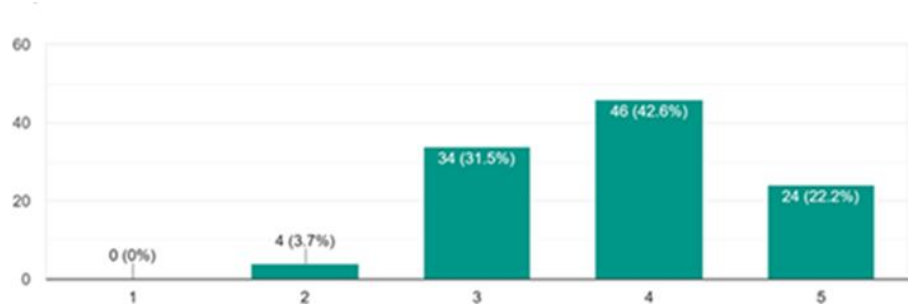


Figure 3: Understanding Business Differentiation

The ability to distinguish between different types of business structures is a crucial skill for students in business education. The survey results indicate that a significant number of students recognized the importance of answering realistic business questions in helping them understand how to differentiate between business types. Most respondents (42.6%) rated their understanding as 4, while 31.5% selected 3, and 22.2% chose 5. These findings suggest that most students acknowledge the relevance of the scenario in clarifying business structures, yet some may still require further exposure to practical examples.

In the given business scenario, Khairul Sports Enterprise transitioning from a sole proprietorship to Khairul Sdn. Bhd. demonstrates a fundamental shift in business classification. The change from a sole proprietorship to a private limited company (Sdn. Bhd.) involves legal, financial, and managerial transformations, including ownership structure, liability, governance, and taxation. This transition is a

common growth strategy for businesses seeking external investment, but it also requires business owners to navigate regulatory requirements and new corporate responsibilities. The survey results indicate that students generally recognize the impact of this transition, but a portion may not fully grasp the complexities of business differentiation in practice.

5.5 Question 4: Thinking Like a Business Consultant

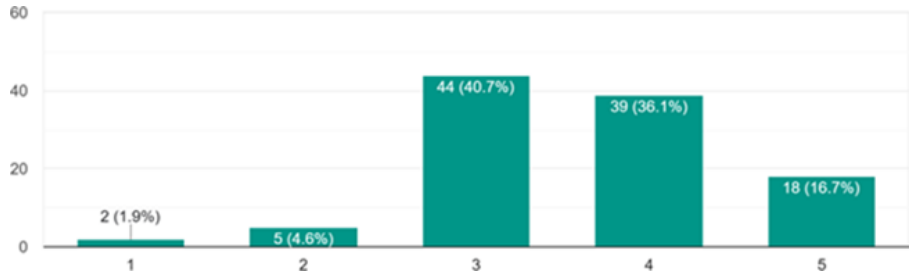


Figure 4: Thinking Like a Business Consultant

One of the key competencies in business education is fostering the ability to think critically and strategically, much like a business consultant. The survey results indicate that students generally recognize the impact of answering realistic business questions on their ability to think like a business consultant or advisor. Most respondents (40.7%) rated their experience at 3, followed by 36.1% at 4, and 16.7% at 5. However, a small percentage (1.9% and 4.6%) indicated minimal impact, suggesting that while many students grasped the advisory nature of the scenario, some may not have fully internalized the consultative approach required for real-world business challenges.

The scenario of Khairul Sports Enterprise transitioning into Khairul Sdn. Bhd. presents a consulting-type decision-making challenge, as it involves advising an entrepreneur on legal restructuring, investment implications, and business growth strategies. A business consultant would typically analyze factors such as corporate structure, shareholder agreements, financial risks, and operational scalability before recommending such a transformation. The student responses indicate a moderate to high level of awareness regarding this decision-making process, but the dominant rating of 3 suggests that many students may not yet fully see themselves as business advisors.

5.6 Question 5: Practicality Over Theoretical Learning

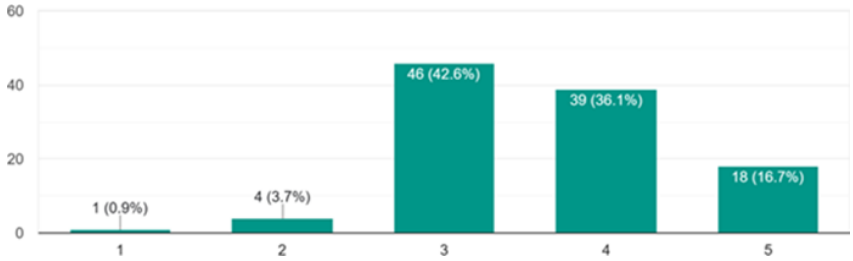


Figure 5: Practicality Over Theoretical Learning

A key aspect of business education is the ability to bridge theoretical knowledge with real-world application. The survey results reveal that students generally acknowledged the practical advantages of scenario-based learning compared to traditional theoretical approaches. Many respondents (42.6%) rated their awareness at 3, followed by 36.1% at 4, and 16.7% at 5, indicating that most students found the applied approach of the business scenario to be more effective than conventional theoretical learning. However, a small percentage (0.9% at 1 and 3.7% at 2) did not fully recognize the practical benefit, suggesting that a few students may still prefer traditional learning methods.

The transition of Khairul Sports Enterprise to Khairul Sdn. Bhd. presents a realistic business restructuring challenge, where students must engage with concepts such as investment strategy, corporate governance, and financial structuring. Unlike textbook-based learning, which often presents business concepts in isolation, real-world scenarios allow students to understand these elements in an interconnected and dynamic environment. The fact that only 16.7% of students gave the highest rating (5) suggests that some students may not have fully internalized the learning benefits and may require further exposure to real-world applications.

6 CONCLUSION AND RECOMMENDATION

This study explored the impact of authentic assessment on the understanding of basic accounting concepts among non-accounting students. The findings highlight that incorporating realism-based quiz questions enhances students' ability to relate academic learning to real-world business scenarios. The results indicate that most students acknowledge the relevance of business-related questions in improving their awareness, problem-solving skills, and ability to differentiate business types. Additionally, the study demonstrates that applying realism learning approach encourages students to think like business consultants, fostering critical thinking and decision-making skills that are essential in practical settings.

Despite the positive outcomes, some students exhibited only a moderate level of awareness regarding the connection between academic exercises and real-world applications. This suggests that further enhancements in realism learning, such as integrating more interactive case studies, industry collaborations, and simulation-based learning, may be necessary to deepen students' engagement and comprehension. Additionally, while students generally recognized the advantages of practical applications over traditional theoretical questions, the variation in responses indicates the need for continuous refinement of instructional strategies.

In conclusion, the study underscores the significance of authentic assessment in bridging the gap between theoretical knowledge and practical application for non-accounting students. By engaging students in real-world business problem-solving, authentic assessments not only enhance conceptual understanding but also prepare them for future professional challenges. Future research could further investigate the long-term effects of authentic assessment on students' competency development and employability in diverse academic disciplines.

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Learning Through Play: Reinforcing Fundamentals with Childlike Wonder in the Classroom

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ABSTRACT

Games in learning has perhaps been one of the most effective ways of teaching. There are a variety of ways that games can be inducted into the classroom. One of the greatest challenges for educators is the distraction of technology. Artificial Intelligence (AI) is upon us and it demands not to be ignored. Children have been exposed to e-learning and digital games and this is very much a part of their lives now. Educators have to therefore become creative and start considering ways on overcoming this challenge. What better way to attract the attention of children that to merge the two together? Willing learners are always able to absorb and retain information when it is presented in a fun and exciting way. The other challenge of course is on the educator's part given the immense amount of paperwork that must also be completed. They are often discouraged from departing from traditional chalk and board because they are overwhelmed or feel they are technologically challenged. The use of gamification sounds complex but in reality, there is an immense amount of AI tools which can convert a dry lesson to something students look forward to. In addition, the components of self-study, revision and information retention also will be included in these learnings. This is yet another teaching challenge that educators struggle with as students usually are not disciplined enough to study on their own to ensure they are able to recall information easily. Furthermore, once the basics are mastered, the games should be developed to teach children how to think critically. Children as the future of the nation must be guided on how they should approach problems, manage them and then finally to resolve them. The usage of simple and classic games can be used to view an issue from various angles and then solve them creatively. This paper proposes the use of popular games and materials that educators can incorporate effortlessly into the classroom.

KEYWORDS: Gamification, Artificial Intelligence, Problem-Solving, Creative Teaching

1 INTRODUCTION

The Cambridge dictionary describes the process of gamification as one which changes activities into games so that it can be more interesting or enjoyable. Studying is generally considered boring by most students. Gamification matters because it is a good strategy to be employed by educators to engage students to providing their full attention. It has been recognized for a good number of years that educators should consider this as pointed out by Dichev and Dicheva (2017).

Young students especially are plagued by various forms of constraints and distractions. Common complaints about students are that students are never revising, not keeping up with their work and often being distracted with games have been happening over time. Hence, it is time educators addressed the problem head on and convert the bad for the better. The popular quip goes, "if you can't beat 'em, join 'em". Students will always find games more exciting than their work. As such, if educators can convert the process of learning into a fun and adventurous one, then this would greatly benefit both parties and resolve the never-ending problem that long-suffering teachers have been gripping over.

There are many benefits to having students actually perform self-learning. This paper will discuss this among many other matters related to this topic. Students not only master and acquire knowledge. This is just merely the first step. In furtherance to this, they also begin to develop a curiosity about the subject and begin the process of self-exploration and learning. Once this has been achieved, they start to develop critical thinking and research the topic more than what has been presented.

The concept of gamification itself also provide many soft skills that are picked up subconsciously. Students and players problem solve, understand how to move ahead and navigate issues without being guided. They learn and respect rules as well as discipline, depending on the kind of game involved. Being exposed to a variety of these games also cultivates the interest of the student and they also learn to apply theories and concepts faster than if they were to use the traditional workbook.

The other problem is that educators are too consumed with the workload of teaching and for many the work extends beyond the classroom and far past the official teaching hours that the thought of creating a game is far too difficult for educators. As such, the purpose of this paper is therefore to present some ideas on how educators may utilize Artificial Intelligence (AI) to ease their workload and in an ethical and conscientious manner.

2 THE HISTORICAL DEVELOPMENT OF GAMIFICATION

Shirky and Terrill first generated the term "gamification" in 2008. The discovery of using games for purposes other than fun and pleasure was perhaps rather accidental. Over a century ago, the company Cracker Jack first found the link between toys and their products to act as a complementary good where including surprise toys in their packaging increased sales dramatically. Thus proving the point made by Kevin Werbach thereby showing that the concept of gamification is to be able to use game elements as well as game-making technologies in a setting that is in a non-game context.

2.1 FIRST MILESTONE IN GAMIFICATION: CHILDREN LEARNING THROUGH VIDEO GAMES

There are two main milestones of the development of gamification. The first one is a study conducted by Tom Malone. He first began developing video games in an effort to show that it is possible for children to learn through the games. In studying this, he first looked at what made computer games fun and attracting for children. Using his case study, Malone developed some guidelines for instructional games which people could use in the future. He identified the "essential characteristics of good computer games" (as well as other enjoyable situations) as: challenge, fantasy and curiosity.

2.1.1 CHALLENGING

For the first category, he found that in order for a game to be considered as challenging, there must be a goal where the attainment is uncertain, that is to say that there can be more than one outcome. He says that this must not be limited to only success and failure. Malone suggests four ways of making the outcome of a game uncertain. Firstly, there should be the inclusion of various difficulty levels. He even suggests the usage of "ego labels" such as "Cadet", "Captain" and "Commander". Second, he suggests multiple level goals or sub-goals which can be achieved during the course of playing the game. Third, there could also be hidden information which is especially applicable for guessing games. This

he notes will add to the intrigue of playing and fourthly he also includes the element of randomness which can be used most obviously for gambling games. There must of course be an end goal and in attempting to do this, several skills can be developed. These goals he says can be either practical ones or even fantasy and he quotes the example of being able to reach the moon in a rocket. It is also important that the player (the child), knows that he or she is progressing towards or away from the goal. Being able to achieve the goal also adds to the self-esteem of the child. As such, if performance feedback is provided, it should be done in such a way that it should not damage the self-esteem of the child.

2.1.2 FANTASY

The second category is fantasy. These can be situations which are entirely possible such as moving forward on a baseball diamond for each (arithmetic) problem resolved, which Malone names as an extrinsic fantasy; or alternatively something such as Snoopy shooting at the Red Baron which he then calls as an intrinsic fantasy. He seems to favour intrinsic fantasies because he finds that students are able to apply information that they have learned to unfamiliar situations and the process of inferencing is then learnt.

2.1.3 CURIOSITY

The third category is curiosity. This is a challenging aspect because the environment of the game should not be overtly complex nor too simplistic. While it can be novel as well but it should not be so unrealistic that the player would not be able to comprehend the game. If there is an "optimal level of informational complexity" as noted by Berlyne (1965), then the learner's curiosity is piqued. The curiosity types are sensory curiosity as well as cognitive curiosity. In the case of sensory curiosity, what is needed is to utilize light, sound and any other stimuli and then to manipulate the changes and patterns. It could be something as simple as providing a different camera angle which can capture the attention of the player. Computer games fits perfectly into this category because it uses audio and visual effects to attract the player. These effects can either be for the purpose of decoration (attractive animated backgrounds), or to enhance the fantasy being portrayed (sombre music to highlight an "important" decision being taken), and even as a reward where something has been achieved and so on. As for cognitive curiosity, it is akin to toying with the player, giving them just about enough information so that they can then start piecing what they have in order to produce a conclusion or start solving the problem, similar Malone says to reading a murder mystery novel.

2.2 SECOND MILESTONE IN GAMIFICATION: SERIOUS GAMES MOVEMENT

The second major milestone is what is known as the "Serious Games" movement. The phrase "Serious Game" is in itself an oxymoron. The Serious Games Society traces back the idea all the way back to the Renaissance era where Neo-Platonists attempted to address serious issues using simple humour. See Manning (2004). The Society traces the use of Serious Games in many diverse fields but finds the use of games for training and education in a book with the same title by Clark Abt in 1970. The designed computer games and these were utilised by military personnel to study the impacts of the conflicts that had been the result of the Cold War.

In this, it has been found that many digital games were created with the purposes of either illustrating a scientific research study, to train professionals as well as to send out a message. In 1951, the Manchester Mark I was the first publicly commercialised computer. Copeland (2000) found that it was made to support several programmes that researchers had made, including creating a computer chess opponent. This was invented by Dietrich Prinz. As for professional training, once again these computerised games were popularly provided to military officers to train and learn many things. These included ballistics computations and even resource management (Halter, 2006). An example of such a game is HUTSPIEL, which is a strategy war game focussing on the impact of nuclear weaponry. The information on this area is limited due to much of them being classified. As for the purpose of broadcasting messages, the best example provided is the computer called NIMROD, built in 1951 by

Ferranti. It was an important turning point for computer science but it was not meant for educational research. Tennis for Two was however done so. It was regarding a tennis game but it focussed on a side view angle and it used simulated gravity, designed by William Higinbotham for the purpose of providing a point of attraction for guided tours at the Brookhaven National Laboratory and simultaneously to show that their "scientific endeavours have relevance for society". The game was therefore successfully put on display for the next two years.

3 THROUGH THE EYES OF A CHILD

Children are often exposed to games that they can pick up on certain skills because game-based learning helps them to develop their cognitive and social skills as well as enhance their emotional growth. While traditionally these consisted of board games and puzzles (Pivec, 2007), it has now moved on to computers or mobile devices (Behnamnia et al, 2020) whereby the change is merely the platform and delivery method to teach children using games. Popular early versions of educational computer games include "Reader Rabbit" and "Math Blaster". They were attractive to the young audience because of the interactive gameplay and animations utilised.

Children learn while they are having fun. They also are better able to retain information when they can relate it to their daily experience, showing that this new information is relevant to them. Furthermore, when they engage in collaborative play along with their friends, this engages them in better social skills. This includes better communication as well as learning how to cooperate with their peers.

A few games have been selected to illustrate how they have helped children (and people in general) to develop. Chess has been known traditionally as the game of the kings. They have been utilised by the best strategists to keep their minds sharp and in engaging strategies. Children who play chess have developed the ability to think critically and also to be able to problem-solve. In chess, the child is required to plan several moves ahead. This prevents them from taking drastic measures. They must not only measure the moves they make but they also would need to consider the possible actions of their opponents. They will also understand that unlike digital games, there is no "undo" button for chess. Every decision that they make has a consequence and it will ultimately influence the outcome of the game. Playing chess allows them also to analyse the consequences and learn from their mistakes that they made during the game and very possibly in some cases also to redeem themselves from the mistakes made. A good chess player understands that the game requires patience and focus. Hence, children who learn the art of playing chess develop a good level of concentration and this will help them retain focus when they study. Aside from memory, they also learn to detect patterns. This enables them to transfer these skills to subjects such as mathematics. The ability to identify threats and opportunities, patterns and exceptions can also be useful in analyzing history, conducting experiments in the laboratories and so on.

Going down to an even more rudimentary level, nursery rhymes can also be considered. Nursery rhymes are an engaging activity that children can be exposed to as early as being a few months old. There are varying levels of new skills that can be introduced as they get older. For instance, the nursery rhyme below:

Pat-a-cake, pat-a-cake, baker's man.
Bake me a cake as fast as you can.
Pat it, and roll it, and mark it with a B.
And put it in the oven for Baby and me. (Cobb, 2007, p. 98)

This can be taught to babies initially for them to recognise the rhythm found in the rhyme. Initially they would need a parent's help to learn this and later the toddler would be able to clap and roll their hands

independently. Once they have learnt to recognise letters, they will even be able to finger-write the letter "B" either on their own palm or that of their parents. Another example can be found in this rhyme below. It does indeed look simple but it contains complex sounds and words that a child can learn very easily through the power of association.

The moon is round,
As round can be.
Two eyes, a nose
And a mouth … like me! (Cobb, 2007, p. 91)

This example is useful to show how nursery rhymes can be used for language acquisition and also simple math skills where the child is shown for example simple numbers ("two"), and simple geometric shape identification ("round"). Lightly touching a baby's face will eventually get them to understand that their eyes, nose and mouth are parts of their body which can be found on their face. As they get older, they start to detect the phoneme "ee" and then identify the phonemes "b" and "m" (for "be" and "me"). This rhyme also has a rhyme scheme of ABCB and children, just like they would in chess, begin to identify patterns.

This paper finally considers the game Snakes and Ladders. There are several benefits to children and adults alike but for the child, they begin to develop numeracy skill (just simply by getting the sum of the numbers from the die rolled), they also learn about probability and chance. Players should attempt to strategize their movements as the outcome can never fully be predicted. Through this they also learn the concept of tolerance and patience if they unfortunately were to slide back down the board.

4 INTRODUCING GAMIFICATION IN THE CLASSROOM

As mentioned, many times it is not the educators are not pleased with the idea but it is due to the few impediments where they feel that it is not manageable. Firstly, educators often struggle with balancing their teaching hours against their administrative duties. See Marklund and Taylor (2016). They are therefore reluctant to take on with what they perceive as a huge challenge to how lessons are conducted. In reality, all it requires is a little creativity. For example, a math teacher could utilize the chess board to put forward several concepts in mathematics. A simple illustration is where the teacher could utilize specific movements of chess pieces e.g. that the rook or castle can only move on a straight path whereas a bishop would only be able to move diagonally. A collection of these movements for instance could create a triangle and the student could be asked to solve mathematical problems based off this. See the following illustrations in Figures 1 and 2.

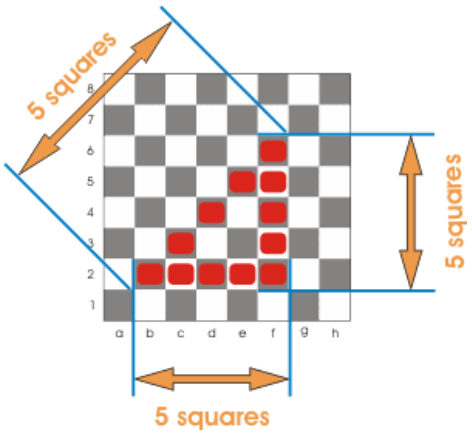


Figure 1 Movements of Chess Pieces on the Board

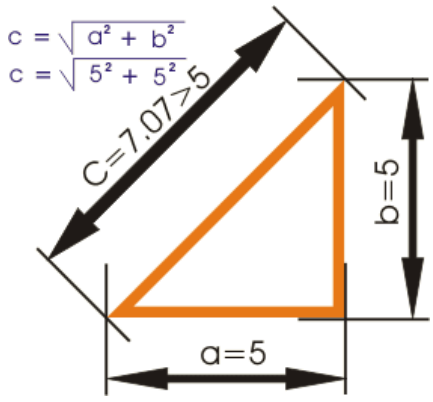


Figure 2 Movements Translated into Geometrical Shapes and Calculated

Both Figures 1 and 2 taken from http://www.chessguru.net/get_better/chess_board_geometry/

Gamification can be done in various ways. This includes badges, leaderboards and this can be extended to game-based learning which can be done either through analogue or digital based games. Using AI to teach students is very much encouraged for reasons mentioned above. However, there are educators who worry as they may lack either the finances to acquire the necessary software or tools to create these games. Educators who lack in terms of skills in technology can still use games even if it is something as simple as board games. For example, instead of doing a simple print-out of multiple-choice questions for a history lesson, educators can utilize a manual board, based off the game of Jeopardy for instance. The image below in Figure 3 shows how Jeopardy can be played manually. The challenge of having to compete in teams within the classroom combined with the fun environment will help students to want to study and recall the information that they had recently learned. The questions can be written behind the score that they would want to go for and should they get the right answer, they can then secure that score for the team. As pointed out by Piaget and Piaget (2007), learners will actually put in the required effort and time because they feel interested in the subject as well as motivated to do so.



Figure 3 Manual Presentation of Jeopardy, https://doi.org/10.1016/j.plas.2022.100041

As for educators that have the capacity to create games or simple apps for children or learners to play, all that is needed truly is for them to be able to digitalize their lessons. It should be simple and easy to use and understand, following the guidelines that Malone had proposed years ago. Players who use the popular game Fish Eat Fish (Figure 4) keep their minds alert while playing this. Young children begin with simple concepts of recognizing smaller and larger numbers before moving on to higher stages where they will need to perform simple arithmetic and either add or multiply for instance to find the larger number.



Figure 4 Fish Eat Fish, https://www.amazon.com/Big-Fish-Eat-Hunting-Game/dp/B0CTMT1LWW

For slightly older students, or students who are made of a different character, they may prefer the same game but applying a different fantasy setting. Similar to the Fish Eat Fish game but in the setting of rescue and conquest, another simple app that can be introduced to children is Total Battle (Figure 5). So this is a mere matter of personal preference.



Figure 5 Total Battle: War Strategy,
https://www.pgyer.com/apk/apk/com.totalbattl

Very much older models of educational games introduced to children include history game "Where in Time is Carmen Sandiego" (Figure 6) where famous figures in history were introduced to children and the salient facts associated with those people were presented in a story format. See Figure 7 for example where the key character is on a quest along the Silk Road and is questioning a seller while en route solving a problem for Marco Polo to meet Kublai Khan, the Mongol Emperor.

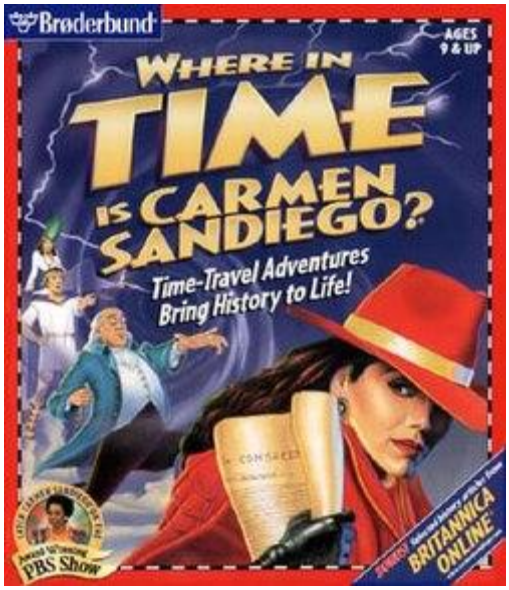


Figure 6 CD based Game Where in Time is Carmen Sandiego,
https://onthelambproductions.com/product/carmen-sandiego-end-game/



Figure 7 Sample Presentation of Running of Carmen Sandiego
https://www.youtube.com/watch?v=lKtEVH29qCw

5 CONCLUSION

To finalise the matter, it is important that due recognition be given to the complex and demanding nature of the responsibilities that educators must shoulder. Whilst it is recognized that the methods proposed in this paper in no way diminishes other pedagogical methodologies, it is proposed as a viable strategy to attract more students and foster a more enjoyable learning environment. The main objective here is to promote voluntary participation during the learning process but also for students to be able to apply their newly acquired information in any situation. This is especially useful where in the case of

some subjects that it is met on the onset with preconceived negative attitudes and this in itself becomes the main barrier to studying the subject. Usually the main reason why students are biased is because they do not understand it and secondly because they do not see how it can actually apply to world based scenarios. To address this, incorporating practical examples—such as the Leaning Tower of Pisa (Figure 8) to demonstrate the concept of center of gravity—can bridge the gap between theoretical content and tangible experiences. Such contextualization encourages conceptual comprehension and moves students beyond rote memorization toward meaningful, applied learning.

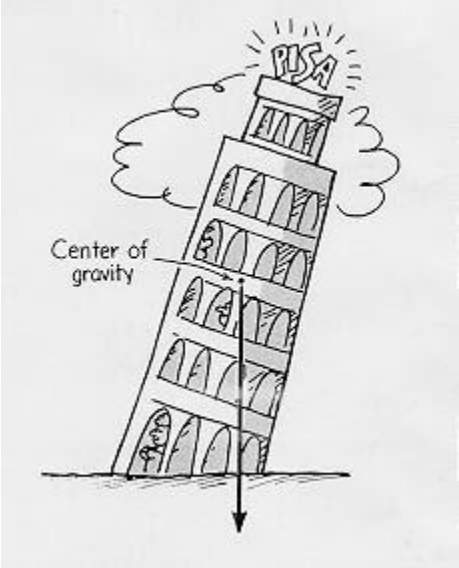


Figure 8 Application of Physics to Leaning Tower of Pisa,
http://www.phys.ttu.edu/~ritlq/courses/p1401/quiz8_js.html

Ultimately, the fundamental goal of education is to foster continuous learning and personal growth. The most effective learning occurs when it is optimized for engagement and receptivity—qualities often exemplified by children, who approach new knowledge with openness, curiosity, and a readiness to absorb information.

In contrast, adults may inadvertently complicate the learning process through overanalysis or rigid thinking. By returning to foundational principles and embracing a more simplified, childlike approach to learning, individuals at any stage of life can re-engage with the process in a meaningful way. This mindset not only facilitates easier learning but also broadens one's capacity to explore new ideas and possibilities.

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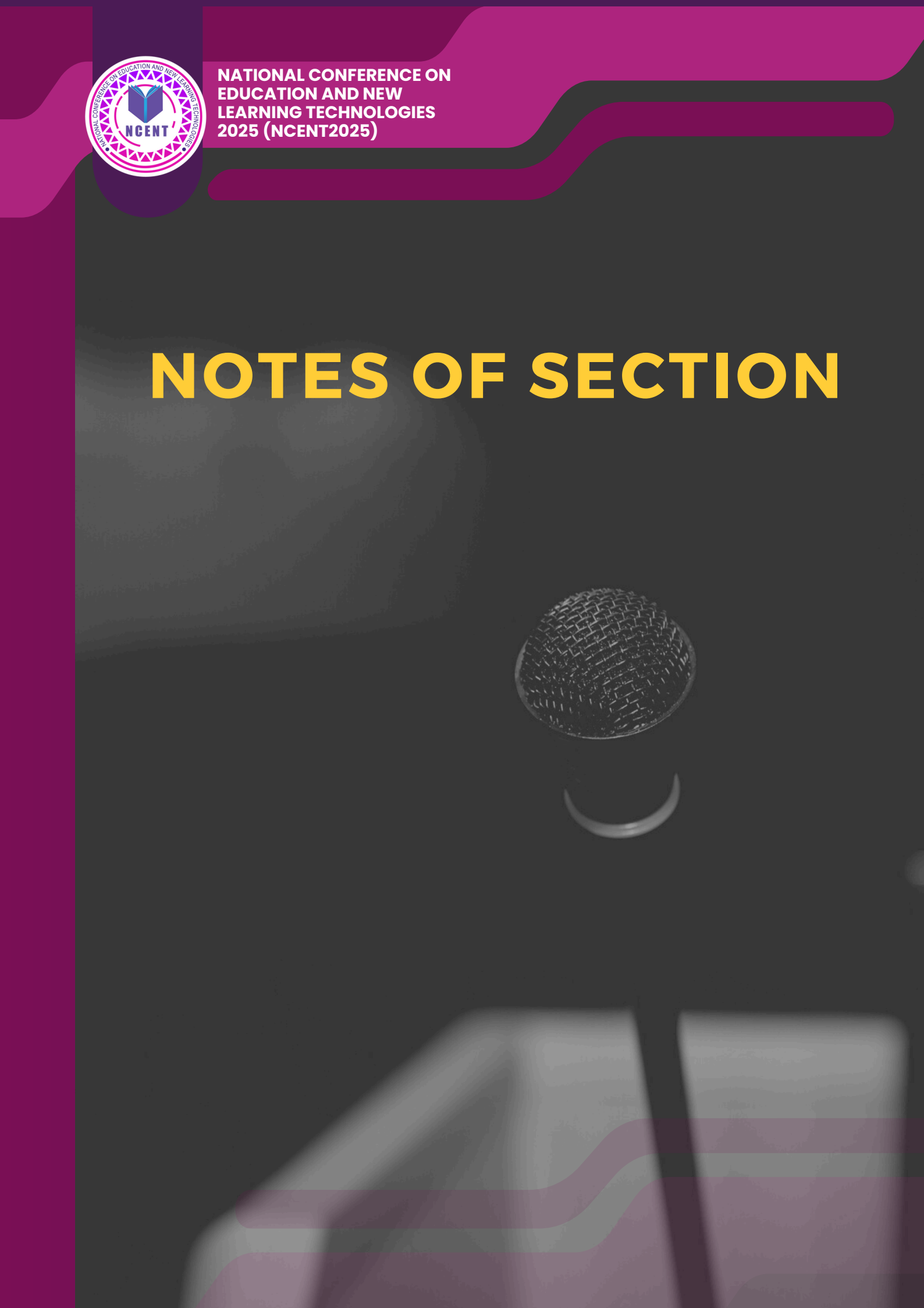
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NOTES OF SECTION



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