Lecture Notes in Educational Technology

Mohd Fakhizan bin Romlie
Siti Haryani Shaikh Ali
Zolman Bin Hari
Meng Chew Leow *Editors*

Proceedings of the International Conference on Advancing and Redesigning Education 2023

ICARE 2023

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Lecture Notes in Educational Technology

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Introduction to ICARE 2023

International Conference on Advancing and Redesigning Education 2023 (ICARE 2023) is a two-day conference hosted at Universiti Teknologi PETRONAS by the Alliance of Government-Linked Universities in collaboration with Majlis Ketua-ketua E-pembelajaran IPTA Malaysia (MEIPTA).

The objective of ICARE 2023 is to establish collaboration opportunities with an emphasis on relationship building between the academic and the industry. It also aims to strengthen the research culture among educators, specifically in the Teaching and Learning areas.

ICARE 2023 featured a variety of forums and keynote speeches by internationally recognised speakers under the theme "Reshaping Future Education through Digital Transformation".

Foreword

I extend a warm welcome to all participants of the International Conference on Advancing and Redesigning Education (ICARE 2023). It is always invigorating when respected speakers, delegates, and attendees come together to champion a noble cause, as the results have the potential to positively reshape the destiny of humanity.

This event is a collaborative effort of the Alliance of Government-Linked Universities (GLU) siblings, which include Multimedia University (MMU), Universiti Kuala Lumpur (UniKL), Universiti Tenaga Nasional(UNITEN), and Universiti Teknologi PETRONAS (UTP) and our organiser by Majlis Ketua-Ketua e-pembelajaran IPTA Malaysia (MEIPTA). I am eagerly anticipating the outcomes of this conference due to this joint effort.

In the present day, the world faces numerous uncertainties and challenges including economic instability, increasingly troublesome environmental conditions, and humanitarian crises. However, this complex global landscape has also acted as a catalyst for uncovering unexplored opportunities and possibilities, particularly for higher education. It is imperative for us as educators to consistently prepare our students to thrive in a new era by immersing them in future scenarios, facilitating change, and empowering future generations.

This significant conference is timely organised as it aims to explore innovative technologies and ideas to effectively address these challenges and provide practical solutions to the communities we serve. With the theme of 'Reshaping Future Education through Digital Transformation', I am confident that ICARE 2023's goal of fostering collaboration between academia and industry with a focus on relationship building will be fully realised. This event will also foster a research culture, particularly in the Teaching and Learning areas, among educators. I hope that the conference and the compelling topics we have prepared will unlock new perspectives that enable us to re-imagine the future in light of global trends.

I would like to express my deepest gratitude to UTP, the host of the conference which has worked tirelessly to make this event a success, our other esteemed GLU partners, our co-organiser MEIPTA, and the conference sponsors for their pivotal role in ensuring the success of this event.

To all the speakers, delegates, and participants of ICARE 2023, your unwavering support for this event is an invaluable contribution to our mission of creating a better tomorrow.

Thank you.

Professor Dato' Dr Mazliham Mohd Su'ud
Chaiman of Alliance of Government-Linked Universities
President and Chief Executive Officer, Multimedia University.

Foreword

This is the second series of International Conference on Advancing and Redesigning Education 2023 (ICARE 2023) by the Government-Linked Universities (GLU), hosted by Universiti Teknologi PETRONAS (UTP), in collaboration with Universiti Tenaga Nasional (UNITEN), Multimedia University (MMU), and Universiti Kuala Lumpur (UniKL) and co-organised by Majlis Ketua-ketua E-Pembelajaran IPTA Malaysia (MEIPTA).

Through our partnership and collective efforts, we hope to expand impact through a platform for educators to share their best practices as well as gain insights from other initiatives in Teaching and Learning, assisted by digital technology.

The theme "Reshaping Future Education Through Digital Transformation" is apt considering how the post-pandemic has catalysed the wave of digital disruptions, which is driven by rapid technological advancements. The democratisation of access to high-quality education through digital disruptions has made digital and media literacy, along with the capacity to adjust and embrace new learning trends, increasingly important.

Indeed, Higher Education Institutions need to prepare themselves for the future learners, who are no longer the digital natives, but rather, the AI natives. Curriculum therefore needs to be more engaging, and interdisciplinary, promoting digital collaboration and digital literacy to meet future market requirements.

Education is not just about imparting knowledge, but it is about fostering collaborations, critical thinking, and enhancing students' learning experiences by leveraging on technology, thus promoting the pathway for innovations in teaching and learning. Thus, ICARE is here for educators to share their ideas, reflecting on their practices and their teaching philosophies in creating and promoting an effective learning environment for all learners, that will benefit not just the learners but the community at large.

My heartiest appreciation goes to all the sponsors and my focus recognition and thank you to all who have contributed to ICARE'2023. Let us work together to bring positive changes to the community and the nation.

Thank you and have an enriching and impactful conference.

Professor Dato' Ts. Dr Mohamed Ibrahim Abdul Mutalib

Vice-Chancellor, Universiti Teknologi PETRONAS

Foreword

There has never been a more critical time to focus on using educational technology in higher education. Universities worldwide learned the benefits and challenges of using technology to teach, learn, and assess during COVID-19. If technology is thoughtfully implemented and focuses on learning, teaching, and assessment, the student experience is enhanced. We can reconceptualise education, redesign our future, and reshape the student experience. The online environment provides another space where good teaching and learning can occur. Students learned to interact in the online environment, and teachers developed their digital literacy in teaching and assessing online. However, universities cannot do this alone; this book provides a role model for collaboration. The following Government-Linked Universities (GLU) collaborated on organising a conference to examine advancing and redesigning education. These include Universiti Teknologi PETRONAS (UTP), Universiti Tenaga Nasional (UNITEN), Multimedia University (MMU), and Universiti Kuala Lumpur (UniKL).

Another critical theme in higher education, as mentioned by the Educause Horizon Report 2023, is that "our shared humanity has also become a key focal point within higher education, as faculty and leaders continue to wrestle with understanding and meeting the diverse needs of students and to find ways of cultivating institutional communities that support student well-being and belonging" (Educause Horizon Report, 2023, p. 4). In particular, Universities need to be aware that the post-pandemic educational context includes

Student demand for flexible learning

The online versus face-to-face dichotomy is being disrupted

The need and demand for lifelong and workplace learning are increasing

The potential for AI to become mainstream is growing (Educause Horizon Report, 2023).

This book is a compilation of conference papers presented at the International Conference on Advancing and Redesigning Education 2023. This event gathered leading experts, researchers, and practitioners to discuss and showcase the latest developments in education and technology. Close to 100 papers were part of the proceedings, and it is heartening to see the emphasis throughout the conference. A glimpse through keywords in the generative cloud word below shows learning, students and education as key themes. It is not unexpected but essential to never lose sight of what we are trying to achieve, particularly when technology and educational technology are used.

The book covers a diverse range of topics and delves into four primary areas of focus:

Technology-Enhanced Learning

This section explores innovative ways technology shapes the learning landscape. It examines how digital technologies facilitate learning, teaching, and assessment. Blended or online courses and learning management systems assist this process. There may be synchronous (real time) and asynchronous (e.g. pre-recorded materials) learning. Mobile learning can also provide flexible, accessible educational options. Technology-enhanced learning can enhance engagement and promote self-directed learning.

Innovative Curriculum and Program Offering

This section examines novel curriculum design and development approaches. Curriculum needs to be designed to empower students with knowledge, skills, and capabilities to thrive in a changing world. Interdisciplinary learning provides holistic learning. Project-based learning assists in solving real-world problems. Others include personalised learning pathways and programs that emphasise a global perspective and the development of transferable skills.

Learning Beyond the Classroom

This section Investigates the expanding boundaries of learning experiences beyond traditional classroom settings. These settings may include environments outside the usual boundaries of the campus. They may consist of community engagement, involvement in industry projects, travel and immersion in another culture, extracurricular activities that involve activities like clubs, sports, arts and community service, online learning, internships, fieldwork, and volunteering. Education needs to be considered as a lifelong journey.

Digital Campus

This section analyses the role of digital technologies in transforming educational institutions. The digital campus can vary from institution to institution and depends on the strategy and technology infrastructure. The aim is to utilise technology to enhance the student experience. Aspects of the digital campus may include online learning, learning management systems, virtual classrooms, e-libraries, communication tools such as email, mobile apps, simulations, and data analytics.

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Contents

Innovative Curriculum and Programme Offering

Learning Beyond Classroom

Digital Campus

Collegial Management Attributes and the School Managerial Effectiveness: A Study of Secondary Schools in Zhengzhou, Henan Province

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Abstract. The purpose of this study is to examine the relationship between collegial management attributes (Human relations, Group working, Flexibility, and New method in education management) and school managerial effectiveness in secondary schools in Zhengzhou, Henan Province. The study was guided by social exchange theory to explain the framework. Using a quantitative research design, the study collected valid data from 287 respondents (school managers) in the regions via purposive sampling. Data was collected using a survey questionnaire, and regression analysis was performed. The study's findings demonstrated positive relationships between human relations and group work in enhancing the school's managerial effectiveness. However, flexibility and new education methods were found not the predictors of school managerial effectiveness. Based on these findings, the study suggests that school managers create collaboration by fostering a culture in which everyone feels valued, appreciated, and encouraged to contribute ideas. To promote effectiveness and job agility, school managers should adopt a flexible approach and be open to new methods. Future research for this study may benefit from a qualitative approach to gain a better understanding of how and why these factors can influence managerial effectiveness.

Keywords: Collegial management attributes · school managerial effectiveness · educational leadership · Quality Education · secondary schools

1 Introduction

School management is an essential part of any educational institution. It involves the coordination and supervision of various activities, such as student affairs, staff management, financial planning, and budgeting [1–3]. Effective school management plays a critical role in ensuring that students receive a quality education while also providing a safe learning environment for all stakeholders. Tony Bush has identified several typologies of school management models, including formal, collegial, political, subjective, ambiguous, and cultural models. Of these, the most popular models are the formal and collegial models [4].

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Although formal school management involves the use of top-down decision-making processes, where rules are established by administrators or governing bodies with little input from teachers or other stakeholders within the educational system [5]. This type of management is often seen as an efficient way to ensure compliance with regulations while providing consistency across different schools in terms of curriculum standards and expectations for student performance. However, this approach can also lead to limited creativity among staff members if their voices aren't being heard or taken seriously [6].

Thus, [4] argued that collegial school management focuses on the idea that all members of staff should have an equal say when it comes to decision-making within an educational institution. He suggests that this type of collaborative approach will create more effective outcomes than those achieved through hierarchical models which often place too much emphasis on administrative control rather than collective inputs from teachers or other personnel involved with running the institution effectively [6]. Furthermore, he believes this model encourages innovation among educators as they can share ideas freely without fear of retribution or criticism from superiors who may not understand their perspective fully due to a lack of time spent working directly with students or faculty members alike.

Collegial management is proven to encourage collaboration and teamwork, rather than hierarchical control [7]. In this system, managers provide guidance and direction to their subordinates but also allow for input from all team members in the decision-making process [8]. This approach is effective in many contexts due to its ability to foster creativity, improve communication between colleagues, and promote trust within teams [9].

However, in the traditional Chinese culture, there is a strong emphasis on hierarchy and respect for authority [10]. This can result in a top-down approach to decision-making, where the authority figure is expected to make decisions without input from others. Additionally, there is a strong emphasis on saving face and avoiding conflict, which can lead to a reluctance to challenge the decisions of those in authority. This top-down approach to decision-making may not take into account the unique needs and perspectives of individuals or teachers. This can lead to policies and practices that may not be effective or appropriate for the specific context, which can result in a waste of resources and reduced effectiveness.

Although, past research shows that this type of organizational collegial management model has a positive effect on teacher morale, student achievement, school climate, and overall school performance [7, 9]. However, there is limited research to test the relationship between collegial management attributes and school managerial effectiveness specifically within the secondary school context. Besides, there have been studies that examined how collegial management affects managerial effectiveness [11–14], this specific area has not yet been adequately explored. Therefore, this study seeks to fill the gap by examining the relationship between collegial management attributes and the school's managerial effectiveness from the viewpoint of employees (school managers).

2 Literature Review

2.1 Theoretical Foundations

Social exchange theory (SET) was also adopted in this study to explain the relationship between collegial management attributes and the school's managerial effectiveness. The theory is based on the notion that a reciprocal relationship between two parties is established through an analysis of cost and benefit [15]. [16] contended that when individuals receive more benefits than risks, they are more likely to retain the relationship, and in return when individuals outweigh the risks over benefits, they will abandon the relationship. Hence, by applying SET in this research, employees who have benefited from the leader and his/her style will perceive the institution in a positive light; thus, contributing positively to the school's managerial effectiveness. When employees benefit positively from the management of the school, they tend to exchange the feel-good factor and satisfaction obtained into higher performance which in the long run, will lead to improved productivity and effectiveness [17].

2.2 Relationship Between Human Relations and School Managerial Effectiveness

Human relations mean the relationships between people in a workplace setting. It focuses on how employees interact, communicate, and cooperate, as well as how they are managed by their supervisors [18]. Human Relations also looks at how organizations can create an environment that fosters collaboration and encourages positive working relationships.

[19] found that there is a positive correlation between effective human resource management (HRM) practices and increased employee performance levels. Hartati argued that when employees have positive relationships with their colleagues, supervisors, and other stakeholders, they tend to be more motivated and productive. This is because having good interpersonal relationships encourages collaboration among team members, which can lead to better productivity and profitability, problem-solving skills, higher job satisfaction, and employee retention rates [20]. Moreover, it also improves communication between managers and staff as well as increases trust within the organization. Based on the discussion, this study hypothesized that:

H1: There is a positive relationship between human relations and school managerial effectiveness.

2.3 Relationship Between Group Work and School Managerial Effectiveness

Group work is a form of collaboration between individuals or teams to achieve a common goal. It involves the sharing of ideas and resources, as well as the planning and execution of tasks to complete projects efficiently [21].

[22] sought to evaluate the impact of team management on workers' productivity. The study found that effective team management had a positive effect on worker performance and productivity. Besides, [23] found that teams are essential for any successful organization, as they can bring different perspectives and skills to projects and tasks.

This was largely attributed to the fact that teams allow for better communication, collaboration, and problem-solving among employees, which can lead to higher levels of motivation and engagement in their work. Moreover, teams tend to be more efficient as they can divide tasks among members, so everyone is working towards a common goal instead of each person having separate objectives or goals. Based on the notion explained, this study postulated that:

H2: There is a positive relationship between group work and school managerial effectiveness.

2.4 Relationship Between Flexibility and School Managerial Effectiveness

Flexibility refers to the ability of a manager to adjust and adapt their strategies, processes, and goals to meet changing needs or conditions [24]. [25] conducted a study to investigate the relationship between work flexibility, job satisfaction, and performance in an organization. The results showed that there is indeed a strong correlation between work flexibility and both job satisfaction and effectiveness. Those who had more flexible working arrangements reported higher levels of job satisfaction than those with less flexible arrangements, while also having better overall performance ratings than their counterparts without such options available to them. Thus, this study hypothesized that:

H3: There is a positive relationship between flexibility and school managerial effectiveness.

2.5 Relationship Between the New Method in Educational Management and School Managerial Effectiveness

The new method is a term used to describe the latest techniques and strategies for managing complex business operations [26]. It is an approach that focuses on improving efficiency, reducing costs, and increasing profitability by utilizing modern technology and innovative methods [27]. For instance, [28] proposes a method that combines practical thinking with big data analysis strategies to evaluate educational management. This has supported the notion of [29] who argued that the new method has become important in the field of educational management due to advancing technology. Effective management of university institutions involves adopting new methods that leverage advancing technologies, such as big data analysis and network platforms in identifying learning challenges and motivating students/ staff to engage in their tasks.

Thus, innovation is a key factor that managers must consider to achieve success. According to [30], innovation can engender new methods and ways of executing tasks, which can help increase productivity and efficiency within the organization. Their study found that organizations with innovative approaches are more likely to outperform their competitors due to their ability to stay ahead of trends and develop creative solutions for problems they face.

[27] in their analysis found that managers can play a critical role in encouraging employee innovation by providing them with opportunities to participate actively within the organization's decision-making process; creating an environment where ideas are valued; allowing for experimentation with new approaches; rewarding innovative behavior

through recognition or other incentives such as monetary rewards or promotions; providing guidance when needed, but also allowing autonomy for employees to take initiative without fear of failure. Based on the discussion, this study hypothesized that:

H4: There is a positive relationship between new methods in educational management and school managerial effectiveness.

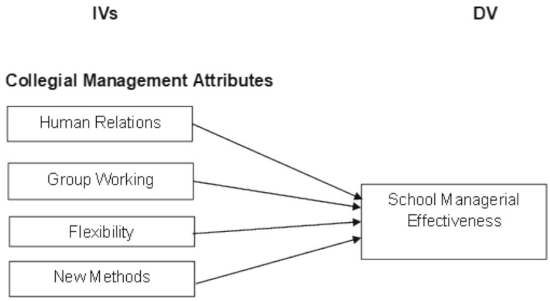

Fig. 1. Conceptual Framework

3 Methodology

3.1 Research Design

This study used a quantitative research design to collect reliable and accurate data. Quantitative design is used as it involves the reduction of phenomena to numerical values [31]. A questionnaire is a research instrument used to collect data from respondents. It consists of a series of questions designed to gather information about the respondent's opinions, attitudes, beliefs, and behaviors.

3.2 Sampling Procedure

The participating schools for this research have been purposively determined with careful consideration given to various factors such as size, location, and type. The size of the school is an important factor, as it can influence the management structure and decision-making processes, hence, only schools that have a minimum of 150 individuals qualified to be regarded as school managers are considered. For a school to be included must also be located in Zhengzhou, Henan Province. The school must also be a public secondary school. This selection process ensures that a representative sample is obtained which allows for an accurate evaluation of the impact collegial management has on managerial effectiveness. Based on this, Zhengzhou No.1 High School (coded as A), Zhengzhou No.8 Middle School (coded as B), and Zhengzhou No.47 Middle School (coded as C) were selected to participate in the study. All the schools have a minimum of 150 qualified school managers, are also all located in Zhengzhou, Henan Province, and are all public secondary schools.

There are about 231 staff who are within the category of school managers in A, 198 from B, and 186 from C. The numbers comprise the principals, vice principals, head of departments and their assistants, and other senior staff who occupies various positions. The population of eligible respondents in the study is 615. Using [32] table, where there are 600 eligible respondents, the recommended sample is 234. But since the number exceeds 600, it is best to increase it further so that more individuals can get involved, thus increasing the credibility of results obtained from the study hence, the sample size shall be 321. Table 1 summarizes the sample of the study.

Table 1. Sample of the study

School	Eligible	Sample
A	231	141
B	198	101
C	186	79
Total	**615**	**321**

3.3 Instruments

The questionnaire used in the study was broadly divided into 6 sections. Section A is about the demographic characteristics of respondents such as gender, age, educational level, and working experiences. This section contains five questions. Sections B to F measures the variables such as human relations, group working, flexibility and new methods, and school managerial effectiveness (*see the detailed measurement of variable from Table 2*).

Sections B, C, D, E, and F contain 4 to 5 items respectively. These questions are based on a Likert-type scale ranging from 1 being strongly disagree and 5 being agree respectively.

Table 2. Operationalization of variables

Section/ Variables	No. of Items	Measures	**References**
Section B: Human Relations	5	Communication, inter-personality, empathy	[33]
Section C: Group working	4	Collaboration and open-mindedness	[34]

(*continued*)

Table 2. (*continued*)

Section/ Variables	No. of Items	Measures	**References**
Section D: Flexibility	5	Adaptability	[35]
Section E: New methods in educational management	4	Innovation, creativity, and Problem-solving	[36]
Section F: Managerial Effectiveness	5	Strengths, weaknesses Qualities	[37]

Table 3. Reliability analysis

Variables	*Cronbach's Alpha (n = 30)*	**No. of Items**
Human Relations	0.936	5
Group Working	0.831	4
Flexibility	0.905	5
New Method in education management	0.910	4
Managerial effectiveness	0.910	5

3.4 Pilot Testing

Pilot testing is an essential step in ensuring that research studies are conducted properly, yielding reliable results which can be used for meaningful analysis and decision-making.

In this study, pre–test was conducted with 30 sample respondents who are not part of the main study sample. The value score obtained for human relations, group working, flexibility, new methods in education and managerial effectiveness are higher than the acceptable threshold value of 0.70 as stated by [38]. Thus, the instrument is reliable and able to proceed with real data collection.

3.5 Normality Testing

To ensure a normal distribution of the data, skewness, and kurtosis analysis were further carried out. [39] mentioned that data must be normally distributed before multivariate analysis can be conducted. It can be said that the data was normally distributed when the values that represented the skewness and kurtosis of the variables were in a range of −2 to + 2, with consideration of 5% sampling errors [40]. With that, as referred to in Table 4, the values for all the variables were within the range of −2 and + 2, thus, showing that data are still normally distributed and multivariate analysis can be further analyzed.

Table 4. Normality analysis based on skewness and kurtosis

Variable(s)	Skewness	Kurtosis
Human Relations	–0.186	–0.187
Group Working	–0.867	0.740
Flexibility	–0.472	–0.222
New Methods	–0.357	–0.750
Effectiveness of Managers	–0.412	–0.209

3.6 Validity Testing

The KMO value from Table 5 is 0.857 (> 0.60), which is highlighted by [41] that the KOM value between 0.8–1.0 indicated the sampling is adequate and shows that the data has a comparatively high validity. As a result, the data is valid and it is suitable for further analysis.

Table 5. Validity testing

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.8576
Bartlett's Test of Sphericity	Approx. Chi-Square	499.795
	df	78
	Sig	0.000

4 Results

As shown in Table 6, there were a total of 287 responses, with 51.2% (147) males and 48.8% (140) female respondents, which shows there is almost equal distribution in terms of gender categories. For the age, nearly half of the respondents age between 40–54 years old (47.4%). In terms of the level of education, more than half of the respondents (59.6%) have a bachelor's degree, which indicated the respondents are well-educated and able to make wise judgments. Regarding tenure, nearly half of the respondents have been working for secondary schools for 5–9 years (43.2%) and have some managerial experience in the job (46.7%).

Table 6. Demographic profile of respondents (N = 287)

Variable(s)	Categories	Frequency	Percent
Gender	Male	147	51.2
Age	Female	140	48.8
	Less than 25	13	4.5
	25–39	49	17.1
	40–54	136	47.4
	55–69	89	31.0
Education Level	Doctorate Degree	15	5.2
	Master's Degree	75	26.1
	Bachelor's Degree	171	59.6
	Others	26	9.1
Tenure (years)	<5 years	68	23.7
	5–9	124	43.2
	10–14	64	22.3
	15–19	17	5.9
	>19 years	14	4.9
Managerial Experiences	None	13	4.5
	Very Little	49	17.1
	Some	134	46.7
	A Great Deal	45	15.7
	Extensive	46	16.0
Total		**287**	**100.0**

4.1 Hypothesis Testing

A multiple regression analysis was performed using the dependent variable, school managerial effectiveness, and the independent variables, Human Relations, Group-work, Flexibility, and New Methods in Education Management. With a R square value of 0.618, this means that Human Relations, Group-work, Flexibility, and New Methods in Education Management contributed 61.8% of the variance in managerial effectiveness, with 38.2% of other variables not yet included in this study. The analysis indicated that human relations and group working were the predicting factors that contributed to managerial effectiveness, while flexibility and new methods were excluded. Hence, H1 and H2 were supported, but, H3 and H4 were rejected.

Table 7. Multiple regression analysis of school managerial effectiveness with predictor variables.

Predictor Variables	Unstandardized	Coefficient	Standardized Coefficients		
	B	Std. Error	Beta	t	**p**
(Constant)	3.944	0.394		10.015	0.000
H1: Human Relations	0.038	0.057	0.040	0.667	0.005
H2: Group Working	0.004	0.061	0.004	0.065	0.048
H3: Flexibility	0.099	0.057	0.107	1.731	0.058
H4: New Methods in education management	–0.049	0.051	–0.058	–0.967	0.335

$R^2 = 0.618$ $df_1 = 4$, $df_2 = 282$ $P = 0.000$.

5 Discussion

The results of the data analysis for the study indicated that human relations and managerial effectiveness have a significant relationship. The research supports the findings of [19], who discovered a positive relationship between effective human relations management methods and higher employee performance levels. Similarly, [20] discovered that human resource management methods had a considerable impact on organizational performance in terms of productivity and profitability, as well as employee satisfaction and retention rates. Thus, effective educational leaders need to create good relationships with their team and foster a positive work environment, which is in line with the positive association that exists between human relations and the effectiveness of managers.

Consequently, the research demonstrated that there is a positive relationship between group work and the effectiveness of managers. This finding is consistent with those of [22] and [23] who posited that effective team management had a positive effect on worker performance and productivity. [23] particularly noted that having effective team management strategies in place could lead to improve efficiency among employees. This has further supported [4] notion that collaborative management strategies are essential to the achievement of success in educational environments.

The study also discovered a non-significant relationship between flexibility and the effectiveness of managers, which make the results different from previous studies of [42] which stated that managers must be flexible in their approach to employees to boost the effectiveness and work agility. A possible explanation is that the study was conducted in China setting, where, there is a strong emphasis on hierarchy and respect for authority [10]. Thus, the flexibility of work might not be fully granted due to the cultural settings.

Finally, the results of the analysis revealed that there is no positive relationship between the new method of education management and managerial effectiveness, which contradicted the study of [27]. The possible explanation is that the school understudied are the public schools, where they might have to follow the government policies set by the nation, thus, creativity and innovation of new methods in the administration might not be applicable without the higher authority from the ministry of education of China.

6 *C*onclusion

This study aims to investigate the relationship between collegial management attributes and the school's managerial effectiveness. The results indicated that human relations and group working have a positive and significant relationship with the school's managerial effectiveness, however, the flexibility and new methods in education management were not the predictors.

6.1 Implications

This study contributed to the social exchange theory, where the reciprocal relationship is evident in the findings, suggesting that the delivery of collegial management attributes as the input in the SET, where these inputs will help to drive improvement in employees' perceptions about the school and in return will lead to positive performance and effectiveness.

The findings of this study give insights into the management of the secondary school in China to implement the collegial management model among the staff. Therefore, the management of secondary schools should encourage a flexible system and empower the staff as it indicates sufficient authority and independence. For instance, the management of the schools should give more freedom and authority to support employees and trust them in performing their tasks.

Besides, the new method in education management was not significant. Thus, the top management of the secondary school should encourage innovative ideas when it comes to the administration of the university. Thus, top management should send the staff/ employees to go for innovative training and equip them with digital skills so that in the future, it can help to enhance the administrative duties among the managers to make the work more effectively done.

6.2 Limitations and Suggestions for Future Research

The first limitation of this study is the current study only looks from the viewpoints of the positivism/ quantitative approach. Hence, future studies could take a qualitative or mixed-method approach to examine how these constructs can lead to the school's managerial effectiveness.

This study only collected based on China and focused on the Henan province. Geographically, similar studies should be conducted at different levels of education and across different provinces. Thus, future comparative studies to examine the difference between private and public schools in terms of collegial management were also interesting to be carried out.

In addition, this study only examined the four aspects of collegial management attributes, thus, further research can analyze the influence of other variables, such as job satisfaction, and manager's identification to name a few, and also test the moderating role of demographic variables on the current framework to add new insights to the education management scholarship.

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Conducting Multi-venue Lectures Through Dual-Mode System

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Abstract. Having exactly the same courses taught to a large number of students at different venues is a big waste of resources for most higher learning institutions. Delivering the same content to different groups of students at different venues at the same time requires the institution to hire different teachers for every venue. This may also cause inconsistencies in teaching and learning (T&L) processes. The objective of the initiative is to save resources by reducing the number of staff teaching the same content and to standardise the methods used in delivering the course, without jeopardising the quality of T&L and students' performance. This will ensure that all students will equally get the same input from the teacher. Using the smartboard available in every classroom, stable network connections and a few sets of cameras and microphones, it is possible to conduct dual-mode T&L sessions from any location, provided the other venues are also provided with similar infrastructures and a group of facilitators. This will only require one teacher to teach from one venue, and the session will be shared by other groups of students at different venues in real-time.

Keywords: Dual-mode system · Smartboard · Resource sharing

1 Introduction

In 2014, the Malaysian Ministry of Education introduced a set of national requirement courses called Mata Pelajaran Pengajian Umum (MPU). The Private Higher Education Institution Act 1996 (Act 555) has made it compulsory for students of private higher education institutions to take and pass these courses. In complying with this requirement, higher education institutions must ensure that they have sufficient resources to deliver these MPU courses to all students. This includes the teaching staff, lecture venues and timetable slots, which, most of the time cause many issues for the institutions.

Realising this, the Centre for Instructional Technology and Curriculum Development (CITC), Universiti Kuala Lumpur (UniKL) has taken the initiative to make use of the existing facilities to allow multiple classes of the same course at different UniKL institutes to be taught concurrently by only one lecturer and assisted by a group of facilitators.

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For this initiative, CITC has worked together with institutes' Academic Service Sections (AcSS) to coordinate the session slots of the MPU courses in the timetables. The course sessions at all involved institutes were set at the same time to allow concurrent sessions to be held together.

The first MPU course implementing this dual-mode system was Tamadun Islam & Tamadun Asia (TITAS), which carries the MPU3123 code, in 2020 just before the COVID-19 pandemic hit the world. The session was conducted physically in a 240 pax-capacity classroom in the Malaysian Institute of Information Technology (MIIT), Kuala Lumpur and joined by groups of students from a mini hall Malaysia France Institute (MFI), Bangi and two classrooms in British Malaysian Institute (BMI), Gombak. These three institutes rotationally hosted the physical sessions at their venues.

TITAS is one of the MPU courses to be taken by all students during the first semester of their study. It is usually conducted in mass lectures as the course does not require practical-oriented sessions. This is one of the reasons why TITAS was chosen to pioneer the dual-mode initiative. It was challenging to find the right time to gather all students at different venues at the same time. Having a large group of students from different bachelor's degree programmes was not easy, since students are allowed to choose courses to be taken in the semester and manage their own time and schedule. This makes it more difficult to find slots with the availability of all students, lecturers, facilitators and venues. However, for first-semester students, their options of courses to be taken are quite limited. Therefore, most first-semester students are having similar timetable.

2 Dual-Mode, Multi-venue Synchronous Teaching

The concept of dual-mode teaching, which combines synchronous face-to-face and online learning in multiple venues, has received limited attention in the literature. Most educators and scholars have focused on either face-to-face (F2F) teaching or online teaching, especially in response to the pandemic [1]. However, there are only a few recent publications that discuss the challenges and implications of dual-mode teaching. Transferring classroom content and activities and expecting students from multiple venues to embrace it is not enough [2]. Therefore, higher levels of technology use are needed [1]. Therefore, the dual-mode approach requires careful consideration and the implementation of equitable pedagogical strategies that cater to the needs of both in-person and online students.

Several studies have highlighted the benefits of multi-venue synchronous teaching. The multi-venue approach enables instructors to incorporate diverse perspectives by inviting expert guests and integrating global and multicultural education into their instruction [3]. Similarly, it provides opportunities for collaborative learning and engagement among students from different locations, fostering a sense of community and expanding their cultural awareness. Additionally, multi-venue synchronous teaching provides flexibility and convenience for students, allowing them to access educational resources and participate in learning activities regardless of their physical location [3]. To the institutions, the multi-venue synchronous teaching leads to efficiently shared and more coordinated resources [4].

While multi-venue synchronous teaching offers numerous advantages, it also presents challenges that need to be addressed. The challenges faced in synchronous

Fig. 1. The TV for the lecturer to view remote students.

dual-campus teaching are similar to those in single-campus teaching but are magnified due to distance. These challenges include technological issues, such as connectivity and audio-visual quality, as well as the need for effective communication and coordination between instructors and students in different locations [5]. The method of using the F2F platform to teach students in another venue via online is challenging as the learners need entirely separate planning and teaching methods from F2F students [6].

3 Methods

For the dual-mode system to be in place, every smartboard must be installed with a suitable video-conferencing application. During the early stage of implementation, a licenced TrueConf application was used. TrueConf provides secured communications since the transmission is through the Virtual Private Network (VPN). The application was later substituted with Microsoft Teams for easier setup and to allow the infrastructure to be used for hybrid mode as well.

The dual-mode system also requires a few sets of wide-angle cameras, each equipped with a tripod or camera stand. The cameras are used to capture images from different angles so that everyone, especially the lecturer, is able to view other venues at the same time. These cameras require USB extension cables of various lengths depending on the placement of the cameras. A motion-tracking camera is needed to focus on the movement of the lecturer. This is important especially for remote students so that the lecturer will always be in their view.

Additionally, every venue may require 50-inch 4K television sets and professional audio equipment that includes USB wireless microphones, depending on the size of the venue. Figure 1 shows the TV for the lecturer to view students attending class from different venues.

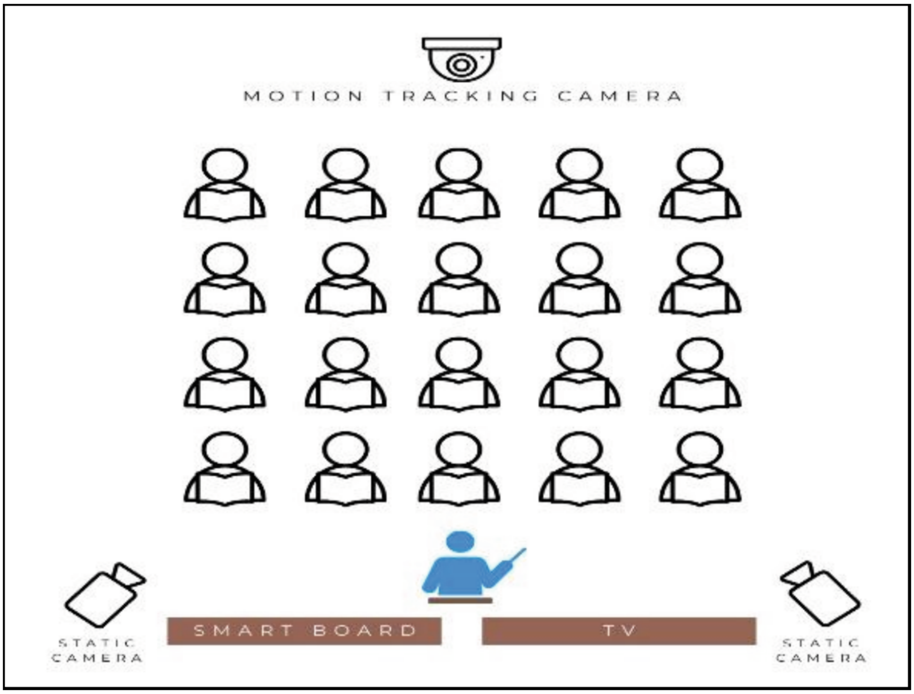


Fig. 2. Dual-mode system setting up in a classroom.

Figure 2 shows an example of dual-mode system set up in a classroom, as implemented in UniKL. The positioning of the equipment can be adjusted to suit the room size and layout. As for now, there is no plan to permanently fix the layout or the position of the equipment to make the venue more flexible for future change or layout conversion.

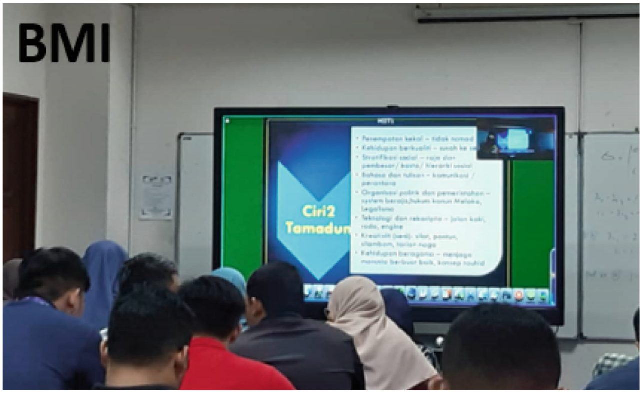
Table 1 summarises the hardware and software requirements for the dual-mode system at every venue. The implementation of the dual-mode system is not limited to venues with smartboards only, but smartboard is recommended for easier setup. For venues without a smartboard, the session can be conducted with a laptop with a connection to the network, a projector, a graphic tablet and a webcam to replace the smartboard functions, either at the host or remote location. This setup is an economical alternative and it may work as good as having a smartboard in place.

4 Results

Figure 3 show three views captured at different venues during the first dual-mode lecture session, which was successfully hosted by one lecturer from UniKL MIIT and joined by MFI and BMI in February 2020 (January 2020 Semester). The session was attended by about 500 attendees in total, including students, lecturers, facilitators, technical team members, and representatives from CITC. During this session, the physical face-to-face with the lecturer only occurred in MIIT. To ensure the smoothness of the session, it was

(a)

(b)



(c)

Fig. 3. Views from host and remote venues.

supported by three facilitators and three technicians at every venue. The two-hour session ran without any interruption and everyone was thrilled with the method of delivery. As for the consecutive session, the presence of technicians is no longer required as the lecturer is already familiar with the system. The technicians only need to get the venue ready with all the necessary equipment before the session and be on standby during the session.

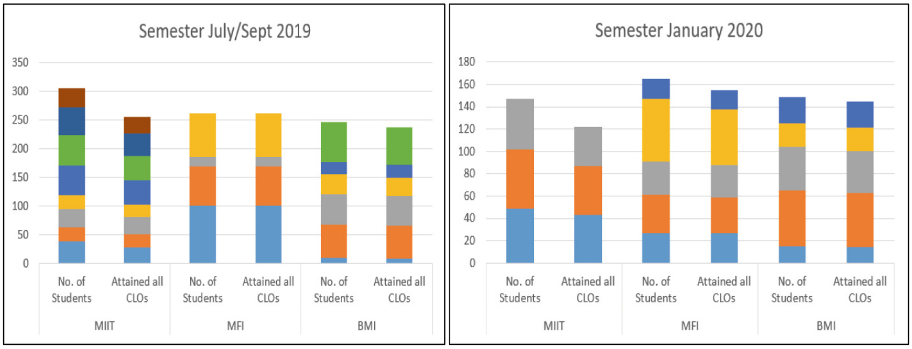
Table 1. Recommended hardware and software per venue

Item	Function	Quantity
Smartboard	To project the lecture materials and T&L activities and to connect the session to the dual-mode system	1
Wide-angle camera	To capture real-time images of the classroom	1–3
Motion-tracking camera	To capture real-time moving images of the lecturer	1
Tripod / Camera Stand	To position the camera. One of the wide-angle cameras can be placed on the smartboard to capture the front view of students	1–3
Audio equipment	To boost the capture and release of sound in the classrooms	1 set
4K Television	To display images captured by cameras in real-time	1–3
USB extension cables	To connect cameras to the smartboard	2–4

The dual-mode system is not only meant for display and lecture sharing but also for most other T&L activities. The facilitators' presence is important to assist the lecturers and facilitate activities at their respective venues. Interactivities like question-and-answer sessions can be conducted as normal since the lecturer can see and hear all students from his or her location. Other activities like group discussions and student presentations may be conducted in a large group or separated by venues, based on the intended activities' outcome. On top of that, sharing of T&L materials on online platforms makes it easier for resource references and assessment submissions.

To control the quality of the T&L process, CITC has grouped all 13 UniKL institutes by regions, namely; Central, Northern and Southern regions. The dual-mode session is only shared among the regional institutes for easier and better coordination. As a start, course assessments are still conducted separately by subject-matter experts at the respective institutes. There is a plan to centralised the assessment sessions and to allow students to be assessed by lecturers from other institutes, in the future.

The effectiveness of the dual-mode system was measured based on the attainment of the course learning outcomes (CLOs) of TITAS course in the July/September 2019 semester, before the implementation of the system, and the CLO attainment of the course in the January 2020 semester, when the system was already in place. For these two semesters, the course was taught by the same group of lecturers, using the same course syllabus version. No curriculum amendment was made between the two semester. Therefore, the same teaching strategies were applied.



(a) (b)

Fig. 4. Number of Students who Attained all CLOs in July/September 2019 and January 2020 Semester.

TITAS upheld three affective domain CLOs altogether, as follows:

- CLO1: Explain the role of civilizational values in the formation of Malaysian society's value system. *(Menghuraikan peranan nilai ketamadunan dalam pembentukan sistem nilai msyarakat Malaysia)*
- CLO2: Demonstrate social communication skills in a diverse cultural landscape. *(Mempamerkan kebolehan komunikasi social dalam kepelbagaian landskap budaya)*
- CLO3: Discuss the elements of civilization with current social issues. *(Membahaskan elemen ketamadunan dengan isu kemasyarakatan semasa)*

Table 2. Percentage of Attainment of All CLOs

Institute	Semesters			
	July/Sept 2019		*January 2020*	
	No. of Students	*% Attained all CLOs*	*No. of Students*	*% Attained all CLOs*
MIIT	305 (8 groups)	83.93	122 (3 groups)	82.99
MFI	262 (4 groups)	100.00	165 (5 groups)	93.94
BMI	246 (6 groups)	96.34	149 (5 groups)	97.32

Figure 4(a) and 4(b) depict bar charts of the number of students enrolled for the TITAS course in three institutes and the number of students who attained all CLOs upon completion of the course in July/September 2019 semester and January 2020 semester, respectively. The colours represent different groups in the semester. The number of students per group is varies, depending on the venue set for the T&L sessions. It is normal for UniKL to have fewer students in the January semester due to the number of new student enrolments in the semester. The number of programmes offered for new student intake is higher in the July/September semesters. So, the number of first-semester students in the semester is more compared to January semester.

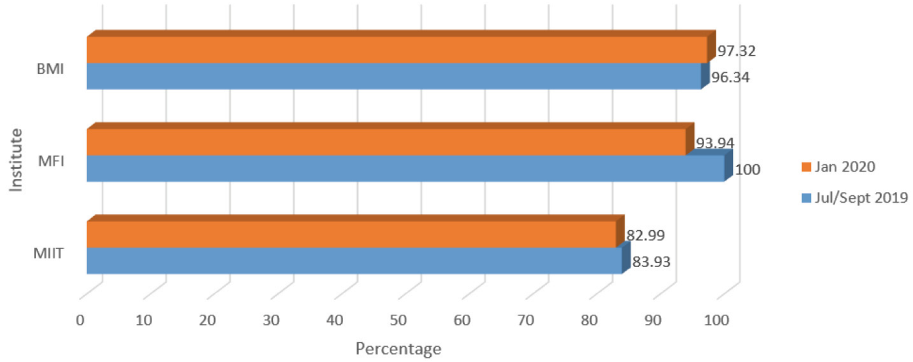


Fig. 5. Percentage of Attainment of All CLOs by Institutes.

Table 2 shows the details of students' CLO attainment for the course at the three institutes for the semesters of July/September 2019 and January 2020. According to the data provided in the table, the percentage difference between the two semesters with different modes of course delivery was only 3.5%. Out of 813 students in July/September 2019 whereas 412 students or 89.37% from 461 students attained all CLOs in January 2020 semester. Figure 5 shows the breakdown of the percentage of attainment of all CLOs by institutes. It can be seen that there is a slight increase in the percentage for BMI and a decrease for both MIIT and MFI.

Based on data captured by UniKL Learning Outcomes Attainment Measurement System (LOAMS), all enrolled students attained at least two of the CLOs. There was no record of students attained only one, or none of the CLOs.

5 Discussions and Conclusion

UniKL is one of the higher learning institutions that has its institute buildings scattered throughout Peninsula Malaysia. Offering courses that are compulsory for all students requires the university to provide qualified teaching staff to be at every institute to teach the same courses as offered by other sister institutes. The dual-mode system has solved the issue with a reduced number of teaching staff. In the situation discussed earlier, only one lecturer needed to give lectures on certain topics to about 500 participants from four different venues. Without the dual-mode system, four lecturers are needed to teach the same topics. At the beginning of the implementation, the system successfully reduced between 20% to 30% of the teaching load of respective lecturers. In the long run, it is expected that the dual-mode system will save more manpower and lessen the university's need for part-time lecturers.

Even though the system is being challenged by the hybrid system, where students can be either in the classroom or accessing the class session from anywhere, the dual-mode system is still applicable to situations where courses must be conducted in physical face-to-face mode, as stipulated in the course syllabus document. On top of that, the dual-mode system has also standardised the T&L delivery and activities throughout UniKL institutes, hence ensuring that all students are getting the same information and instructions from the same source. With this, quality assessments can be easily constructed, and students' performance and attainment of learning outcomes can be fairly measured. Data collected has obviously shown that changes in course delivery mode do not have a huge impact on students' academic performance. The slight drop of performance at two of the institutes may also be the result of Movement Control Order (MCO) that affect the later weeks in January 2020 semester.

Despite the fact that the dual-mode system has shown positive impacts in T&L practices, there are still issues that have never been less important. The timetabling issue does not allow many courses to implement the system. It is not an easy task to reserve dedicated time slots for a large group of students due to a number of internal and external factors. Students come from different programmes and multiple institutes. Some programmes follow different academic calendars, so they cannot be grouped together. Some institutes start their first T&L learning period of the day at 8.00 a.m., while some others start at 8.30 a.m. Therefore, the slots have to be allocated during odd hours, usually in the late afternoon or at night time. Alternatively, the class have to be conducted during the weekend, which is not favourable for most. The setting where Malaysian states are divided into two groups of different weekends and non-standard public holidays also contributes to this timetabling issue.

The initiative was halted during the MCO in 2020. Not long after the MCO was lifted, TITAS faced cessation, as there was the introduction of two MPU U1 category courses. Realising that the dual-mode system can be beneficial to the institution, CITC is currently working with a number of different parties to find suitable courses to resume the implementation of the system.

Acknowledgement. Our sincere gratitude goes to all CITC members who contributed a lot in terms of knowledge, skills, time and effort. Not forgotten the Information & Communication Technology Division of UniKL for their assistance to ensure everything is working smoothly as planned. We are deeply grateful to the lecturers, facilitators and students for their full cooperation in the success of this initiative. We would like to also thank the management of UniKL for their invaluable and continuous support for the betterment of T&L.

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Deep Insights: Elevating Academic Performance Through Facial Expression Classification with Advanced Deep Learning Techniques

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Abstract. Facial expressions play a vital role in academics by influencing student engagement and teacher-student interactions. The identification and classification of facial images during classroom learning offer a promising method to measure students' academic performance. This system holds significant potential benefits for educators, teachers, policy makers, and parents, enabling them to take early steps to enhance students' academic progress. Among the four deep learning algorithms, utilized for facial emotion expression extraction and detection, namely CNN, VGG-16, ResNet-50, and MobileNet, CNN stands out as the top-performing method. With an impressive accuracy of 87.56% and a validation score of 61.58%, CNN's results reinforce its effectiveness in assessing students' academic achievements through facial expressions. This innovative approach has the potential to revolutionize how academic performance is monitored and supported, fostering better educational outcomes for students.

Keywords: Convolutional Neural Network · CNN · VGG · MobileNet · Deep learning · Facial emotions · Transfer learning Academic performance

1 Introduction

The expression of facial emotions, such as happiness, sadness, tension, anger, and confusion, is something people do every day when communicating. Recognizing students' facial emotions holds significant importance in fostering effective learning, as cognition and emotions are deeply interconnected. Furthermore, numerous researchers have examined how cognition influences the emergence of emotions. Notably, positive emotions have the potential to enhance students' interest and motivation for learning [1].Also, the facial expressions of surprise, sadness, and disgust are highly valuable in predicting changes in students' knowledge [2]. According to Lyu, Zhang [3], negative emotional

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states such as worry, fear, and despair can hinder learning, while positive emotional states like joy, pride, and curiosity enhance the quality of learning. Nowadays, educational experts face the challenge of identifying the reasons behind students' academic failures and their inability to complete education, leading to a growing social concern. Fortunately, machine learning techniques come to the aid of researchers, enabling them to analyze students' learning patterns and academic performance [4]. One of the preeminent measures that guarantees the best for the user is the development of an artificially intelligent solution for the detection and classification of facial emotions. People may find it easier to recognize their own emotions and those of others around them. Additionally, it should make it simpler for teachers to recognize students' emotions so that the teaching and learning process may proceed smoothly [5].Both teacher performance and learning outcomes are profoundly affected by the emotional state of students. As a result, integrating emotional recognition into learning systems becomes imperative to gain insights into the essential elements necessary for achieving high-quality education, taking into account the perspectives of both students and teachers.

Consequently, emotion recognition systems will assist teachers in effectively and precisely engaging with students to promote active learning. This allows the teacher to monitor and suggest suitable expressions, particularly when addressing negative emotions. The outcome of this facial emotion classification is to aid educators in recognizing students who may be experiencing emotional challenges, such as stress and despair. The purpose of this study is to suggest a novel method for identifying facial expressions of emotion that can improve upon the generally accepted present method's accuracy. Four experiments were used to gauge the effectiveness and performance of the suggested system.

2 Related Work

This study focuses on analyzing the facial expressions of students during class to identify prevalent emotions such as sleepiness/boredom, confusion, engagement/enthusiasm, and neutrality. These emotions are considered fundamental and are experienced by learners universally [6].The study [6] used normal based face detection (NBFD), Haar face detection technique and current class-member face (UCCF) boosting techniques for classifying facial emotions and achieved results of 88.7%.

This paper explores an enhanced facial expression recognition system, presenting a novel method for facial expression recognition using a deep residual network. To complete facial expression classification jobs, ResNet-50 performed convolution operation on the input, then 4 residual blocks, and finally full connection operation. ResNet-50 network structure, which consists of 50 Conv2D processes. The overall accuracy 95.39 $\pm$ 1.41 was obtained [7].

In this paper, a novel two-layer convolutional network is introduced for facial emotion recognition. The primary objective of the model is to classify five distinct facial emotions using an image dataset. Remarkably, the training accuracy and validation accuracy are found to be comparable, indicating a well-fitted and generalizable model. To minimize the loss function during training, the model employs the Adam optimizer, yielding promising results with an accuracy of 78.04% on the test set [8].

In this study, Transfer Learning model is applied that combines three extra convolution layers after the pre-trained ResNet50 convolution blocks that have been frozen. In order to extract low–and high-level features, different-sized convolutional layers have been implemented. Convolution layer features are retrieved, flattened, and multi-class classification is carried out by fully linked layers of the network. The suggested model is trained and tested using the FER2013 dataset. When compared to other face expression models, the model produced findings with an accuracy of 85% [9].

This research presents the Enhanced ConvLSTM, an algorithm designed for facial expression recognition. By incorporating spatial and temporal skip connections and temporal gates, the algorithm overcomes gradient vanishing and effectively captures changes in facial expressions over time. Evaluation on two databases, eNTERFACE05 and CK, shows promising results, with accuracy reaching 49.26% for eNTERFACE05 database and 95.72% for CK, respectively. The Enhanced ConvLSTM algorithm shows great potential in facial expression recognition tasks [10].

3 Methodology

Four deep learning and transfer learning algorithms namely Convolutional Neural Network (CNN), VGG-16, ResNet-50 and MobileNet have been employed to analyze accuracy and validation in the field of emotion recognition. Each model comprises several components, including data collection, feature determination, pre-processing, testing, training, and result categorization. Pre-processing is particularly utilized when balancing the dataset is necessary. FER-2013 dataset, have been utilized in research projects concerning emotion recognition. FER 2013 dataset comprises of following classes (Fig. 1).

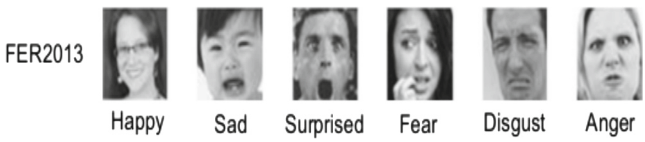

Fig. 1. Facial expressions [11]

3.1 Convolutional Neural Networks (CNN)

Convolutional Neural Networks (CNNs) are primarily employed for tasks such as image classification, object detection, and image segmentation [11]. Due to their proficiency in handling high-dimensional data, CNNs can effectively analyze large images and extract valuable information [12]. In this context, a CNN was applied to the task of Facial Emotion Recognition, utilizing 150 epochs in the training process. The model achieved an accuracy of 87.56% on the training set, a validation accuracy of 61.58%, and a loss of 0.34 during the training process (Table 1).

A Convolutional Neural Network (CNN) was trained on a dataset consisting of 28,709 images, each with a resolution of 48×48 pixels. The training process involved

Table 1. CNN Model Evaluation and results

Epoch	Optimizer	Accuracy	Validation	Training loss	Validation loss
150	Adam	87.56	61.58	0.3467	1.6509

150 epochs using the Adam optimizer and employed the categorical cross-entropy loss function to optimize the model. During training, the model achieved a training accuracy of 87.56%, indicating that it correctly predicted the class labels for this proportion of the training dataset. The model's performance on a separate validation dataset was evaluated, resulting in a validation accuracy of 61.58%. The training loss of 0.3467 represented the average deviation between the predicted and actual labels during the training process, while the validation loss of 1.6509 reflected the average deviation on the validation dataset. These metrics provide valuable insights into the model's performance and its ability to generalize to new and unseen data.

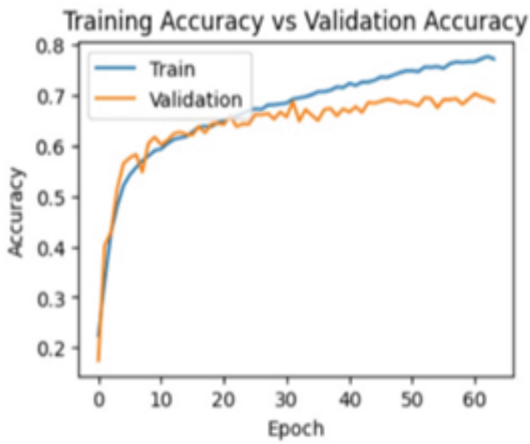

Fig. 2. CNN-Training and Validation Accuracy

Figure 2 shows training and validation graph which is quite consistent as CNN shows steady training improvement and validation as well. However Fig. 3 represent training and validation loss started from 2% and ends up at 0.346 and 1.650 respectively. As per deep learning standards training accuracy is accepted between ranges of 0–1%, however, validation is little bit on the higher side which shows that validation module facing problem in terms of unseen data.

3.2 Vgg-16

The Visual Geometry Group-16 (VGG-16) model is a pre-trained deep learning model that was developed using a substantial number of labeled images from the ImageNet dataset. Through this training process, the model has acquired the ability to recognize

Fig. 3. CNN–Training and Validation Loss

important elements within images and can use these attributes to make predictions about future data. Apart from its original classification task, the learned features within VGG-16 also capture general representations of images that can be beneficial for various computer vision applications. By utilizing the VGG-16 feature extraction model, a significant amount of data can be extracted, leading to accurate results. This method is widely used, especially in tasks where a deep learning model is employed for classification assignments [13]. The algorithm was implemented using Python, and the obtained results showed promising performance (Table 2).

Table 2. VGG-16 Model Evaluation and results

Epoch	Optimizer	Accuracy	Validation	Training loss	Validation loss
40	Adam	41.06	42.04	1.5249	1.4989

VGG-16 is a powerful convolutional neural network architecture renowned for its excellence in image classification tasks. The network comprises 16 convolutional layers along with fully connected layers. To ensure the model receives sufficient examples for learning, a dataset of 25,116 images was used for training and evaluation. To maintain consistency, the images were resized to 48×48 pixels. During the training process, the dataset was divided into batches of 64 images, facilitating efficient memory usage and parallel computation. The model underwent 40 epochs, allowing it to learn from the dataset multiple times and refine its performance. To optimize the learning process, the Adam optimizer was utilized, which adapts the learning rate for each parameter individually, leading to faster convergence. The model's performance was evaluated using the categorical cross-entropy loss function, which measured the discrepancy between predicted and true class labels. The training accuracy, which indicates the percentage of correctly classified images in the training dataset, was found to be 41.06%. On the other hand, the validation accuracy, representing the model's ability to generalize unseen data, was recorded as 42.04%.Furthermore, the training loss of 1.5249 reflected the average discrepancy between predicted and true class labels during the training process. Similarly, the validation loss of 1.4989 served as an indicator of the model's performance on unseen data. Lower validation loss indicates better generalization capabilities of the model, showcasing its ability to perform well on new and unseen data.

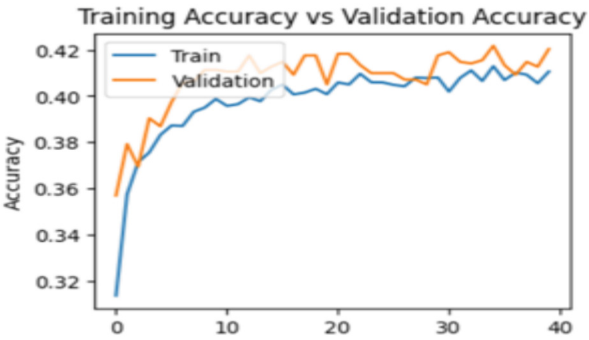

Fig. 4. VGG-16–Training and validation Accuracy

Fig. 5. Figure 6 VGG-16 - Training Loss and Validation Loss

The training and validation accuracy curve is detailed in Fig. 4. According to deep learning standards, this is highly unacceptable as both training and validation worsen. Additionally, due to increased loss, the training and validation loss illustrated in Fig. 5 is also unacceptable.

3.3 Resnet-50

ResNet-50 is a widely acclaimed deep learning model architecture that has found extensive application in various computer vision tasks, including face emotion recognition Reference [7]. This model leverages transfer learning, a technique that allows it to learn from previously acquired data and patterns from one task to enhance performance in another task [14]. Through transfer learning, ResNet-50 achieves faster and more efficient training, resulting in improved facial emotion recognition capabilities. After conducting the analysis, the following results were obtained and observed (Table 3).

Table 3. Resnet50 Model Evaluation and results

Epoch	Optimizer	Accuracy	Validation	Training loss	Validation loss
30	Adam	99.65%	49.08%	0.0315	2.6692

For image classification, the ResNet50 algorithm, a deep convolutional neural network architecture, was utilized. The dataset used for training and evaluation comprised 7,894 images, each resized to 224×224 pixels to maintain uniform input dimensions. During training, the dataset was split into batches of 32 images for efficient processing. The model underwent 30 epochs of training with the Adam optimizer, which adjusts the learning rate individually for each parameter, optimizing the training process. To facilitate multiclass classification tasks, the categorical cross-entropy loss function was employed. The model demonstrated impressive training accuracy of 99.65%, meaning it correctly predicted the classes for a vast majority of the training data. However, its validation accuracy was 49.08%, indicating the model's performance on previously unseen data was not as strong. When examining the training process, the model achieved a low training loss of 0.0315, signifying that its predictions were quite close to the true labels for the training data. However, the validation loss was comparatively higher at 2.6692, highlighting that the model's performance on unseen data was not as accurate. In summary, the ResNet50 algorithm showed exceptional training accuracy, but its validation accuracy and loss pointed out the need for improvements to enhance its generalization capabilities on new, unseen data.

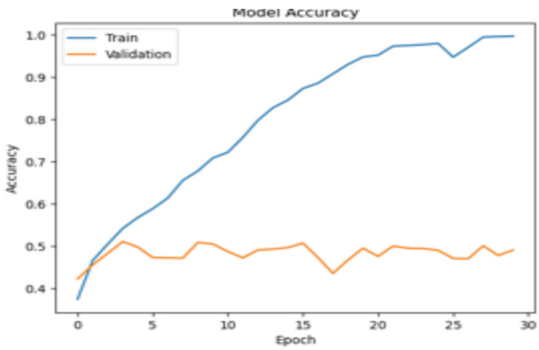

Fig. 6. ResNet-50- Training and validation accuracy

Figure 6 depicts the training and validation graph; training is significantly improving, but validation is somewhat advancing. Figure 7 shows training and validation loss, with

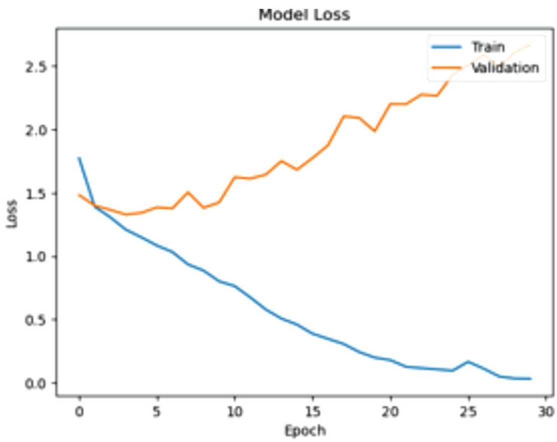

Fig. 7. ResNet-50-Training Loss and Validation Loss

training loss being permitted but validation loss being prohibited. The module is having issues with unobserved data, according to validation loss.

3.4 MobileNet

MobileNet is a prominent model known for its superior performance in emotion recognition tasks. Its lightweight architecture makes it particularly suitable for applications that demand swift and responsive facial or emotion recognition, such as real-time video analysis or mobile applications. This is because the model can achieve faster inference speeds and ensure real-time performance [15]. After conducting the analysis, the undermentioned results were noticed (Table 4).

Table 4. MobileNet Model Evaluation and results

Epoch	Optimizer	Accuracy	Validation	Training loss	Validation loss
50	Adam	99.46	54.57	0.0277	3.3108

The MobileNet algorithm was trained on an 8,414-image dataset with a resolution of 224×224 pixels, using a batch size of 32 and running for 50 epochs. During training, the algorithm achieved an impressive training accuracy of 99.46%, indicating its ability to classify images accurately. However, when evaluated on a separate validation dataset, the performance dropped to a validation accuracy of 54.57%, suggesting potential overfitting and difficulties in generalization to new, unseen images.

The training loss was low, measuring 0.0277, signifying effective minimization of discrepancies between predicted and actual outputs during training. Conversely, the validation loss was considerably higher at 3.3108, indicating challenges in handling new data and a potential lack of generalization.

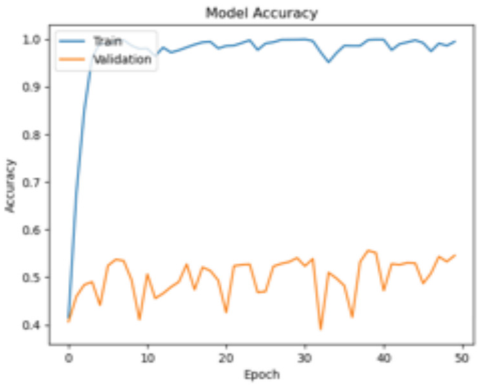

Fig. 8. MobileNet-Training and validation accuracy

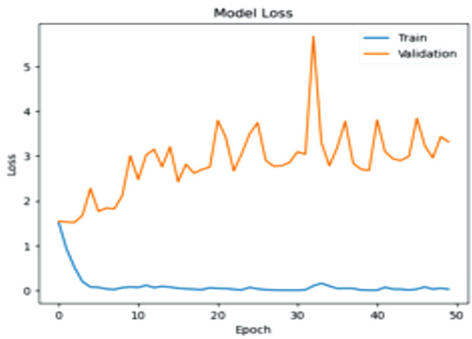

Fig. 9. MobileNet-Training Loss and Validation Loss

The MobileNet algorithm performed exceptionally well during training but encountered difficulties in generalizing to unseen data during validation. To improve its performance on new images, further analysis and optimization may be necessary.

Figure 8 shows training and validation graph, training is improving a lot but validation accuracy is dropping. Whereas Fig. 9 depicts training and validation loss, training loss is low whereas validation loss is high.Validation loss indicates module is facing problems with respect to new data.

4 Conclusion

This paper worked on four deep learning algorithms namely CNN, VGG-16, ResNet-50, and MobileNe for recognition and classification of facial emotions expression to focus on emotions of students during classroom learning. The primary objective is to identify instances where students display sustained sadness or unhappiness in the classroom, enabling timely intervention to address their emotional well-being to take strong measures to improve academics of particular student. The FER-2013 dataset is employed for training and evaluation. CNN has secured training accuracy of 87.56% and validation score of 61.58%.This result may be improved by changing hyper parameters. By fine-tuning hyperparameters, it is anticipated that the recognition and classification performance of the deep learning models can be significantly improved, providing more effective insights into students' emotional states during class learning.

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Digitalization in Education and its Impacts in Teaching and Learning

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Abstract. This paper aims to study on digitalization in education and its impacts in teaching and learning environment. Digitalization in education has emerged as a transformative force, revolutionizing traditional teaching and learning approaches. This abstract examines the impact of digitalization on the educational landscape, focusing on its effects on teaching and learning processes. As technological advancements continue to reshape the global education sector, digital tools and platforms have become integral components of modern classrooms. The adoption of e-learning platforms, virtual classrooms, and digital learning resources has enabled personalized and flexible learning experiences for students. Instructors are empowered with innovative teaching methods, leveraging digital tools to create interactive and engaging lessons. However, challenges such as the digital divide, ensuring equitable access to technology, and maintaining student motivation in virtual environments have also surfaced. This abstract provides insights into the opportunities and challenges presented by digitalization in education, emphasizing the need for educators and policymakers to harness its potential while addressing the associated issues to build a more inclusive and effective education system for the future.

Keywords: Digitalization in education · digital tools · virtual classrooms

1 Introduction

Online teaching and learning (T&L) are no longer an impossible thing in the Education system as well as for primary, secondary, college or university. T&L has already begun to be actively implemented at the school and institutional level higher education when our country and the world are hit by the COVID-19 pandemic. Will but, lecturers and students will necessarily face issues and challenges when run this T&L.

At the beginning of 2020, the whole world was hit with the Pandemic of COVID-19 also known as the coronavirus pandemic or the coronavirus outbreak. In the middle December 2019, the city of Wuhan, Hubei, China, has begun to detect the existence of the disease the said. On March 11, 2020, the World Health Organization (WHO) recognized this disease as a pandemic because this disease is the transmission of an epidemic new diseases around the world [1]. In Malaysia, it is no exception from the

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spread of this disease. The transmission of this disease epidemic does not only have an effect to the economy and even to the education system especially Technical Education and Vocational Training (TVET) implemented at the Malaysian Community College. The COVID-19 pandemic this has also had an impact on the structure of Teaching and Learning (T&L) in Malaysian Community College. Higher education institutions include community colleges and schools as well ordered to close and the direct or face-to-face T&L method was changed to T&L is completely online.

From the author's observation, at the beginning, most lecturers do not want or not willing to accept this change and therefore not follow the workshop that has been implemented due to not being ready to change the traditional T&L method to online teaching & learning method. After a series of e-learning workshops have been implemented, there are change in perception from the lecturer's acceptance. Lecturers began to accept the change traditional T&L method to online T&L method. The lecturer began to ask how to operate the four platforms. All these things happened before the outbreak the spread of the COVID-19 Pandemic. On July 13, 2020, the implementation of T&L at the most universities was decided by using blended learning (BL) that is the combination of online and face-to-face lecture. So, the lecturers have already started conducting T&L in the June 2020 session [2].

To achieve these system and student aspirations, the MEB (HE) outlines 10 shifts that will spur continued excellence in the higher education system. All 10 shifts address key performance issues in the system, particularly regarding quality and efficiency, as well as global trends that are disrupting the higher education landscape. In Malaysia, internet penetration is currently stands at 75%—the seventh highest penetration rate across Asia. This puts Malaysia in a good position to harness the power of online learning to widen access to good quality content, enhance the quality of teaching and learning, lower the cost of delivery, and bring Malaysian expertise to the global community [3].

There are significant opportunities to achieve the desired outcomes first set forth in the National e-learning Policy (Dasar e-Pembelajaran Negara or DePAN) [3]. Malaysia needs to move from a mass production delivery model to one where technology-enabled innovations are harnessed to democratise access to education and offer more personalised learning experiences to all students. So, all digitalization in education has been projected under shift no. 9 (globalized online learning) and shift no. 10 (transformed higher education delivery) [4].

2 Literature Review

The study of digitalization in education identifies problems such as dehumanization and crisis of intellectual culture, but also outlines prospects for equipping institutions with high-quality software and online learning, which can help coordinate efforts to promote socio-economic and cultural development, and approach fundamental problems of managing cultural policy more objectively.

Digitisation is frequently associated with transformation, from the micro transformation of processes to the transformation of nation-states' agendas. It is increasingly associated with progressive societies and modernisation (International Labour Organization (ILO), 2021 [4]. Digitalisation creates new opportunities for enhancing the accessibility, flexibility, and quality of TVET where the digital resources may enable learners to access learning content anytime and anywhere; digital platforms can facilitate collaboration and networking among learners, lecturers, and employers; digital tools can support personalized learning paths and feedback mechanisms; and digital systems can improve data collection and analysis for monitoring and evaluation purposes [5].

The shift to online and remote instruction has highlighted the digital divide in the TVET sector [6]. Research indicated that many TVET institutions, particularly those in developing countries, lack the necessary digital infrastructure and resources to support online learning effectively [7]. The pandemic has also raised concerns about the quality and effectiveness of remote and online learning in TVET institutions. As a result, students have had to complete their coursework and practical assignments remotely, with limited access to the necessary tools and equipment required for practical training [8].

One of the key challenges faced by TVET institutions in Malaysia during the pandemic has been the need to adapt the curriculum to remote learning. As a result, instructors have had to develop innovative ways to teach practical skills online, such as through virtual simulations and demonstrations [9]. Assessments have also been a challenge for TVET institutions in Malaysia during the pandemic. Remote assessments have proven challenging, with concerns around academic integrity and the ability to ensure fair and reliable testing conditions. As noted by [9] the shift to online assessments has required TVET institutions to develop new assessment strategies that consider the limitations of online testing.

3 Benefits of Digitalization

Digitalization in higher education has brought about significant changes in how education is delivered, accessed, and managed. Here are some benefits of digitalization in this context:

A. *Flexibility and Accessibility*
   i. **Remote Learning**: Digitalization allows students to attend classes, participate in discussions, and submit assignments from anywhere in the world.
   ii. **Flexible Timings**: Online courses often come with flexible timings, allowing students to learn at their own pace.
   iii. **Resource Accessibility**: All learning materials, including lectures, slides, and reading materials, are available online for easy access.

B. *Quality and Customization*
   i. **Adaptive Learning**: Digital platforms can adapt to individual student needs, offering personalized learning paths.
   ii. **Interactive Learning**: Gamification, quizzes, and interactive simulations make the learning experience more engaging.
   iii. **Up-to-Date Content**: Digital platforms make it easier to update course material, ensuring students have access to the latest information.

C. *Collaboration and Networking*
   i. **Global Exposure**: Digital education removes geographical barriers, allowing students to collaborate with peers and experts worldwide.

ii. **Discussion Boards**: Online platforms offer forums for discussion, providing a space for academic discourse outside of the classroom.
iii. **Group Projects**: Digital tools facilitate teamwork through shared documents, virtual meetings, and collaborative platforms.

D. *Cost-Effectiveness*
i. **Lower Costs**: Online courses often cost less than traditional courses, making higher education more accessible.
ii. **Reduced Infrastructure**: Digital education can reduce the need for physical classrooms, lowering overhead costs.
iii. **Digital Libraries**: Expensive textbooks and journals can be replaced by less costly digital versions.

E. *Administration and Analytics*
i. **Streamlined Administration**: Online platforms can handle scheduling, grading, and tracking, freeing faculty to focus on teaching.
ii. **Data-Driven Insights**: Analytics help educators understand student performance and adapt teaching methods accordingly.
iii. **Transparency**: Digital tools can make processes like admission, examination, and grading more transparent and easier to audit.

F. *Lifelong Learning*
i. **Skill Upgradation**: Online platforms offer a plethora of courses for skill development and lifelong learning.
ii. **Professional Development**: Working professionals can pursue further studies without leaving their jobs, thanks to the flexibility offered by online education.

G. *Environmental Benefits*
i. **Reduced Carbon Footprint**: With fewer people commuting and less energy expended on maintaining physical facilities, digital education is often more eco-friendly.

H. *Inclusion*
i. **Accessibility for Disabled**: Digital platforms can be designed to be more accessible for people with disabilities.
ii. **Wider Demographics**: The online model makes it easier for people from various age groups, and socio-economic backgrounds to access higher education.

However, it's important to note that digitalization also comes with challenges such as digital divide, issues related to academic integrity, and the potential for reduced interpersonal interaction. Therefore, a balanced approach that combines the best of digital and traditional methods is often considered ideal.

3.1 Challenges in Digitilization

While digitalization in higher education comes with numerous benefits, it also presents several challenges that educational institutions, policymakers, and students must navigate. Here are some of those challenges:

A. *Digital Divide*
i. **Limited Access to Technology**: Not all students have access to the necessary hardware and software needed for digital learning, exacerbating educational inequalities.

ii. **Internet Connectivity**: Poor or unavailable internet connectivity can hinder students' ability to participate in digital education.

B. *Quality of Education*

i. **Content Quality**: **The** proliferation of online courses makes it difficult to ascertain the quality of educational material.

ii. **Skill Gaps**: Online education may not be suitable for teaching some types of skills, such as those that require hands-on practice or labs.

C. *Social and Psychological Factors*

i. **Isolation**: **Online** education can limit social interaction, affecting students' social skills and mental health.

ii. **Distractions**: **Home** environments may not be conducive to learning, leading to decreased concentration and effectiveness.

D. *Academic Integrity*

i. **Cheating and Plagiarism**: Digital formats can make it easier to cheat on exams and plagiarize material.

ii. **Authentication**: **Verifying** that the person enrolled in the course is the one actually doing the work can be challenging.

E. *Adaptability and Training*

i. **Faculty Adaptation**: Not **all** educators are comfortable with or trained in digital teaching methods.

ii. **Student Preparedness**: **Students** also need to be trained to use digital tools effectively.

F. *Data Security and Privacy*

i. **Data Breaches**: Educational institutions are targets for hackers, putting personal and academic data at risk.

ii. **Privacy Concerns**: The **collection** of student data for analytics or other purposes raises ethical and legal questions.

G. *Accessibility and Inclusion*

i. **Special Needs**: Not all digital **platforms** are accessible to students with disabilities.

ii. **Cultural Sensitivity**: Global access to education through digital means requires content to be culturally sensitive and adaptable.

H. *Assessment and Certification*

i. **Standardization**: It's **challenging** to standardize assessments and outcomes across different digital platforms.

ii. **Credential Recognition**: Not all employers or educational institutions recognize online courses or degrees, limiting their value in some cases.

I. Infrastructure and Costs

i. **Initial Setup Cost**: Although **digital** education can be cost-effective in the long run, the initial investment in technology and training can be high.

ii. **Maintenance**: Digital **platforms** require ongoing maintenance, which can strain an institution's resources.

J. *Regulatory Hurdles*

i. **Accreditation**: Regulatory bodies may be slow to recognize or accredit digital educational platforms.

ii. **Policy Gaps**: **Policymakers** may not have caught up with the digital education revolution, leaving gaps in regulation and oversight.

Overcoming these challenges often requires a multi-faceted approach, including infrastructure investment, training programs for educators and students, and the development of policies that encourage fair access and maintain educational quality.

4 Methodology and Results

This research is done by using a survey as a main instrument. This is a quantitative approach where an online survey had been conducted over 856 students from foundation to PhD level. The objective of this survey is to give some information on implementation of online learning and its related matters. Based on this survey, it will give some inputs on how university is going to plan and invest for digitalization implementation in near future.

A. Overall Participation of UniKL Online T&L Feedback
   The summary of online T&L feedback participation from 5th April – 10th April is as follows:
   i. Out of 1407 UniKL lecturers, **481 (34%)** provided feedback on their online T&L sessions.
   ii. Lecturers are allowed to provide multiple feedback for their different online class sessions. The total of feedback received from the 481 lecturers from 5th April – 10th April 2020 is **1242** (Fig. 1).

No.	Programme Level	No. of Courses
1	PhD	1
2	Master	5
3	Bachelor	634
4	Diploma	181
5	Foundation	35
	Total	**856**

Fig. 1. No. of courses by programme level

B. Overall Percentage of Student Attendance
   The overall percentage of student attendance during the online T&L sessions are as follows (Fig. 2):

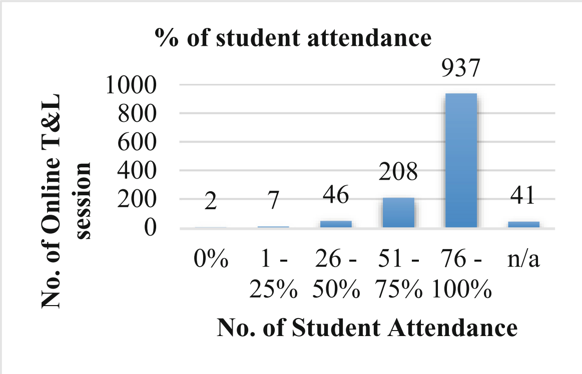

Fig. 2. Percentage of student attendance vs no. of online T&L session

Out of the 1242 online T&L session:

i. **937 (75.4%)** achieved more than **75%** of student attendance.
ii. **7 (0.6%)** had less than **25%** of student attendance.

The Online Platforms used for T&L

The platforms used by lecturers for their online T&L from the total of 1242 sessions are illustrated in the table below (Fig. 3):

- Almost 100% of lecturers in this feedback used more than one platform in conducting their online T&L sessions.
- The majority of the sessions (84.1%) used Microsoft Teams for their online T&L sessions.
- Only a small percentage (4.4%) used other platforms besides the four main suggested ones in the guideline.
- The type of other platforms used are such as Facebook Live, Zoom, Telegram and phone call.
- Nine (9) or 0.7% online T&L sessions did not specify the platform(s) that were used.

Issues in T&L is illustrated as below figure (Fig. 4):
There are five (5) main categories of issues in conducting online T&L:

i. *Technical/Internet Connection*
Technical issues/Internet connection includes issues such as slow internet connection, large data consumption, problems with audio/video, and lagging. A majority (72%) of lecturers reported this as the main issue in conducting online T&L.
ii. *Teaching and Learning*
Teaching & Learning includes classroom management, nature of the course (for example, practical course), lecturers competency in using the online platform(s) and suggestion of other platform(s) (Facebook Live) to conduct the online T&L. Only 11% (80 out of 697) of the issues are on teaching & learning.

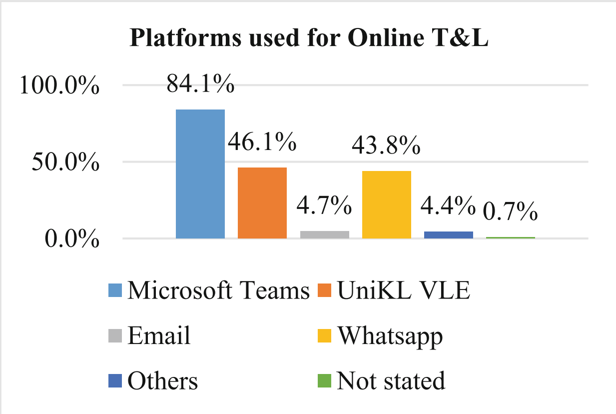

Fig. 3. Platforms Used for online T&L

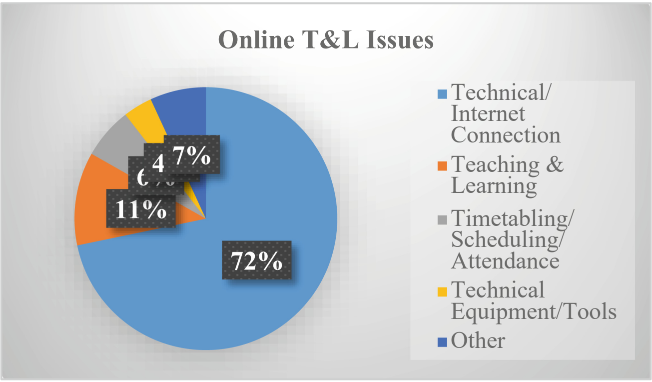

Fig. 4. Issues in T&L Online

For classroom manangement, lecturers reports that they are unsure if their students can understand the lesson, as they are not able to see the students face to face. They also have difficulties in communicating with the students about the online sessions (no response from students, students waking up late).

Lecturers also mentioned that they need to explore and familiarise themselves more with the platforms to ensure a smoother and more effective online T&L session.

From the total of 80 feedback on teaching & learning, 12 of them are on the nature of the courses. Lecturers reported that their course is more of a practical nature, hence, online T&L is not suitable.

iii. *Timetabling/Scheduling/Attendance*

About 6% (44 out of 697) of lecturers reported on timetabling/scheduling/attendance issues. The issues are on monitoring students' attendance (using the QR code and getting the list of attendance). Other issues are such as low attendance by students and also clash of online T&L sessions with other lecturers. This may be due to lecturers not following the set timetable for their courses.

iv. *Technical Equipment/Tools*
4% (25 out of 697) of the issues are on the lack of technical equipment/tools for both lecturers and students. Lecturers find it difficult to conduct online T&L due to the inadequate tools available (such as math equations, tablet such as wacom to teach maths, and video camera/microphone). Some students also do not have laptops and need to use their mobile phones (which can be very limiting to participate in online T&L sessions).

v. *Other*
7% of the feedback are on other issues that are not related to issues in conducting online T&L. For example, lecturers want to know how many of our students have access to the internet/wifi.

5 Conclusion

In conclusion, digitization or digitalization is a complex phenomenon that affects various aspects of TVET Institutions and skills systems. It poses challenges but also creates opportunities for improving the quality and relevance of TVET provision. To harness the potential of digitalisation, TVET stakeholders need to adopt a holistic and coordinated approach that addresses the competence development of lecturers and trainers, as well as the governance structures and processes of TVET institutions. The challenge lies mainly in how HTVET institutions can cope with this post-pandemic digital transformation and ensure their programs' quality and relevance.

Acknowledgment. I would like to acknowledge and give my warmest thanks to my friends Mdm Shahrizad and Dr. Siti Haryani who made this work possible. Their guidance and advice carried me through all the stages of writing this paper. I would also like to thank my friend Iqa for helping me in correcting English language and related issues, and for your brilliant comments and suggestions, thanks to you.

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Learning Environment Preference for a Physical Classroom: A Student Survey

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Abstract. The learning environment is one of the important factors in making the learning process effective. In the post-pandemic era, as the majority of the learning in higher learning institution reverted to physical face-to-face, the physical classroom environment or space has become important again. A cross-sectional online survey was conducted among students at Universiti Tenaga Nasional (UNITEN) between May 25, 2023, and May 31, 2023. The main objective of this survey was to know more on what the student's preference on features of physical classroom and their learning environment are, especially after returning to on-campus learning. Descriptive analysis was used to evaluate the rating given by the students. The survey was opened to all students, and 635 responses (62.8% male, 37.2% female) were collected. For the rating of existing classrooms, the students prefer a flat-type spacious class with mobile chair and table. Most of the respondents indicated that this class type is comfortable (76%), having good seating arrangements (73%), and having good interior design/ambience (68%). As for the future classroom, the highly wanted features are classrooms having good air flow and circulation (86.5%), followed by comfortable seating (84.4%), having good acoustics attribute (80.2%), spacious room (74.2%), and moveable chair/table (68.2%). The outcome of this study should provide a good guide when designing classrooms in the future.

Keywords: learning environment · learning space · classroom features

1 Introduction

In the COVID-19 pandemic era, most of the learning was forced to be conducted in virtual classrooms, where all the interactions are carried out online. Various issues and problems were reported due to this such as on learning motivation [1], boredom due to online class [2] and privacy and security issues [3].

As the world is moving back to the pre-pandemic situation, more and more learning institutions are reverting the leaning into physical classes. Recently trending approaches such as hybrid learning and hybrid flexible (hyflex) learning, which comes with their own advantages and disadvantages, has also be adopted by some of the higher learning institutions [4, 5].

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Learning environment can be viewed from the angle of physical dimension, pedagogical dimension, and psychosocial dimension [6]. As the majority of the classes are back to on-campus physical location, classroom settings or the physical dimension of the learning environment will be important again.

As part of the continual improvement of the learning environment, a study was carried out among the Universiti Tenaga Nasional's (UNITEN) students to find what would be the features and functions that they want in their classroom to provide a better environment for effective learning. The main objectives of this study are:

- To acquire students' opinion and feedback on the current classroom
- To acquire students' opinion on what kind of features and functions they want for their future classrooms.

It is believed that the findings from this study will not only be useful for UNITEN to improve its classrooms environment, but also may also be used as a general guide for other higher learning institutions to design future classrooms.

2 Background

A conducive learning environment is important as it impacts the students' performance. There are many dimensions of learning environment especially when looking from students' needs and expectations [8].

The focus of our study is on the physical dimension of a learning environment. The physical dimension generally associated with the classroom physical attributes encompassing the structure and size of the classroom, the furniture, and tools for learning, as well as the ambience including the lighting, color and texture, acoustic, temperature and air quality [6]. These physical attributes can have significant impact the students' performance [7]. As the students are the ones that are most impacted by the learning environment, it is utmost important to acquire their views and incorporate their perception when designing learning environments.

3 Method

An online survey was conducted between 25th to 31st May 2023, opened to all UNITEN students. Invitation email was sent to all active students this semester. No exclusion criteria were set for this survey.

The survey was divided into two major parts. In the first part, the students were asked to evaluate the current classrooms. In the second part, they were asked to give opinions on what kind of features and functions that they want in their classrooms.

A. *Survey Questionnaire*

In Part A, the students were asked to give ratings for three types of classrooms – Type A, Type B and Type C. Type A classroom is categorized as a lecturer hall type that has a capacity of up to 200 students. Type B classroom is a middle-sized typical rectangular shaped room that has a capacity of around 30 students. Type C classroom is a large sized rectangular-shaped room that has a capacity of around 100 students. The details are as shown in Tables 1, 2 and 3.

The students would rate these three types of classrooms based on three criteria using a 5-point Likert style scale. The criteria are (1) Comfort (2) Seating arrangements and flexibility (3) Ambience and interior design. Table 4 shows the details of the criteria and rating.

Table 1. Type A Classroom

No.	Classroom
Classroom photo	
Classroom characterist ics	Type: Lecture Hall (large) Layout: Rectangular theatre style with stage at front. Carpeted. Bright light from high ceiling. Capacity: 200 pax Furniture: Fixed tiered seating with fixed table.

In Part B, students were asked to give importance rating for each of the given features for each of the class types, as shown in Table 5. The rating ranges from Not important (NI) to Very important (VI). They were also given the option of No opinion (NO).

B. *Analysis*

For this study, a simple frequency analysis and descriptive statistics approach was used to analyze the survey data. The main aim is to find which features are highly rated or ranked by the students.

Table 2. Type B Classroom

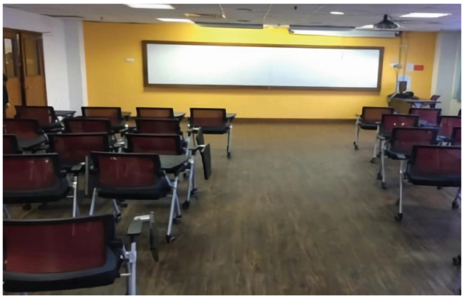
No.	Classroom
Classroom photo	
Classroom characteristics	Type: Classroom (medium) Layout: Rectangular room, seats facing to the front, flexible furniture layout. Capacity: 35 pax Furniture: Tablet armchairs, no table. High flexibility.

Table 3. Type C Classroom

No.	Classroom
Classroom photo	
Classroom characteristics	Type: Classroom (large) Layout: Rectangular room, seats facing to the front, flexible furniture layout. Capacity: 120 pax Furniture: Modern mobile chairs and tables, high flexibility.

4 Results and Discussion

A. *Respondent Demographic*

Table 4. Rating criteria for existing classes

No.	Criteria to rate each classroom	Selection of answer
1	Comfort	5-point Likert scale style; Very poor (VP), Poor (P), Neither good nor poor (N), Good (G), Very good (VG)
2	Seating arrangement & flexibility	
3	Ambience & interior design	

Table 5. Survey Questions

No.	Question	Selection of answer
1	Comfortable seating	0: No opinion (NO) 1: Not important (NI), 2: Less important (LI), 3: Somewhat important (SI), 4. Important (I), 5: Very important (VI)
2	Spacious room	
3	Good air flow/circulation	
4	Moveable chair/table	
5	Good acoustics (sound system)	
6	Having advance VR/AR facility	

The number of respondents is 635 students. Table 6 shows the breakdown of demographic of the respondents. Majority of the respondents were male (62.8%, n = 399), while the remaining were female (37.2%, n = 236).

Table 6. Demographic Characteristics of the Respondents

Aspect	Characteristics	n (%)
Gender	Male	399 (62.8%)
	Female	236 (37.2%)

B. *Rating of existing classrooms*

The findings of the ratings for each class type is as shown in Fig. 1. Overall, the students prefer class type C the most (based on rating of "good" and "very good"). Most of the respondents indicated that it is comfortable (76%), has good seating arrangements (73%), and has good interior design/ambience (68%).

Table 7 shows the detailed breakdown of the percentage of respondents for each of the class types.

From these results, it can be said that the students do not prefer fixed chairs and tables, and the tiered seating is uncomfortable to them. The students also seemed to dislike tablet arm-chair type without a proper table, as a significant number indicated that the seating arrangement is "very poor" or "poor" (27.4%) and not comfortable (31.8% rated very poor and poor).

Table 7. Responses for all criterion of each classroom type (Questionnaire Part A)

Criteria	% of respondents				
	VP	*P*	*N*	*G*	*VG*
Comfort					
Type A	8.03	18.27	27.09	37.95	8.66
Type B	12.76	19.06	27.56	34.02	6.61
Type C	2.05	2.20	20.00	48.03	27.7
Seating arrangement					
Type A	8.03	17.01	27.56	36.38	11.0
Type B	9.45	17.95	29.29	36.22	7.09
Type C	2.20	4.41	20.79	48.03	24.6
Interior design					
Type A	9.13	16.85	29.92	33.23	10.9
Type B	6.30	10.71	28.98	43.15	10.9
Type C	3.31	6.93	22.05	45.83	21.9

B. *Rating of features for future classroom*

The detailed response frequency of the result from Part B of the survey is shown in Table 8.

Table 8. Frequency Analysis on the Coping Ability

Respondent (n)	% of respondents					
	N.O	*N.I*	*L.I*	*S.I*	*I*	*V.I*
Comfortable seating	1.57	1.42	1.10	11.50	28.5	55.91
Spacious room	2.99	1.42	4.09	17.48	34.9	39.06
Good air flow/circulation	3.46	0.63	0.94	8.50	20.7	65.67
Moveable chair/table	3.46	2.83	7.40	18.11	26.3	41.89
Good acoustics (sound system)	5.04	0.79	1.57	12.44	28.3	51.81
Having advance VR/AR facility	7.72	5.04	8.03	20.00	25.5	33.70

The highest rated feature (based on "important" and "very important" answers) is good air flow and circulation (86.5%), followed by comfortable seating (84.4%), good acoustics (80.2%), spacious room (74.2%), moveable chair/table (68.2%), and having advance VR/AR facilities (59.2%).

The result shows that most of the students want good fundamental features such as spacious rooms with good acoustics and comfortable seating for their classrooms environment.

From open comments at the end of the survey, the most students also indicated that they want ample table space to put not just books and papers, but also their laptop and tablet.

5 Conclusion

In this study, a survey was conducted to learn about the student's preference for their learning environment particularly on the physical classroom attributes. It was found that being comfortable in the class is one of the main aspects that would lead to better learning. Several attributes that are associated with comfort are the type of chair and table, the seating arrangement, spacious space with good air flow as well as having good acoustic attribute.

Even though there are limitations of this study and only surface level analysis conducted, these findings should be able to provide a certain insight on what students prefer for their classroom environment.

Acknowledgment. The authors would like to express their thanks to those who helped in conducting the surveys and analysis.

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Navigating the Digital Wave: Evaluation of Online Vocational Education in the Higher TVET Institution

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Abstract. The rapid onset of digitalization has profoundly altered the landscape of vocational education, particularly noticeable in the shift towards online vocational education. While this transformation presents numerous opportunities for vocational institutes such as enhanced employability, flexible and accessible learning, and improved practical training, it simultaneously poses significant challenges like integration of digital competences into curriculum and the management of digitalization. This paper focuses on the impact of digitalization on Technical and Vocational Education Training (TVET) institutions, specifically on UniKL (Universiti Kuala Lumpur), a leading vocational education institution in Malaysia. The study examines student and faculty responses to online education through a satisfaction survey conducted by UniKL. Findings indicate a preference for a hybrid mode of instruction and identify issues such as unstable internet connection and limited facilities for tasks. The study concludes that a comprehensive approach addressing competency development and institutional governance is crucial for leveraging the potential of digitalization in TVET.

Keywords: Technical and Vocational Education Training (TVET) · digitalization · online teaching and learning

1 Introduction

In recent years, the digital wave has brought about significant changes in the field of education, including vocational education. The increasing availability and accessibility of online platforms and resources have paved the way for the emergence of online vocational education. This shift towards digitalization has not only impacted the delivery of vocational education but has also raised questions about its effectiveness and future prospects.

The sudden shift to remote and online instruction has presented numerous challenges for Technical and Vocational Education Training (TVET) institutions, underscoring the need for digital transformation in the sector. Some institutions have had to suspend practical training due to public health guidelines, forcing students to complete their coursework and assignments remotely with limited access to necessary tools and equipment [1].

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In Malaysia, TVET transformation focuses on the employability components of its future graduates. The success of this transformation can be seen when it significantly contributes to the government's agenda to make Malaysia a high-income country. The transformation of TVET under several agencies has been introduced to strengthen the vocational and technical education system at par with others. To cope with the drastic change of several TVET institutions, UniKL has come out with its own model or framework – Higher TVET (HTVET) Educational Model [2] that emphasizes innovative teaching and learning, quality curriculum, academic professionalism and student talent enhancement.

The objective of this paper is to explore the current situation and future prospects of HTVET education in the context of digitalization, with a specific focus on UniKL students. UniKL, as a leading vocational education institution, provides a unique case study to examine the effects of online vocational education on students' learning outcomes and experiences.

2 Digital Wave for Vocational Institutes

The digital wave has brought about significant opportunities and advantages for TVET institutes, revolutionizing the way education is delivered and accessed. However, along with these opportunities there are challenges that need to be addressed to ensure the effective integration of digital technologies in vocational education. Despite that increasing interest, research on vocational school students is scarce since the majority of the literature has focused on primary grades and other educational levels [3]. It was highlighted by [4] that more empirical studies are needed to understand the importance of online courses in vocational education. This section explores the opportunities and challenges of the digital wave for vocational institutes, providing insights into the current state of research and potential strategies for success.

The digital wave presents numerous opportunities for vocational institutes. One key opportunity is the development of digital competences among students. Digital skills, in line with Industrial Revolution (IR) 4.0 technologies, are considered essential nowadays, and vocational institutes have the chance to equip students with these skills, enhancing their employability and adaptability in the digital age [5]. By integrating and supporting digital skill development, vocational institutes can prepare students for the demands of the modern workforce.

Another advantage for vocational institutes is the flexibility and accessibility of online learning. Digital technologies enable vocational institutes to provide education to a wider range of students, including those who may face geographical or time constraints. Online learning platforms and resources can be accessed anytime and anywhere, allowing students to learn at their own pace and convenience. Additionally, digital tools and simulations can enhance practical training, providing students with realistic and immersive learning experiences [6].

Despite the opportunities and advantages, the digital wave also presents challenges for vocational institutes. One challenge is the effective integration of digital competences into the curriculum. Vocational institutes need to address how digital competences are specifically integrated and instructed in the classroom, ensuring that students develop the necessary skills for the digital age, which requires the development of motivation-based learning environments and the use of appropriate instructional strategies [5]. Another challenge is the management of digitalization and the organizational changes it entails. Vocational institutes need to navigate the complexities of implementing digital technologies, including addressing organizational, financial, and cultural constraints [6]. Additionally, there is a need for effective continuing vocational training that utilizes digital learning environments. Vocational institutes must also consider the role of firm-based competence development and the integration of new skill requirements into the curriculum [6].

The digital wave presents significant opportunities and advantages for vocational institutes, including the development of digital competences, flexibility in learning, and enhanced practical training. However, challenges such as integrating digital competences into the curriculum and managing digitalization need to be addressed. By understanding and addressing these challenges, vocational institutes can harness the full potential of the digital wave and provide high-quality education that prepares students for the demands of the digital age.

3 Methodology

The shift to digitization during the pandemic has forced all vocational institutions such as UniKL to move drastically towards online teaching and learning, in order to evaluate the effectiveness of teaching & learning, an UniKL Online Learning Satisfaction Survey was conducted by UniKL's Centre for Instructional Technology and Curriculum Development (CITC). The survey was made accessible to students via Microsoft Forms. The survey consisted of nine questions, and students' online class experiences were evaluated by identifying the advantages and challenges of online learning. The effectiveness of online classes and the mental stress level of online learning are also determined using the Likert Scale. The survey concluded with an open-ended question, where the respondents can provide feedback or suggestions related to their online learning experience.

4 Results and Discussions

For the survey, 231 UniKL lecturers while 1019 students responded, with 84.6% (862) of respondents are undergraduate students. Referring to Fig. 1, it was found that if given options, both lecturers and students vote to have a combination of face to face and online learning as the class format. This was voted by 161 (69.7%) academic staff and 565 (55.4%) students. Only 20 (8.7%) lecturers and 172 (16.9%) opted for fully online learning.

Both lecturers and students have mixed views on the effectiveness of online learning. As shown in Fig. 2, about half of the respondents feel that online teaching and learning is moderately effective. Only 7.3% of the students stated that online learning is not effective at all. As for the online learning experience, academic staff experiences it better with 220 (95.2%) rated excellent, good and average. However, on the student's side, it tends to be lower with 827 (81.2%) rated the same. In fact, almost half of that particular groups felt they only had an average online learning experience.

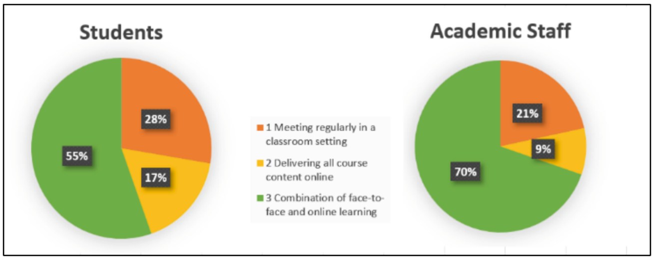

Fig. 1. Preference of class format

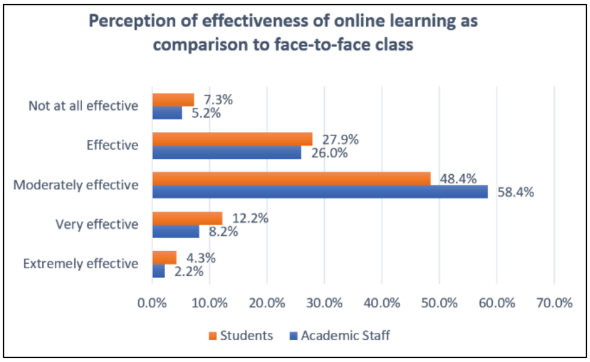

Fig. 2. Perception of effectiveness of online learning as comparison to face-to-face class

Referring to Fig. 3, it was interesting to note that the lecturers reported they were only slightly stressed (40.3%) when it comes to online teaching. A similar situation was reported by the students as they reported slightly stressful (25.8%) and moderately stressful (36.9%) in learning online. About a quarter of respondents (24.4%) stated that online learning is very or extremely stressful (rating 4 or 5), and only 9.9% claimed that the online learning mode is not stressful at all.

There was also a small group of academic staff and students claimed online learning was extremely stressful. These figures are consistent with the cooperation received by the students, or the assistance received from the lecturers as a support towards online learning. Only 22 (9.5%) academic staff rated their students are very cooperative during online learning. On the other hand, 412 (40.4%) students are very satisfied with the assistance given from their lecturers.

The flexibility to study from home or any locations is shown as one of the strongest advantage in online learning and it was agreed by both academic staff and students, as in Fig. 4. It was voted by 125 (54.1%) lecturers and 596 (58.5%) respectively. This is probably due to the contents can be delivered to students using two different approaches: self-directed and lecturer-directed learning. Self-directed e-learning allows the learner to manage his activity independently. This eventually contribute to another agreed advantage of online learning which opportunity to explore new technology and tools. 118

(51.1%) academic staff also agreed that online learning contributes to better understanding of various teaching methods/techniques. This is especially for technical academic staff that needs to convert their hands on experiment to simulation or remote labs. On the students' side, 597 (58.6%) students found out the lecturers are more creative to ensure students are engaged with the online class. This, at the same time allows the creativity in completing the tasks as well.

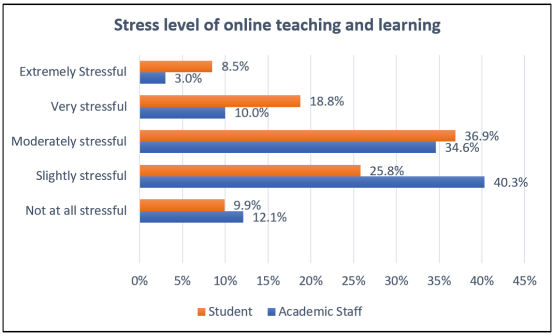

Fig. 3. Stress level of online teaching and learning

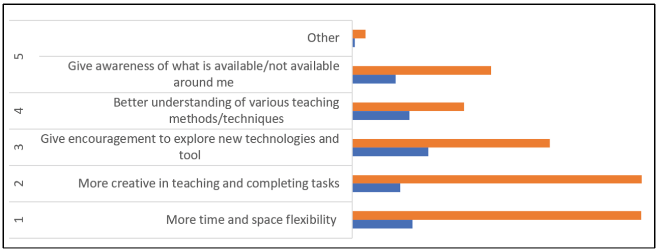

Fig. 4. Added values gained from online teaching/learning

Online learning is not without its disadvantages. Figure 5 shows that the main challenges faced by the respondents in the survey was unavailable or unstable internet connection. This factor was agreed by 156 (67.5%) lecturers and 743 (72.9%) students. Another major disadvantage agreed by both respondents; 113 (48.9%) academic staff and 406 (38.8%) students are limited facility to do tasks at home. This is most probably due to unexpected extensions of MCO. The students, for example, left their laptops at the hostel and limited online learning. 53 (22.9%) lecturers thought they had limited knowledge on how to use the technologies and tools while 647 (63.5%) students found out it was difficult to discuss with group mates. The online platform is always ready for discussion however it needs to be supported with a good/stable internet connection.

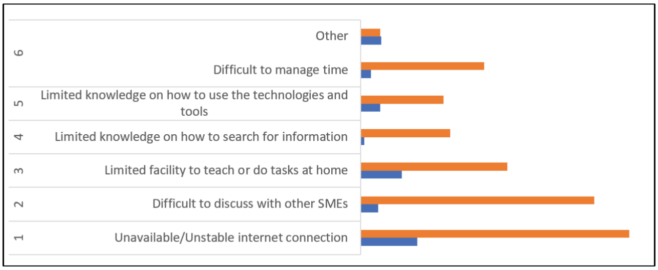

Fig. 5. Challenges faced during online teaching/learning

5 Conclusion

In conclusion, digitization is a complex phenomenon that affects various aspects of TVET and skills systems. It poses challenges but also creates opportunities for improving the quality and relevance of TVET provision. To harness the potential of digitalization, TVET stakeholders need to adopt a holistic and coordinated approach that addresses the competence development of TVET teachers and trainers, as well as the governance structures and processes of TVET institutions.

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Portable Private Network for Teaching and Learning

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Abstract. Bring Your Own Device (BYOD) has become a popular trend among technology users of all sectors. This concept has been supported by massive invention and manufacturing of mobile and portable devices. People nowadays want flexibility in accessing resources from anywhere, at any time and on any device. This research project aims to build a portable network infrastructure to allow teachers to provide a secure Moodle environment for teaching and learning (T&L) using Raspberry Pi as a server. The network can be activated and deactivated as needed to ensure that only the dedicated group of students get the privilege of accessing it. The teacher can activate the network during the T&L session, let students connect to the network, and access the Moodle platform for exclusive class materials and activities. The connection can be terminated when the T&L session is over or when it is no longer in use. This will somehow control the access to files and folders stored in the server, hence securing them. On top of that, this method can also be considered a cost-effective solution for sharing and storing files and folders for T&L.

Keywords: Portable web server · Raspberry Pi · Moodle LMS

1 Introduction

Way back, students were burdened with heavy books and bags for their daily T&L activities. Nowadays, most students possess their own mobile devices, which become part of their life. In higher education, some universities encourage their student to bring their own laptop because of insufficient resources or room to conduct the exam in a dedicated computer lab at the required scale, e.g. 500 students at a time [1]. With these devices, students no longer need to carry the heavy burden around as everything is available in the form of a softcopy. Nevertheless, mobile devices have limited storage capacity and storing the same items in everyone's device is not economical. Even though there are several options available for additional storage, it requires data to traverse the public network to get to the server where the storage space is located. Without proper security measures, this will expose the data to external threats.

Most current implementations of the learning management environment (LMS) are using the Moodle platform. Moodle is commonly installed and configured in a server

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for user access. The server is usually fixed in a data centre owned by an organisation and is accessed by users via public networks or the Internet. Again, online requests and the provision of files and folders over public networks make them vulnerable to external parties. To make things worse, an organisation usually uses a server to support multiple applications or functions. This means the server must be made available at all times and accessible to many people.

The limited physical space at some institutions has also become one of the issues that require urgent attention. This also has given the idea of providing various types of creative 'curriculum space' instead of constantly being in boring boxed classrooms. Students these days prefer more open spaces, where there are full of lights, modern designs, different textures, shapes and arrangements [2]. Coverage of provisioned networks may cover indoor areas and parts of outdoor space. Therefore, T&L sessions that require the sharing of softcopy documents and online activities have to be conducted within those areas only.

The main objective of this research is to secure the storing and sharing of files and folders among students or between the teacher and students. Storing files on a personal server keeps them safe as the owner can set the access privilege on the device. Sharing over a private network will increase the safety of files as they are only being shared by authorised users. Having a personal server creates an exclusive and flexible environment. Another objective is to build a network using devices that are compact yet powerful enough to support the required tasks. This will allow teachers to carry the necessary devices, including the server, to any venue where the session is to be conducted, activate the network, let students join in, and run the T&L session as normal.

2 Private and Portable Network

The concept of the private network is nothing new. This type of network extends a private network across a public network and enables users to send and obtain information across pooled or public networks. Several years ago, the most common way to connect computers between multiple venues was by using a leased line [3]. However, this method showed some drawbacks, especially in terms of security. Starting from the current millennium, there has been rapid development and deployment of virtual private network (VPN) services [4] with the intention of securing remote connections. The major benefit of VPNs is that they are considerably cost-effective. Moreover, having the Internet as the backbone for communication guarantees the reliability of service as the logical path between the parties is simply changed transparently to the user in the case of a node in the path or line between routers going down [3]. However, with all the highlighted benefits, security, privacy and confidentiality issues keep on arising as data are being sent over public infrastructure.

On the other aspect, there is an increased popularity in the concept of mobile classrooms in which the class can be conducted anywhere as long as the power source is available. Teaching and learning experiences that take place outside of the confines of the classroom walls have a range of benefits for both students and teachers [5]. This allows them to explore lots of different T&L methods that can enhance the learning process and experience.

3 Methods

3.1 Development Works

The work begins with defining problems with the current implementation of files and folder sharing. Lots of security issues are being discussed on top of inflexibility and cost-related matters. The work follows with clarifying concepts and approaches to several solutions and identifying suitable hardware and software.

The conceptual designs are refined into a functioning model, followed by the installation and configuration of Raspberry Pi 4B microcomputer and D-Link DIR-842 wireless router; deployed in a local area network (LAN) environment. Figure 1 shows the hardware setup layout of the portable network. Here, the wireless router is used as the main device that will group all connected devices in a local network with /24 prefix and the gateway to the external network. A Raspberry Pi 4B microcomputer is physically connected to the router using an Ethernet cable and becomes the portable server for Moodle.

The Raspberry Pi runs on an SD card that stores the operating system (OS) that allows it to create its own independent environment. Besides the provisional general-purpose input and output (GPIO) pins, it is also equipped with network connections depending on the model. Raspberry Pi 4 Model B, which is being used in this initiative, comes with different options for RAM capacity. However, for testing purposes, the microcomputer is equipped with 4 GB RAM, 1.5 GHz 64-bit quad-core ARM Cortex-A72 processor, onboard 802.11ac Wi-Fi, Bluetooth version 5, USB 3.0, micro-HDMI and is powered using USB-C port. 32 GB MicroSDHC/XC UHS-I memory card was used to provide storage space and support the system implementation.

On the other hand, the D-Link DIR-842 wireless router was chosen due to its size, which is smaller than most of the latest midrange and high-end models. It provides dual-band Wi-Fi, relatively good throughput, and some efficient management settings like guest networking and Quality of Service (QoS) prioritization. In this project, the router was named as MoodleRouter, and installed with OpenWrt firmware to get more Linux features and advanced functions. This includes the ability to customize settings and use advanced networking features which are not offered by the default firmware of routers. Raspberry Pi microcomputer acted as the Moodle server and ran on Raspbian OS Lite.

Wireless LAN (WLAN) is configured on the D-Link router so the private network's clients can connect and access the Moodle server. The router, which also runs Dynamic Host Configuration Protocol (DHCP) and dnsmasq services, helps resolve MoodleBox Internet Protocol (IP) address and supplies the IP address to the client connected via Wi-Fi. Here, the dnsmasq service, which is a free service for Linux systems, is not configured in Raspberry Pi. Instead, it is configured in the router for better handling of DNS requests as the router is the central device.

The MoodleBox is configured before other configurations are applied in Raspberry Pi. By default, MoodleBox is preconfigured with its own access point. Here, Wi-Fi is served by the router to allow the use of more advanced features. Therefore, the access point feature of MoodleBox is disabled. All wireless clients connected to the dedicated Wi-Fi will get their IP addresses from the DHCP.

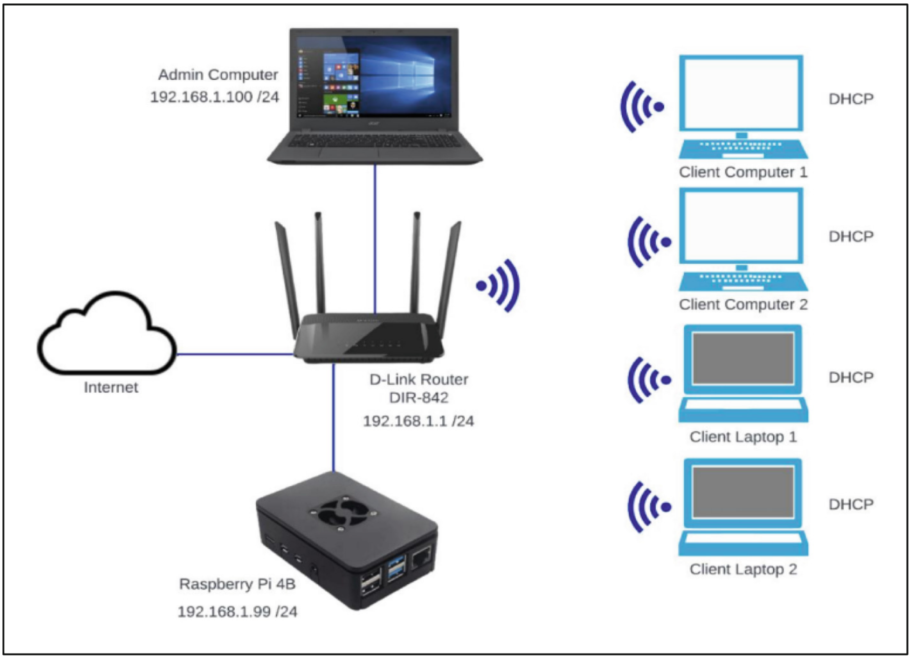

Fig. 1. The portable network layout.

As shown in the layout, the network also connects an administrator's device, which is to be used by the teacher, and wireless connections are offered to clients' devices or end devices to be used by students joining the T&L sessions.

The connection to external networks or the Internet via the wide area network (WAN) port of the router is made optional to allow the private network to communicate with external parties if necessary. Finally, user, course, enrolment lists, and T&L activities are set on Moodle accordingly for testing purposes. Figure 2 shows the overall flow of the development processes.

3.2 Test and Optimisation

The portable private network is deployed and tested in the campus area. The tests and results are focused on the system's functionality. The functionality test covers Domain Name System (DNS) request connections, wireless connections, DHCP requests and configured static lease.

The DNS connection tests were conducted using *nslookup* command, which requires the Raspberry Pi Lite OS to be installed with *dnsutils* package. The wireless connection was tested by scanning the available wireless signals and looking for the network service set identifier (SSID) broadcasted by the network. A number of client devices were used to connect to the network using the pre-configured SSID and password. The DHCP request was tested on the client devices, which require dynamic IP addresses. Static lease is

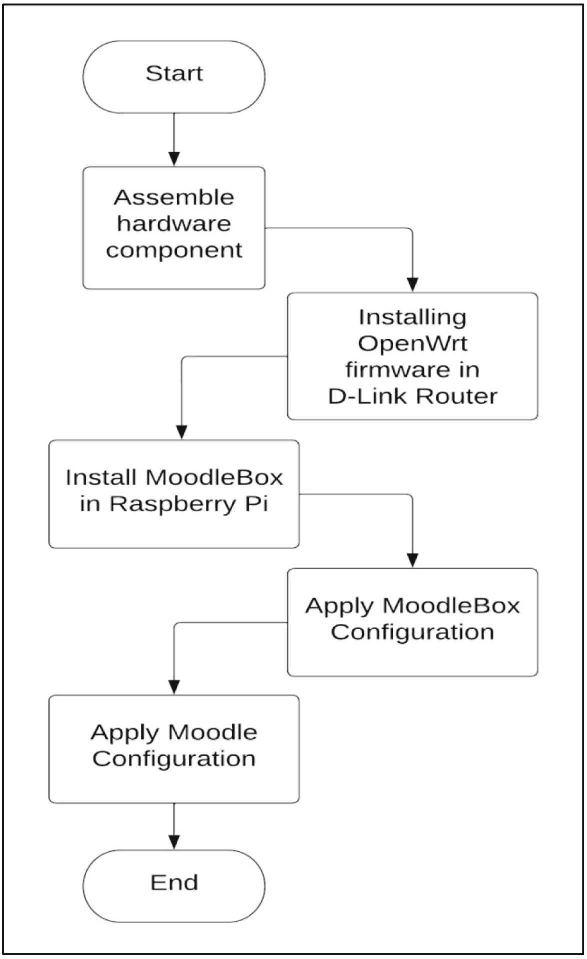

Fig. 2. The flowchart for development works.

Table 1. Wireless Network Configuration

Parameters	Details
SSID	MoodleWiFi 2.4 fGHz
Encryption	WPA2-PSK
Wireless Password	FYP@pi2022

configured in the D-Link router. In this scenario, the static lease was configured to bind the IP address to the MAC address for the administrator's computer and MoodleBox.

On the software side, the process continues with examining the connection to MoodleBox via SSH using Putty, and Moodle web server connection using a browser.

A few popular browsers were also tested to find the most suitable to be used for this secured environment.

Once all tests conducted on hardware and software were successful, another test involving end users was conducted at Level 6 of UniKL City Campus building to ensure students could connect their devices to the portable private wireless network during the real implementation. Table 1 shows the wireless network configuration for connection to the 2.4 GHz network.

Students need to scan for the SSID and request for connection. The password is required as the wireless network is protected for security. Several tests were conducted to measure the network performance using iPerf, a commonly used network performance testing tool. These tests focus on the amount of maximum achievable bandwidth on IP networks for every connected device. To allow iPerf to capture the required results accurately, it needs to be installed on both the server and the client sides.

4 Results

A series of tests were conducted to ensure the system was functioning as intended. The tests include the inspection of the hardware and software setup, compatibility and workability, network connections, platform configurations, and overall system functionality.

Since the objective is to provide a network connection to students' mobile devices during the T&L session, the readiness of the infrastructure is crucial. All installed software and configurations must be kept in non-volatile storage so that the setting is available when the network is activated. Here, the power supply is needed to power up the D-Link router and the Raspberry Pi. Based on a series of tests conducted, it only needs about 3 to 5 min to boot up the devices, run the services and get the infrastructure ready. Once the network is booted up, the server is available and connections of all devices are successfully established, the T&L sessions can resume.

Since the network was set with /24 prefix, there were only eight bits left for host portion in the IP addressing scheme. This provides 254 usable IP addresses for connections, including the addresses which were already statically assigned to the gateway, administrator's computer and MoodleBox. Should there be more IP addresses required, the network address setting must be changed accordingly to allow more devices to connect to the network.

In terms of overall network performance, it relies heavily on the number of connected devices. The more devices connected to the network, the lesser the amount of bandwidth received by every device. When the bandwidth is low, it contributes to higher latency, which will then affect the online T&L activities and assessments, especially if it involves real-time applications, such as video conferencing, real time assessments and online games.

Table 2 shows the results of performing iPerf tests using command prompts that run in several situations where the resource was shared among 1, 5, 10, 15 and 20 devices, connected to the 2.4 GHz network or 5 GHz network. Looking at the decreasing pattern of the amount of bandwidth achieved per device in Fig. 3, if the 2.4 GHz network is implemented, the setup is suitable for a small number of connections. If there are

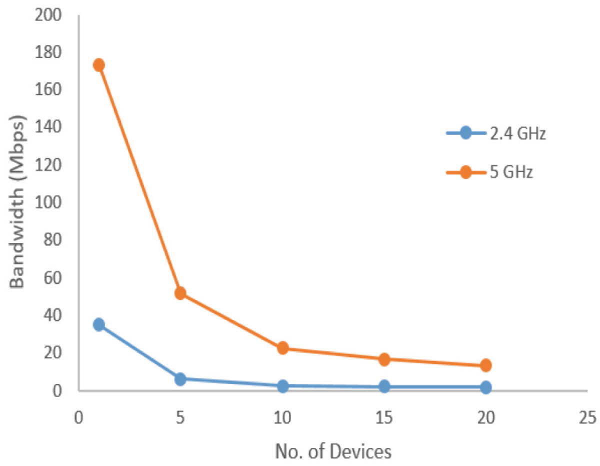

Fig. 3. The achievable bandwidth.

Table 2. Shared Bandwidth

No. of Device	Bandwidth (Mbits/sec) per Device	
	2.4 GHz	*5* GHz
1	35	173
5	6	51.6
10	2.5	22.5
15	2.1	16.7
20	1.8	13.3

20 devices, each will get about 1.8 Mbps bandwidth, which still allows the users to access the LMS and perform activities that do not require high throughput. Streaming high-definition videos is no longer possible as it requires higher bandwidth allocation.

Tests conducted on four popular Internet browsers show that lecturers or students may access the LMS using any preferred browser. The selection of browsers does not have any significant impact on access to online materials and activities, performance and security.

5 Discussion and Conclusion

The trend of having students take their own mobile devices around has changed the T&L paradigm. There are no more physical textbooks, foolscap papers and stationaries in students' bags. They are having their devices, chargers, external drives and power banks instead. It is understandable that students prefer changes in environments. To suit this trend, the university and the teachers particularly, have to be creative in selecting the most conducive setting to run the show without jeopardising the quality of T&L. It can be seen that teachers have creatively started to conduct their classes at odd places such as on the rooftops, in the gardens, and at places with better views. Perhaps some may have plan to have their class on moving vehicles. The T&L sessions nowadays should no longer bounded by four-wall classrooms.

This portable private network initiative was commenced to cater for the latest T&L needs and at the same time to attract students' interest and attention. It allows teachers to carry around tiny networking devices and set up some kind of 'hotspot' for students to connect to and share necessary materials with each other. On top of that, the session will also be equipped with Moodle LMS, which is a platform to provide various on-the-spot T&L activities and assessments, document sharing and work collaborations.

To add security and privacy to the connection, as well as the stored and shared materials, the network can be activated and deactivated when needed. No one can access the stored files and folders when the network is down, as the portable server is only connected to the network. Once the network is deactivated, the server is totally unreachable.

With the overall hardware and software cost of less than RM500.00, excluding the end devices and licenced Moodle platform, this solution is very cost-effective to implement for a small class with a capacity of less than 30. All devices and the necessary cables and connectors can fit in a small briefcase with less than 1 kg total weight, thus making them portable. The wireless router weighs 288 g and the Raspberry Pi is only 46 g. The weight of the cables is depending on the length. The compact size of devices requires only small space to set everything up. Figure 4 shows the portable network setup at a corner of a student's desk in Lab 607, UniKL City Campus. For better coverage, it is advisable for the setup to be placed in the middle of the area. Additionally, extra devices like access points, and higher-specification microcomputer and router are required to support more connections, should the lecturer be teaching bigger crowds.

Fig. 4. The portable private network devices.

Besides for T&L purposes, this private portable network concept is also suitable to be applied to small businesses that do not have a permanent office. Once the configurations are readily applied to the devices, the setup of the network is just a plug-and-play process, which can be done anywhere, provided there is power source available.

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Teaching Basic French Language Online

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Abstract. The aim of this paper is to share and discuss the importance of integrating learning theories, learning strategies and multimedia elements when offering learning language online. The discussion will be about students' perception or view and teacher towards this approach. The method applied in this study is quasi-experimental design. Subjects or respondents are composed of three French teachers and 56 students of diploma in Engineering Technology in a Private Technical University of Malaysia. In this study, students were divided into two separate groups, a total of 28 people whose attended the Basic French subjects by learning the subject online (as developed) while 28 other students from different classes have learnt the basic French language in the conventional way. In this study, seven instruments were used for achieving the said objectives. The findings were analyzed by using Statistical Package of Social Science (SPSS) software version 17.5 and descriptive and inferential statistics were used to answer the purpose of this study. The findings showed that this Basic French online has applied learning theories, strategies in learning and multimedia elements in it.

Keywords: Online learning · learning theories · learning strategies · web technology

1 Introduction

The process of learning a language should not only aim to mastering language only. This is because the process of learning and teaching a language can be generated to achieve some additional goals such as developing critical skills among students. The development of communication and critical skills is essential for the students in addition to the mastery of language proficiency. The ability to communicate well in any language will create a generation of students who not only master in science but also have a mature mind. The latest trend in communication over the Internet, email, social media, digital images as well as the latest trends in the spread of news and advertising has led to the use of complex words, images, and text in communication.

[8] in her study has identified 98 skills to be mastered by the teachers which of them are related to web-based learning and teaching. Many previous studies have found the use of multimedia in learning the language enables students to memorize and master

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new words more effectively and supports the view that electronic media can facilitate enrichment of the term. [1] said the use of the Internet in R & D is a modern method that can be used in the study of the language, particularly French in the 21st century.

[7] claimed that Internet provides a lot of information in a more attractive and structured way and can be used during learning and teaching in the French language. The material from the Internet such as web pages related papers in French, learning French, magazines, articles, chat room French language, e-mail, MSN French, Yahoo French and TV stations and Radio France can be reached through web technology. It is very useful in terms of its language and current terminologies used in learning language.

Many people have tried to produce quality and marketable students who are able to master many languages in the face of today's globalized world. Malaysia is no exception in this aspect where the emphasis given in creating a human resource that can capture a foreign language in driving the knowledge-based economy (k-economy) and is also competitive at the national or international. In today's globalized world foreign language proficiency is no longer seen as an added value but may become necessary to compete in the arena of politics, security, international trade, and education. What's more important is the development of software that considers the needs and learning objectives without neglecting aspects of local value or character of the national identity.

The National Council of State Supervisors of Foreign Languages outlining six key findings of the studies and reports over twenty years indicate additional requirements for students to master and capable of at least two languages.

Among other things the study shows (i) foreign language education has been classified at the same level as the basic academic areas such as English language, Mathematics, Computer Science, Social Sciences, Pure Sciences, (ii) foreign language learning is no longer confined to certain groups even abilities master a foreign language is part of the national agenda and is a matter of national security (nation's security), (iii) higher education makes foreign language as one of the entry requirements, (iv) a means for improving the teaching of foreign languages at all levels (primary, secondary and high) and raise the standard or standards in education, (v) knowledge in foreign languages is a necessity to compete in the 21st century.

2 Background Study

Learning through internet or also known as e-learning, can change how a person or an individual acquires new knowledge and skills in acquiring any language. [5] defined e-learning as the use of innovative technologies and learning modules that can be used at any time and any place if we have connected to the internet. [4] stipulates that the students can develop their knowledge and access various learning resources that abound in the Internet space. According to [10] with the Internet, students now can access language resources on-line or open educational resources (OER) online much like the notes, item documentaries, essays, quizzes online, announcements, and various other reference materials.

[9] mentioned that the use of learning online or internet in any language is a new tool or media in learning and teaching languages. [10] stated that learning language through medium such as computer or assisted by a computer is not new in education. Most

applications are still not widely implemented in Malaysia and have not yet integrated into the Malaysia educational system.

2.1 French History in Malaysia

The history of learning French in Malaysia is a story of cultural exchange, education, and diplomacy that spans several centuries. French language education in Malaysia [13] has evolved over time, reflecting the changing dynamics of international relations, trade, and education. Here is a brief overview of the history of learning French in Malaysia:

i. **Colonial Era (18th to mid–20th century):** French influence in Malaysia can be traced back to the colonial era when the region was under British and French colonial rule. While the British controlled most of Malaysia, the French established a presence in the neighboring Southeast Asian countries, including Vietnam and Cambodia. During this period, French was taught in select schools and institutions, primarily by French missionaries and colonial administrators.
ii. **Post-Independence (1950s–1960s):** After gaining independence from British colonial rule in 1957, Malaysia focused on nation-building and modernization. The Malaysian government recognized the importance of foreign languages, including French, as a means to foster international relations and trade. As a result, French language programs were introduced in some Malaysian universities.
iii. **Diplomatic and Economic Relations:** The relationship between France and Malaysia strengthened over the years, with both countries engaging in diplomatic and economic ties. French language learning was encouraged to facilitate communication and collaboration in various fields, including trade, science, and technology.
iv. **Educational Institutions:** French language education continued to expand in Malaysia, with several universities and language schools offering French language courses. The Alliance Française, a renowned international organization promoting French language and culture, established branches in Malaysia, offering language classes and cultural events.
v. **Cultural Exchange and Diplomacy:** Cultural exchange programs, such as student exchanges and cultural events, played a significant role in promoting French language and culture in Malaysia. These initiatives fostered a deeper understanding of France and the French-speaking world among Malaysians.
vi. **Contemporary Era:** In recent years, French language learning in Malaysia has continued to grow, driven by various factors, including globalization, tourism, and international business. Learning French is seen as an asset for Malaysians seeking career opportunities in multinational companies and international organizations.
vii. **Language Policy:** Malaysia is a multilingual country with Malay (Bahasa Malaysia) as the official language. However, English is widely used for business and education. While French is not an official language, it is taught in some schools and universities, and its importance in the global context is acknowledged.
viii. **International French Language Examinations:** Malaysians interested in proving their proficiency in French can take international examinations such as the DELF (Diplôme d'Études en Langue Française) and DALF (Diplôme Approfondi de Langue Française) exams, which are recognized worldwide.

2.2 Benefits of Learning French Language

Learning the French language offers a wide range of benefits, from personal enrichment to professional opportunities. Here are some of the key advantages of learning French [12]:

i. **Cultural Enrichment:** Learning French allows you to immerse yourself in the rich and diverse culture of the French-speaking world. You can explore literature, art, music, cinema, and cuisine that are deeply influenced by the French language and culture.

ii. **Global Communication:** French is one of the most widely spoken languages globally, with over 220 million speakers across the world. It is an official or administrative language in numerous international organizations, including the United Nations, the European Union, and the International Red Cross. Learning French opens up opportunities for global communication and collaboration.

iii. **Travel and Tourism:** France is one of the world's top tourist destinations, known for its iconic landmarks, beautiful landscapes, and vibrant cities. Learning French enhances your travel experience by allowing you to communicate with locals, understand signs and menus, and navigate the country more easily.

iv. **Business and Career Opportunities:** French is a key language for international business. France has one of the largest economies in the world, and French-speaking countries are spread across Europe, Africa, and the Caribbean. Knowing French can be a valuable asset for career advancement and expanding business opportunities in these regions.

v. **Education:** France is home to some of the world's top universities and educational institutions. Learning French can open doors to higher education opportunities in France and other French-speaking countries. Additionally, many academic publications and research are available in French.

vi. **International Relations:** French is a prominent language in diplomacy and international relations. It is used in negotiations, treaties, and diplomatic missions. Proficiency in French can be advantageous for careers in international organizations, politics, and foreign service.

vii. **Cognitive Benefits:** Learning a new language, including French, enhances cognitive skills such as problem-solving, multitasking, and creativity. It also improves memory and language processing abilities, which can have positive effects on your overall cognitive function.

viii. **Personal Growth:** Learning a foreign language is a rewarding personal achievement. It broadens your perspective, increases your empathy for other cultures, and makes you a more informed and open-minded individual.

ix. **Multilingual Advantage:** If you already speak English, learning French is even more advantageous. French and English share a significant amount of vocabulary due to historical ties, making it relatively easier for English speakers to learn French.

x. **Access to Literature and Media:** French is a language of great literature, including works by authors like Victor Hugo, Albert Camus, and Marcel Proust. Learning French allows you to enjoy these literary treasures in their original form. French cinema and music also have a global following.

Therefore, the aim of this paper is to develop a method of teaching by using web technology or online learning for learning and teaching basic French. The development of learning and teaching Basic French online is an innovative approach and interactive specially to meet the learning styles and requirements of today's students. According to [10] interactive features such animated menus, navigation, structured modules, and assessments in language learning will have some good impacts and more meaningful on students and teachers especially in acquisition basic skills in learning language.

3 Problem of Statements

In the development of increasingly sophisticated technology and globalization era, proficiency in multiple languages is a necessity and advantage. Malaysians should be able to master more than one language if they want to compete in the international arena. [6] (in the News Daily) said Malaysians need to communicate more effective with multiple languages and should be ready to learn other languages to increase knowledge and information.

[11] and [5] have found that students have a high perception of online learning. [3] mentioned that the French language taught in schools or institutions of higher learning (HEI) in accordance with the teaching style and the world itself. Grammar problems and pronunciation were the major problems. This happen is because there was no motivation (absence of interest/motivation), inadequate support system in teaching, not enough time for teaching, don't have the opportunity and enough time to practice the French language and coupled with timidity of some Malaysian students. Those elements mentioned above could be addressed if learning and teaching was carried out through internet or online learning.

Many previous studies revealed that the online learning or web-based learning is a must for the current educational approach and the use of recent technology is unquestioned, especially the usage of latest tools such as computer and ICT related tools and internet in learning and teaching language. [1] stated that online learning or learning through web-based can encourage students to be more critical and train students to be more creative in thinking as well as to promote a higher level of learning among students.

4 Rasionale of this Paper

The aim or purpose of this paper is to share and discuss the importance of integrating learning theories, learning strategies and multimedia elements when offering learning language online. The discussion will be based on the perception of students and teachers towards this approach or methodology.

4.1 Study Objective

To achieve the purpose of the study, the following objectives were introduced.

i. The basic French language was developed using the approach of tutorials, drills and practice and educational games.

ii. The basic French language was developed using self-learning strategies, mastery, flexible, cooperative, active, and problem-based learning.
iii. The basic French language was developed based on learning theories such as behaviorism, cognitivism, and constructivism.
iv. The basic French language was developed by applying interactive multimedia elements.

4.2 Research Questions

To achieve these objectives, several key questions were constructed as follows:

(i) Does the Basic French language was developed using a tutorial approach, drills and practices and educational games?
(ii) Does the Basic French was developed applying the self-learning strategies, flexible, mastery, cooperative and active?
(iii) Does the Basic French apply the learning theories such as behaviorism, constructivism, and cognitivism?
(iv) Does the Basic French was developed by applying interactive multimedia elements?

5 Methodology

The quasi-experimental design was used as a method in this study. Samples or respondents were composed of three French teachers and 56 students of Diploma in Engineering Technology in a Private Higher Technical University of Malaysia. In this study, students were divided into two separate groups, a group of 28 people have learnt the Basic French subjects by learning the course online (as developed) while the other 28 students from different classes have learnt the same course (French language) in a conventional way. In this study, seven instruments were used for achieving the targeted objectives. The findings were analyzed by using Statistical Package of Social Science (SPSS) software version 17.5 and descriptive and inferential statistics were used to answer the questions asked in this study.

5.1 Population and Sample Survey

Samples or respondents were composed of three French teachers, and a total of 56 students of Diploma in Engineering were involved. In this study, students were divided into two separate groups, a total of 28 students have experienced the Basic French course online as being developed while the other 28 students from different classes have learnt the basic French language in the traditional way.

5.2 Procedure and Implementation Study

In the process of developing Basic French course online (EASIFRENCH), several phases have been followed by the function are:

1. Analysis process in term of technical requirements and students' performance.
2. The process of designing the prototype and come out with a specific model

3. The development process – in term of technical requirements and contents development
4. The process of implementation – including pre and post implementation
5. The process of testing and evaluation of some aspects of the use of software

Below are the figures of the reliability index of construct/dimension used in this study (Table 1).

Table 1. Cronbach alpha's values for each construct

No	Construct /dimension	Item No	Cronbach Alpha's value
1	Design aspects of presentation	7	0.6053
2	Interactivity aspect	7	0.6096
3	Aspects of content design	6	0.6455
4	Aspects of Language	32	0.8635
5	Learning Approaches	13	0.8676
6	Learning Theories	22	0.6144
7	Learning Strategies	19	0.6290
	TOTAL	122	0.7662

6 Findings

Based on surveys and interview sessions with students, the following findings were revealed.

The Basic French Modules online have been developed in taking consideration upon:

(i) Language teaching approach – considering the development of this Basic French course online approaches used in the process of learning a language like role play, search vocabulary, imitation, exploration, observations, auditory and repetition.
(ii) The holistic and comprehensive development of students – is focused on courseware development aspects in accordance with the holistic or comprehensive students' development such as cognitive domain (thinking), affective domain (values and ethics) and psychomotor domain (physical) students.
(iii) Network/structured teaching – the modules contained in the application were well structured from easy to difficult level.

The results showed that that 82.1% of respondents agreed (23 students) and 17.5% (5 students) disagreed that Basic French online using these approaches drills and practices and educational games. For tutorial approach, 85.7% (24 students) agreed and 14.3% (4 students) disagreed that the Basic French online applied tutorial approaches. For the approach to educational games, showed students 100% agreed that this courseware online provides educational games approach, and this approach was designed to ensure the total understanding of users towards the information provided.

The results also showed that 100% (28 students) were agreed that the Basic French course online applied self-learning strategy, self-pace learning and cooperative. For active learning strategies, 96.7% (27 students) and 3.3% (1 respondent) were disagreed that the Basic French applied s active learning strategies.

7 Conclusion

This study has successfully developed Basic French online by integrating web-based pedagogical approaches such as tutorials, drills and practice and educational games. This web-based or online development strengthened further by applying learning theories such as theories of behaviorism, cognitivism, and constructivism. Some learning strategies such as independent learning strategies, flexible, mastery, cooperative and active learning also successfully applied in the development of this application.

The conceptual model based on characteristics such as language teaching approach, holistic development of students, a systematic and planned module, chain of inter-related modules with each other and approach has made development multisensory. The Basic French online is unique and distinctive. By integrating elements of interactive multimedia, software development has been successful in increasing student achievement as being obtained from pre and post tests conducted by two research groups that have used two different methods of learning.

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Innovative Curriculum and Programme Offering

A Review of Factors Influencing Students' Choice in Tertiary Technical Education

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Abstract. Malaysian Education's Science/Technical: Arts Policy demands a 60:40 ratio of enrollment in science and arts. However, the current enrollment of science, technology, engineering and mathematics (STEM) in higher education programs is still greatly below the targeted percentage. STEM education is important for the country's development and provides the needed workforce and experts. Bachelor of Technology (B.Tech) is one of the options for STEM in tertiary education. This research aims to discuss the significant factors that affect students' decision to choose B.Tech in their tertiary education. There are several components that influence students' selection of higher education programs such as the students' individual perspective, external influences, and institutional qualities. A survey investigating ten factors from these components is designed to assess their influence towards students' decisions. The survey involved 93 respondents who are currently pursuing pre university or diploma in STEM related streams. Based on the finding, tuition fees (18%), campus facilities (13%) and career interest (12%) are the top three factors that influence the students' decision.

Keywords: STEM · B.Tech · education · student choice

1 Introduction

In 2018, Malaysia had a gross enrolment ratio for tertiary education (GERTE) of 45% and more than 1.3 million students' enrolment. Meanwhile, in 2019 a total of 567,625 students were enrolled in public universities, along with 96,362 at polytechnics, 26,118 at community colleges, 328,978 at private universities, 88,530 at university colleges, 187,733 at colleges, and 28,103 at overseas branch campuses [1].

Despite the high number of students' enrolment to tertiary education in Malaysia, there has been a steady downward trend in the number of students enrolling in science, technology, engineering and mathematics (STEM) related programs [2]. According to Malaysian Ministry of Higher Education (MOHE) statistics for 2021, only about 18.75% of students enrolled in STEM programs, which is far below the 60:40 target of the Malaysian Education's Science/Technical: Arts Policy. This policy intends to have 60%

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of the students' population are from the scientific or technical stream and 40% from the arts stream.

Improving students' exposure to STEM is crucial for societal economic growth and providing equal opportunities to all individuals, regardless of socioeconomic origin [4]. Engineering, information technology, and engineering technology are at the vanguard of technological advancements such as automation, robotics, artificial intelligence, and data analytics. Bachelor of Technology (B.Tech) and Bachelor of Engineering (B. Eng) are among the available STEM degrees. Both focus on engineering, but they differ in their emphasis and focus. B.Eng focuses on fundamental scientific knowledge of engineering, while B.Tech programs tend to have a stronger emphasis on the practical application of technology and engineering principles, which more emphasis towards hands-on training, laboratory work, and industry-oriented projects.

Rashidin et. al listed ten obstacles to the implementation of STEM [3]. Among the obstacles is students are more interested in hands-on STEM education than on theory alone. This may be the primary reason for the decline in engineering student enrollment. Practical experiences and physical items enable students to directly interact with and manipulate concepts, which improves their understanding and retention of information. Thus, B.Tech has the upper hand and able to cater to the students' interest. Nonetheless, like other STEM courses the intake for B.Tech program need to be improved. Hence, this paper investigates the factors that influence students' selection of technical degree. Broadly the factors involve the students' individual perspective, external influences, and institutional qualities. Specifically, 10 criteria were studied, and three top factors are identified. They are tuition fees (18%), campus facilities (13%) and career interest (12%). Understanding these factors are important towards improving the students enrolment in STEM education, specifically in B.Tech degree.

This article is divided into five sections. Section 1 introduces the research approach and context. The second section presents relevant research on factors influencing students' selection of higher educational institutions technical education. In Sect. 3, the methodology for conducting the survey is described. Section 4 presents the survey results and discusses the research output. Section 5 concludes the study with a summary and recommendations for future research based on the findings.

2 Related Work

Higher education is valued as a way for people to rise up within their communities and as a tool for the nation's development goals, particularly in support of social cohesion among multiethnic populations and the development of a dynamic labour force. Tertiary education is highly valued in Malaysian society as a means of personal advancement [5]. The students have a variety of considerations to make while choosing a university, and these considerations can be broken down into various categories. The elements include the institution's reputation, fees, employment opportunities, parental influence, educational offer, and location [6]. In addition, various promotional information sources, such as websites, publications, television, and events such as school visits, influence the students in choosing the university to continue their tertiary education. Moreover, infrastructure such as classrooms, computer facilities, and library quality are also among the determining factors in making decisions of which university to pursue tertiary education.

Siregar et al. [7] in their work investigated the relationship between parental education and students' interest in STEM subjects. The study involved 150 Indonesian students. Based on the results the parental education does not give significant impact in students' interest towards STEM fields. The authors suggested additional research on STEM interests based on tuition fees and location of institutions should be conducted. They also highlight the significance of integrating STEM education at a young age and involving parents and institutions in providing support.

The research by Kaleva et al. [8] concentrated on mathematics as a student's preferred subject and explored the reasons for this preference. The survey used a best-to-worst scale to collect data on the subject selection decisions of students. The students ranked enjoyment, interest, and ability as the most significant considerations when selecting and rejecting a programme. The importance of advice from teachers, parents, or peers seemed to be comparatively low. The study suggests that enhancing students' enjoyment, interest, and perceptions of their ability in science, as well as their perceptions of the value of science in future careers, may contribute to an increase in the number of students majoring in STEM subjects. Besides that, the significance of implementing evidence-based programmes and policies to eliminate barriers and encourage youth to pursue STEM-related careers.

Most of the research reported on a broader perspective of STEM as students' choice for their tertiary education. To the best of our knowledge no paper focused specifically on B.Tech program. Number of higher learning institution offering B.Tech is on the rise. Therefore, this research studies the factors that influence students' selection of pursuing B.Tech.

3 Methodology

The study involved a group of pre-university students who are currently pursuing their study in technical at Multimedia University. The online survey collected 93 responses. The participants were students from Foundation in Engineering (18.3%), Foundation in Information Technology (47.3%), and also students of Diploma in Information Technology programs (34.4%). These participants represent a portion of the overall target population of Malaysian students pursuing tertiary technical education. These students have options to pursue an engineering degree, or a degree in information technology or a degree in technology.

The degree of technology is a 3-year program which has a work-based learning component. Work-based learning provides students hands-on experience with industry partners for a year. During this duration, students will gain real world and practical learning experiences. This complements the classroom learning that students would have gained in their first two years of their degree and increases their career readiness.

The survey is distributed to understand the important factors that might influence the students' decision in choosing a B.Tech degree for their under-graduate study. Among the factors studied covers tuition fees, the university's reputation, the location of the university, career interest, student's academic strength, the course's duration and structure, and influence of parents, peers and alumni.

4 Results and Discussion

From the survey, the factors influencing students' choice to enroll in technology programs are assessed. The results are presented here using table and graph for easy understanding and interpretation.

Table 1 presents the responses collected from the survey. The values of 1 to 5 are given with 1 for 'not interested' and 5 for 'extremely interested'. Based on the surveys, the top three factors are tuition fees, campus facilities and career interest. These are followed by academic strength, university's location and program's duration.

Table 1. Survey results

	1	2	3	4	5
Tuition Fees	-	-	13	13	67
Campus facility	1	1	15	29	47
Career Interest	-	1	13	36	43
Academic Strength	-	-	16	36	41
Location of University	1	2	20	29	41
Duration	-	3	15	37	38
Reputation of university	1	0	20	38	34
Recommendation from alumni	3	7	32	28	23
Parents influence/choice	10	10	36	21	16
Peers factor	5	10	36	26	16

Figure 1 below illustrated the percentage of the 10 factors that influence students' decision, with tuition fees (18%), campus facility (13%), career interest (12%), academic strength (11%), location of university (11%), duration (11%), reputation of university (9%), recommendation from alumni (6%), parents influence (5%) and peers factor (4%).

The tuition fee is a primary consideration for many students when choosing a tertiary education institution. Approximately, the tuition fees of technical degrees in Malaysia range from RM5000 to RM15000 per year for public universities and colleges, whereas the tuition fees for private universities and colleges are at a higher range from RM15,000 to RM30,000 per year. The fee varies depending on the higher institution, program of study, duration of the program, and additional fees for facilities and resources. It is learned that high tuition fees can deter students from pursuing education in certain technical fields, especially for those from low-income backgrounds. According to the Household Income and Basic Amenities Survey Report 2020 conducted by the Department of Statistics Malaysia (DOSM), 20% of households from M40 groups have reclassified as B40 households as result of the Covid-19 pandemic.

High-quality campus facilities create a conducive atmosphere for learning, personal growth, and holistic development. These facilities include a wide range of physical resources, services, and amenities offered by educational institutions. These include

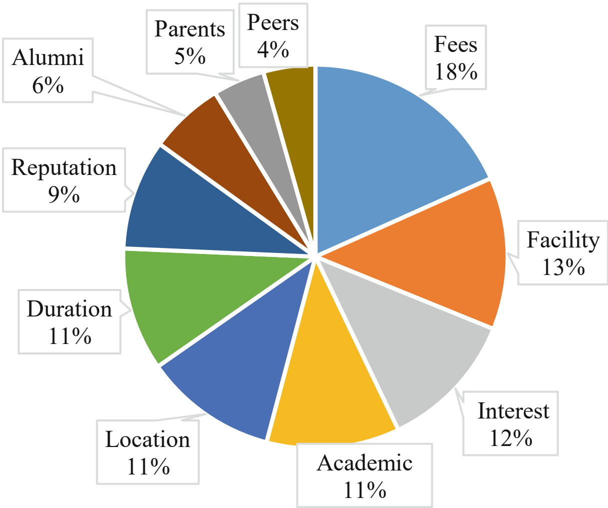

Fig. 1. Importance of the studied factors in choosing technical degree

well-equipped and up-to-date lecture halls, libraries, laboratories, and technology infrastructures, as well as accommodation, dining, sports, and recreational facilities. These amenities are important to support learning, research, and practical training needs while ensuring physical well-being and a healthy lifestyle that provides opportunities for social interactions. Therefore, the students voted facility among the most important factors in this study.

In response to the high cost of living, the majority of the students consider the job prospects and market demand for specific careers when making their decision. As vibrant developments in cloud computing, cybersecurity, and artificial intelligence continue, the job market is constantly shifting, thus shifting students' interest too. According to MOHE's Malaysia Education Blueprint (Higher Education), there will be an increase in demand for an additional 1.3 million TVET workers by 2020 in the 12 National Key Economic Areas (NKEA) identified under the government's Economic Transformation Programme (ETP). While academic strength does not guarantee employment, certain industries may prioritize academic performance when evaluating the candidate. Therefore, this may be the reason why the students found it is essential to balance academic capability and career's interest.

The students also give emphasis on the location of the university, duration and course structure offered for the program and reputation of the university. A good location can influence the accessibility to internship, industry and job prospects as well as cost of living while pursuing tertiary education. On the other hand, a reputable university can enhance the student's credentials, which increases chances for employability. The duration also matters as longer programs may require more commitment and financial investment. Work-based learning within the course structure is appealing to students who seek hand-on experience of their learning. The work-based learning is also perceived to offer better employability prospects. Additionally, students seek guidance from their alumni, parents, and peers in making well-informed decisions about their tertiary education course. However, interestingly the alumni recommendation is observed to play a more important role. This ensures a balance between external influences and their own individual preference.

5 Conclusion and Recommendations

B.Tech is one of the options for STEM education in higher learning institutions in Malaysia. It is typically offered as a three-year course. The Malaysian STEM education field is observing a declining number of interests among the current generation of students. The percentage of students enrolling in tertiary STEM education including B.Tech fails to meet the target ratio of 60:40 of science and technology vs arts. This issue needs to be addressed as STEM education is important towards a country's development. Hence, this study is conducted to determine the important factors influencing students' decision to pursue B.Tech. The top three reasons identified are tuition fees, campus facilities and career interest. Based on the findings, in order to increase the number of students enrolling in B.Tech requires collaborative effort among the higher learning institutions, government and the industry. Other than offering the courses at affordable cost, the students need to be exposed to the campus facilities and the career opportunities. Additionally, the government and private sector can contribute by providing scholarships and education loans for students pursuing technical education.

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Enhancing MSc by Coursework Offering Through the Industry Driven Program

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Abstract. The Master of Sciences (MSc) by coursework program faces challenges hindering its appeal to prospective learners, resulting in a decline in applicants. This paper explores strategies to enhance the program's attractiveness by integrating industry-driven elements. Addressing the financial constraint through increased accessibility to funding opportunities is crucial to attract a wider pool of candidates. Efforts to raise awareness of the value of a higher-level degree among employers and industries are vital to combat the prevailing lack of appreciation. Collaboration with industry partners can showcase the benefits and contributions that MSc graduates can bring to organizations, fostering motivation among individuals to pursue the program. Aligning the program content and learning experience with industry needs is essential. Incorporating industry certifications, industrial training, and project-based learning can provide practical experiences and industry-relevant skills to learners. The involvement of subject matter experts (SMEs) as co-teachers enhances the learning process, bridging the gap between academia and industry. Through these enhancements, the MSc by coursework program can address the challenges it faces. By providing financial assistance, raising awareness of the degree's value, and integrating industry-driven elements, the program can attract more applicants and align with industry demands. This transformation will equip learners with the necessary knowledge and skills for career advancement, making the program more appealing and relevant in the professional sphere.

Keywords: MSc by Coursework · Transformative program · Industry driven courses

1 Introduction

1.1 Challenges Faced by MSc by Coursework

The Masters by coursework program faces several challenges that contribute to a decline in the number of applicants. In general, limited availability of financial assistance poses a significant barrier for potential learners. Many individuals, despite their desire to pursue higher education, are unable to afford the tuition fees and associated expenses, especially when they already have on-going loans used for their undergraduates studies

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[1]. This financial constraint restricts access to the program, resulting in a smaller pool of candidates [2]. In addition, there is a prevailing lack of appreciation for the value of a higher-level degree in certain professional spheres. Some industries and employers may not recognize the benefits and potential contributions that individuals with a Master's degree can bring to their organizations. This lack of recognition diminishes the motivation for individuals to pursue this degree, further exacerbating the decline in takers.

Other than that, the content and learning experience offered in the program may not always align with industry needs. In order to boost their career prospects, individuals seek courses that provide practical, industry-relevant knowledge and skills [3]. If the Masters by coursework program fails to offer such content, learners may perceive it as less valuable in terms of enhancing their employability and advancing their careers. This misalignment between the program and industry demands becomes a deterrent for potential applicants [4].

In this study, one of the MSc by Coursework that is currently offered in the university is designed to be very niche, to cater the needs for specific area of drilling engineering. During the benchmarking studies, it was made to be known that the area of drilling engineering is very specific and engineers are encouraged to have more understanding about the whole process of drilling engineering. Unfortunately, such programs are not offered in the region and require high operation cost in delivering the program which might translate into higher tuition fees. In addition, drilling engineering knowledge are best shared by the practitioners despite the theory behind that could be learnt beforehand.

Hence, the program was then offered in a way that integrating the involvement of the industry players within the area as well as other curriculum enhancement to cater the needs while not jeopardizing the quality of the graduates and the requirement from the accreditation body. As a result, the objective of this approach is to enhance the practical skills and industry relevance of our learners through certification and a strong partnership with subject matter experts (SMEs) from the industry while cultivating lifelong learning and adaptability at the same time.

1.2 Theoretical Framework

The model of transformative learning in this context incorporates elements of Jack Mezirow's theory of transformative learning, combined with industry sharing which they have implement the long-life learning principles prepared for their staff members [5].

Jack Mezirow's theory suggests that transformative learning occurs when individuals critically reflect on their assumptions, beliefs, and perspectives, leading to a significant shift in their understanding of themselves and the world around them. It involves a deep examination of one's assumptions and the exploration of alternative perspectives and new ways of thinking.

The modules also include industry sharing, which involves the collaboration and knowledge exchange between staff members and industry professionals. This element enriches the learning experience by providing real-world insights, practical examples, and diverse perspectives from experienced individuals in the industry. The industry sharing sessions offer opportunities for the new learners to challenge their existing assumptions and expand their understanding of their field. Through this model, all students are encouraged to engage in deep reflection, question their assumptions, and explore new ways of thinking. They are exposed to a variety of perspectives through industry sharing, which helps them gain valuable insights and broaden their understanding of their work.

Jack Mezirow's theory of transformative learning is highly relevant in addressing the objectives of producing drilling engineering specialists with insights to articulate complex industry problems and solutions, as well as industry leaders with integrity towards sustainable development through continuous improvement and innovation. Mezirow's theory emphasizes the role of critical reflection and the examination of assumptions in promoting transformative learning [6]. Furthermore, Mezirow's theory recognizes the importance of perspective transformation and the integration of new knowledge and experiences. The industry sharing component in the long-life learning modules allows the learners to interact with industry professionals, gaining insights into real-world challenges, innovative solutions, and diverse perspectives. This interaction supports the integration of new knowledge and experiences, facilitating transformative learning and enhancing leaner's ability to articulate complex industry problems and propose innovative solutions.

2 Strategies

2.1 Collaborative Learning and Knowledge Exchange

One of the objectives of our program is to promote collaborative learning and knowledge exchange among our learners. To achieve this, we have established a strong partnership with SMEs from the industry. The SMEs are invited to co-deliver the program which also supported by other researches [7, 8]. This approach is expected to enrich the learning experience by bringing real-world perspectives and practical insights into the classroom. The students are freely encouraged to actively engage with the SMEs, participate in industry projects, and collaborate with their peers to share knowledge and experiences, fostering a collaborative learning environment.

On top of this, the SMEs also play a significant role in curriculum design to ensure alignment with industry needs. By actively participating in curriculum development, SMEs bring their extensive industry knowledge and expertise to shape the program's content [9]. Their involvement helps us bridge the gap between academia and industry, ensuring that our learners acquire the most relevant and up-to-date skills. SMEs' insights guide us in incorporating industry trends, practical applications, and real-world challenges into the curriculum. This collaborative approach enhances the program's industry relevance, providing learners with a comprehensive and tailored learning experience that prepares them for successful careers in the field, particularly drilling engineering.

2.2 Bridging Theories and Practices

In our pursuit to enhance the practical skills and industry relevance of our learners, the program offers unique opportunities to go beyond cognitive knowledge. Everybody recognizes the importance of practical application and experiential learning [10–12]. To achieve this, two vital components are integrate; the International Well Control Forum (IWCF) Level 4 certification in drilling engineering and land rig training.

The IWCF Level 4 certification equips learners with the necessary knowledge and expertise to excel in supervisory roles, specifically in well control [13]. This certification ensures the graduates possess the industry-recognized skills and competencies required to navigate critical decision-making processes. By including this certification, it is the aim to enhance learners' practical capabilities and improve their prospects in the job market.

Additionally, the land rig training immerses learners in a hands-on experience that surpasses traditional classroom learning [14]. By utilizing cutting-edge simulators and providing access to real drilling rig environments, learners have the unique opportunity to apply their knowledge, build skills, and gain an authentic feel for the working conditions in the field. This practical exposure bridges the gap between theory and practice, preparing learners to tackle real-world challenges confidently and competently. By combining cognitive understanding with immersive experiences, we ensure that our graduates are not only equipped with the necessary theoretical foundation but also possess the practical skills and industry relevance to excel in their careers.

2.3 Alternative Assessment

The alternative assessment delivered through the IWCF, and land rig training offers a unique and practical approach to evaluating learners' knowledge and skills. Unlike traditional assessments that solely rely on written exams, this alternative assessment goes beyond cognitive understanding and assesses learners' ability to apply their knowledge in real-world scenarios. The IWCF certification involves practical assessments that simulate well control situations, allowing learners to showcase their decision-making skills and demonstrate their competence in supervisory roles. Similarly, the land rig training provides hands-on experiences using simulators and real drilling rig environments, enabling learners to apply their knowledge and skills in a realistic setting. This alternative assessment methodology not only enhances the authenticity of the evaluation process but also ensures that learners are better prepared for the industry, as they have demonstrated their practical abilities alongside their theoretical understanding [15].

3 Results and Discussion

3.1 Outcomes

The initiative of incorporating the IWCF certification, land-rig training, and co-delivery with SMEs aligns well with the learning outcomes of the program. The program's educational objectives of producing drilling engineering specialists with insights to articulate complex industry problems and solutions are supported by these initiatives. The inclusion of the IWCF certification demonstrates a commitment to equipping learners with industry-specific knowledge and expertise. This certification enhances their understanding of well control and decision-making in drilling engineering, which aligns directly with the objective of producing specialists who can articulate complex industry problems and solutions. Similarly, the land-rig training provides learners with a real-world experience, allowing them to apply theoretical knowledge in a practical setting. This hands-on training fosters a deeper under-standing of the drilling process and equips learners with the skills necessary to address industry challenges. It contributes to the development of industry leaders who can articulate complex problems and propose innovative solutions. Figures 1 and 2 show the feedbacks on the IWCF certification and SME involvement, where the students are satisfied and rated with 4.8 out of 5. Total of 20 students have answered the survey.

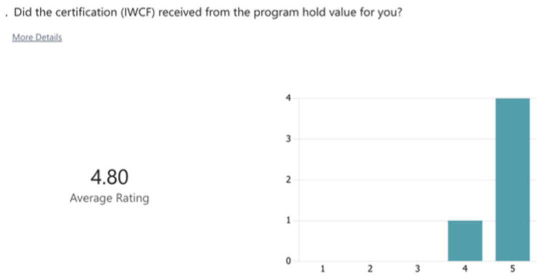

Fig. 1. Feedback on IWCF

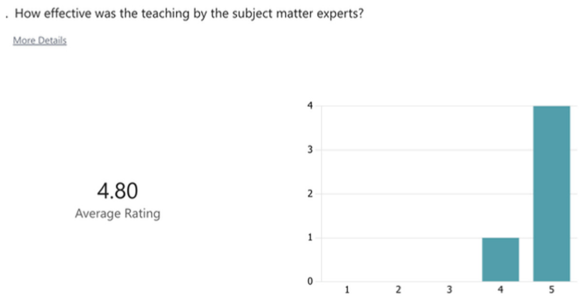

Fig. 2. Feedback on SMEs involvement

Moreover, the co-delivery of the program with SMEs enriches the learning experience by incorporating real-world perspectives and practical insights. Learners benefit from the expertise and experiences of industry professionals, which enhances their ability to understand and address industry problems. This collaboration supports the program's objective of producing industry leaders with integrity towards sustainable development through continuous improvement and innovation.

On top of these initiatives, the assessment taken are not only the general in-class assessment, but the students are also assessed based on their understanding after the land-rig training and certification modules.

Furthermore, by addressing the cognitive, psychomotor, and affective domains, the transformative teaching project ensures that students are actively engaged in meaningful learning experiences. It facilitates cognitive development through critical thinking and problem-solving, enhances psychomotor skills through hands-on activities, and nurtures the affective domain by fostering motivation, personal growth, and a positive learning environment. The incorporation of industry sharing sessions and collaborative learning enables students to gain diverse perspectives, explore alternative viewpoints, and develop higher-order thinking skills. Additionally, the inclusion of experiential learning through simulations and land-rig training allows students to apply their knowledge in practical scenarios, fostering cognitive development and enhancing their problem-solving abilities. The adoption of these approaches engages students in reflective exercises, discussions, and problem-solving activities, which promote critical thinking and cognitive development. Figure 3 shows the feedbacks from the industry in evaluating the approach.

anonymous	Eagerness to learn
anonymous	Strengths = Eager to learn, Attentive, Inquisitive. Weaknesses = Lack of industry experience
anonymous	For most without any oil field experience or knowledge, I am surprised they quickly grasp most of the topics. Strength in calculation. Area for instructor to improve upon, niche concept of directional drilling.
anonymous	Students need to have pre-requisitr study. They are smart students,lesrning fast
anonymous	Sometimes they are very quiet and don't speak up.
anonymous	Sufficient enough
anonymous	Strength in diversity of the students
anonymous	strengths is students involvement during class to know more and details every steps operation sequence. The weaknes sutedents need to know the basics of every steps

Fig. 3. Feedback from SMEs

The transformative learning also provides students with hands-on experiences through the simulation project, land-rig training, and certification activities. These experiences allow students to develop and refine their psychomotor skills, such as technical competence in drilling engineering and well control decision-making. By engaging in simulations and practical exercises, students have the opportunity to apply theoretical knowledge in real-world contexts, improving their psychomotor abilities and enhancing their confidence in performing industry-related tasks.

In addition, the approaches of embedding such strategies have also fostered the affective domain of learning. It promotes emotional engagement, motivation, and personal growth through various elements. The inclusion of industry sharing sessions with SMEs enhances students' affective experiences by fostering a sense of inspiration and aspiration. Interacting with industry professionals who share their expertise and experiences can motivate students to excel in their studies and future careers. Reflective exercises and ongoing feedback provide opportunities for self-reflection and personal growth, supporting students' affective development. The collaborative learning environment encourages teamwork, empathy, and the cultivation of positive interpersonal relationships, contributing to the affective domain by fostering a sense of belonging and community.Alumni testimonials highlight several factors that have positively influenced students' motivation throughout the program as given in Fig. 4.

The sessions with SMEs from the industry, where real case scenarios and applications are discussed, have been particularly valuable. This engagement with industry professionals provides students with a direct connection between the content they are learning and its practical application in real-world industrial contexts. By bridging the gap between theory and practice, these sessions enhance students' motivation by demonstrating the relevance and importance of the knowledge and skills they are acquiring. The positive feedback from industry professionals, alumni, and SMEs indicates that the project has effectively prepared students for the drilling industry, resulting in industry recognition, employment prospects for graduates, and requests for a more flexible program from industry stakeholders. Furthermore, the alumni feedback highlights the value of the IWCF certification, which is highly sought after by the industry. The inclusion of this certification in the program not only enhances students' marketability and employability but also increases their motivation to excel in the program and acquire the certification. The recognition that lecturers were sought from within the industry further enhances the program's credibility and authenticity, contributing to students' motivation by providing them with practical and in-depth learning experiences facilitated by industry experts.

I had its of fun. Got the opportunity to meet face to face with the SMEs that taught us virtually in January 2022 semester. Not only that, we managed to chat with our fellow seniors and ask about their experiences
There is no clear way forward for graduate to be involve in drilling engineering
MSc in Drilling Eng itself, I think is a great program. One additional subject (that was not covered) that can be added is rig-platform interface for offshore shallow water wells
Good stepping stone to join the industry
Good Program in overall
Back then program was not systematic because some learnings or subject were repeated in other courses. This make us felt that the teachings were redundant. Theoretical subjects like fluids mechanics were hardly related to real drilling problems. It was too theoretical. There were no teachings of engineering software like landmark applications and drillbench to students. Students lack of operational knowledge because the course didn't really expose stuff myself to how real drilling operations.
The program is tremendously planned out and executed. Even though the session was done fully remote, it doesn't completely hinder the two way communication between the students and lecturers. The structure of the program, the modules and the lecturers were also adept and willing to answer all our curious questions.
Excellent
Well thought course with excellent real world learning scenarios
Excellent program. Recommended.

Fig. 4. Feedback from Alumni

3.2 Benefits and Way Forward

One of the key achievements of this approach is measured when it has attracted annual sponsorships for the MSc by Coursework program, indicating that industry stake-holders recognize the value and relevance of the program. This allows more students to access and benefit from the program, promoting inclusivity and widening participation. The continuous involvement of SMEs in the program has proven beneficial in terms of time-saving for students. By leveraging the expertise of industry professionals, students gain direct access to practical knowledge, real-world scenarios, and industry insights. This accelerates their learning process, enabling them to acquire skills and competencies more efficiently. The SMEs' contributions facilitate a bridge between academic theory and industry practice, allowing students to quickly grasp the practical applications of their learning.

The program's success is evidenced by the increasing number of international students enrolling in the MSc by Coursework program. This indicates the program's growing reputation and appeal, attracting students from around the world. The involvement of stakeholders, such as industry professionals, SMEs, and sponsors, further highlights the program's strong engagement with key industry players. Their active participation demonstrates their recognition of the program's value and their commitment to shaping the next generation of drilling engineering specialists. The latest enrolment of 20% international student from total number of students has really showed the attractiveness of the program from the world perspective.

Additionally, the program's uniqueness within the region enhances stakeholder involvement. Being known as one of the unique programs offered in the region distinguishes it from other educational offerings, making it an attractive choice for prospective students and industry partners. The program's distinctive features, such as the integration of IWCF certification, hands-on land-rig training, and collaboration with SMEs, create a compelling value proposition that sets it apart from similar programs in the region.

With the significant advantages observed through this approach, it is also good to expand the implementation to other area. The approach of incorporating industry engagement, hands-on learning, SMEs, and practical applications can be applied to various fields of learning beyond drilling engineering. The key is to identify the specific industry-related knowledge and skills relevant to the field and integrate them into the teaching and learning process. For example, in fields like healthcare, business, or technology, industry professionals can be invited as guest speakers or mentors, real-world simulations and case studies can be utilized, and certifications or practical experiences can be incorporated to enhance students' learning and motivation.

Other than that, the above approach can also be applied within the institution across different departments or disciplines. Many institutions recognize the value of connecting academic learning with industry practices. Faculty members and instructors can collaborate with industry experts to develop curriculum content, invite guest speakers from relevant industries, and create opportunities for hands-on experiences. This approach helps students understand the practical applications of their academic knowledge and fosters their motivation and engagement. Furthermore, institutional partnerships and collaborations with local businesses or organizations can provide students with real-world projects and internships, further enhancing their learning experiences.

4 Conclusion

Overall, this transformative teaching project has positively impacted students' motivation. The feedback from alumni emphasizes the value of engaging with SMEs, hands-on learning, the inclusion of industry-relevant certifications, and the integration of real-world scenarios. These factors collectively contribute to students' motivation by establishing the relevance of their learning, providing practical experiences, and creating a sense of connection to the industry.

The approach can extend beyond the institution by establishing partnerships with external organizations, businesses, or industries. This can involve internships, industry-sponsored projects, or apprenticeship programs that provide students with real-world exposure and practical experiences. By connecting students with industry professionals and experts, outside of the institution, students can gain insights into the current industry practices, develop industry-relevant skills, and foster their motivation. Such collaborations can also provide opportunities for students to apply their academic learning in solving real-world problems and contribute to the development of industry-relevant solutions.

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Exploring Students' Perspectives on the Support Needed for Open and Distance Learning (ODL) Success: A Comprehensive Survey Study

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Abstract. Open and Distance Learning (ODL) is defined as an academic delivery approach that focuses on opening the opportunity to education and training provision, freeing learners from the constraints of time and place and offering flexible learning opportunities to individual and groups of learners by UNESCO. This is a rapid growing trend in the education industry. In contrast, the withdraw rate is also in an increasing trend. The present study investigates the support needed in ODL study from students' perspective by conducting survey. The success factors in ODL study were compiled. The correlation between their background with these factors and how the University can support them in improving the students' success was concluded.

Keywords: Open and Distance Learning (ODL) · Survey · Success factor

1 Introduction

The Malaysian Qualifications Agency defines Open and Distance Learning (ODL) as the provision of flexible educational opportunities that offer various means of access and multiple approaches to acquiring knowledge [1]. Furthermore, courses provided through Open and Distance Learning (ODL) are anticipated to be accessible at any location, at any time, and through any means, typically devoid of restrictions related to time and physical location. Particularly considering the pandemic, adaptability has emerged as a pivotal factor in drawing interest toward ODL [2].

As summarized by Risenga [3], the concepts of success and failure are categorized into two distinctive attributes i.e., the exogenous attributes, which fall under the institutional realm of control and are beyond the student's influence, as well as the indigenous attributes, which are outside the scope of institutional control. External factors encompass tasks associated with registration, course planning, delivery, assessments, and student support activities. In contrast, internal factors pertain to students' cognitive capabilities in understanding course materials and effectively organizing and completing their studies. Domestic studies were performed by a group of researchers from UiTM, Kedah. As reported by Zaihuddin et. al [4], students often encounter challenges

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stemming from factors such as limited internet coverage, insufficient training in communication platforms, overwhelming assignment loads, and disruptions in home-based learning. Concurrently, Z. Khairuddin et. Al [5] conducted a study assessing students' preparedness for Open and Distance Learning (ODL), encompassing six key aspects including the technology availability, technology utilization, self-confidence, acceptance, self-directed learning, and training. In addition to UiTM's research, Wawasan Open University [6] has also outlined a range of potential difficulties faced by ODL students, including adaptability issues, feelings of isolation, procrastination tendencies, thoughts of quitting, motivational shortcomings, inadequate support, and a lack of feedback from instructors, among others. The present study investigates the support needed in ODL study from students' perspective by conducting survey.

2 Methodology

To obtain comprehensive perspectives from students, our research methodology incorporates surveys. The data-gathering procedure encompasses a diverse student population, including different groups of potential students, present students, and alumni.

2.1 Respondent Selection

This study focuses on the respondents from the three key categories i.e., potential students, present students, and alumni. This diversified approach ensures that the study obtain a comprehensive perspective spanning different stages of a student's academic journey.

2.2 Survey Questions Design

The methodology for assessing the attributes of success factors within the onboarding framework employed a survey-based approach. A structured questionnaire was developed with specific questions focused on six key areas including being directed, maintaining focus, receiving nurturing support, active engagement, fostering connections, and feeling valued within the onboarding process. The survey was administered to a representative sample of participants.

2.3 Survey Data Collection

The primary method involved administering surveys to a large group of students. The survey was designed to capture a wide range of perspectives and opinions regarding factors influencing their academic success. The respondents will represent a diverse cross-section of the student population, providing a broad understanding of prevailing issues and concerns.

2.4 Data Analysis

Through the analysis of the survey responses, the present paper was identifying factors that significantly influence student success. Additionally, the present study explored the potential correlations between students' backgrounds and these influencing factors. Ultimately, the study aim to draw conclusions that can inform strategies and initiatives to enhance student success at the university.

3 Results and Discussion

In the following section, the present paper delves into the results and discussions derived from the methodology for assessing success factors. Through a structured survey, six pivotal areas including being directed (D), maintaining focus (F), receiving nurturing (N) support, active engagement (E), fostering connections (C), and feeling valued (V) were investigated. The analysis of these findings offers valuable insights into the dynamics of the onboarding process and sheds light on the attributes that play a significant role in fostering success. The following discussions will provide a deeper understanding of the implications of these results.

3.1 Respondent Demography

The study's respondent demography is notably diverse, encompassing a range of employment statuses and industry backgrounds, as illustrated in Figs. 1 and 2. A majority, 72%, represent permanent staff, underlining a strong presence of individuals with established careers. Additionally, 12% are contract staff, and 8% identify as self-employed or currently unemployed, contributing valuable insights from varying employment perspectives. Industry-wise, 9 out of 24 participants hail from the oil and gas sector, offering sector-specific viewpoints. Furthermore, our respondents span different stages of their academic and professional journeys: 11 are prospective students, 9 are current students, and 5 are alumni. This multi-faceted demography ensures a comprehensive exploration of success factors within the onboarding framework, with insights rooted in diverse backgrounds and experiences.

3.2 Survey Data Analysis

This paper utilized SPSS, the Statistical Package for the Social Sciences, to analyze the survey data. SPSS is a versatile tool known for its ability to process and extract valuable insights from complex datasets, allowing us to draw meaningful conclusions based on our research findings.

3.3 Normality Test

In the analysis of the survey data, a normality test was employed to assess the distribution of responses across all attributes, as tabulated in Fig. 3. The test results showed that the p-value exceeded the significance threshold of 0.05, signifying a lack of statistical

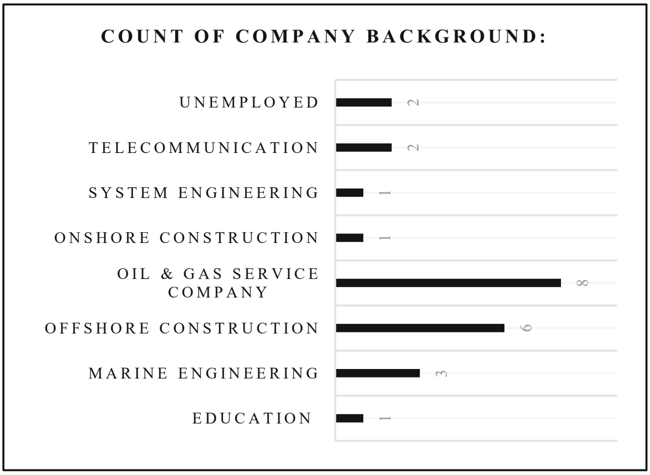

Fig. 1. Count of respondent by company background

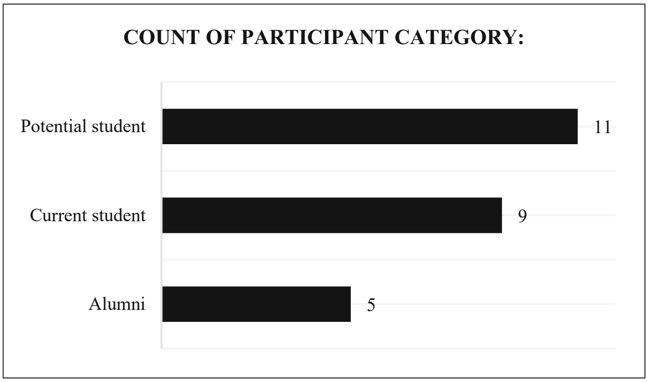

Fig. 2. Count of respondent by participant category

significance in the deviation from a normal distribution. This outcome suggests that all the attributes within the survey data exhibit a normal distribution, which is a fundamental assumption for many statistical analyses. Therefore, the data can be deemed to meet the normality assumption, providing a solid foundation for subsequent statistical inferences and analyses.

3.4 Descriptive Statistics

The descriptive statistics analysis reveals interesting insights regarding the attributes (D, F, N, C, and V) within our survey, as tabulated in Fig. 4. A notable trend emerges, as most respondents express agreement with these attributes. This suggests that most participants find the onboarding process to be directed, focused, nurtured, connected, and that they feel valued within it. Furthermore, for attribute (E), the analysis indicates

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D	.228	24	.002	.933	24	.112
F	.157	24	.128	.933	24	.111
N	.130	24	.200*	.959	24	.427
E	.134	24	.200*	.955	24	.352
C	.183	24	.036	.935	24	.124
V	.163	24	.100	.940	24	.160

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Fig. 3. Normality test outcome

an even more positive sentiment, with the majority of respondents strongly agreeing. This suggests a particularly high level of engagement within the onboarding framework. These findings collectively underscore the effectiveness of the onboarding process in aligning with the expectations and needs of the participants, ultimately contributing to a favorable experience.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
D	24	3.10	5.00	4 3.9792	.51159
F	24	2.88	5.00	5 3.8594	.60040
N	24	3.13	5.00	2 4.2083	.45245
C	24	2.60	5.00	6 3.7833	.56234
E	24	3.00	5.00	1 4.2731	.47365
V	24	3.00	5.00	3 4.0333	.50619
Valid N (listwise)	24				

1 – Engaged
2 – Nurtured
3 – Valued
4 – Directed
5 – Focused
6 – Connected

Fig. 4. Descriptive statistics outcome

3.5 Reliability Analysis

Reliability analysis plays a crucial role in assessing the trustworthiness of survey questions and the consistency of the data they yield. In this study, we utilized Cronbach's Alpha, a well-established measure of internal consistency. The obtained Cronbach's Alpha value of 0.952 for the designated questions signifies a remarkably high level of reliability, as stated in Fig. 5. This result surpasses the commonly accepted minimum threshold of 0.70, as outlined by Cronbach and Shapiro [7], signifying that all the questions within our survey exhibit strong internal consistency. This robust reliability analysis enhances our confidence in the accuracy and repeatability of the data collected, underscoring the validity of our survey instrument for further research and analysis.

3.6 Correlation Analysis

Figure 6 tabulated the correlation analysis outcome. Correlation analysis is a statistical method employed to examine the presence and strength of relationships between different

Reliability Statistics

Cronbach's Alpha	N of Items
.952	45

Fig. 5. Reliability statistics outcome

attributes or variables. In this context, a significant relationship is typically indicated when the p-value (Sig. 2-tailed) is less than 0.05, suggesting that the attributes in question are indeed significantly related. However, it's important to note that not all attributes necessarily exhibit significant correlations with one another. For instance, in the analysis, attribute E was found to have an insignificant relationship with attribute C, while attribute C showed no significant relationship with attributes D and E. These findings help in understanding the complex web of connections or the lack thereof among the attributes under investigation, providing valuable insights into the dynamics of the studied factors.

Correlations

			D	F	N	E	C	V
Spearman's rho	D	Correlation Coefficient	1.000	.797**	.538**	.645**	.343	.603**
		Sig. (2-tailed)	.	.000	.007	.001	.101	.002
		N	24	24	24	24	24	24
	F	Correlation Coefficient	.797**	1.000	.477*	.469*	.524**	.640**
		Sig. (2-tailed)	.000	.	.018	.021	.009	.001
		N	24	24	24	24	24	24
	N	Correlation Coefficient	.538**	.477*	1.000	.621**	.312	.516**
		Sig. (2-tailed)	.007	.018	.	.001	.138	.010
		N	24	24	24	24	24	24
	E	Correlation Coefficient	.645**	.469*	.621**	1.000	.340	.603**
		Sig. (2-tailed)	.001	.021	.001	.	.105	.002
		N	24	24	24	24	24	24
	C	Correlation Coefficient	.343	.524**	.312	.340	1.000	.645**
		Sig. (2-tailed)	.101	.009	.138	.105	.	.001
		N	24	24	24	24	24	24
	V	Correlation Coefficient	.603**	.640**	.516**	.603**	.645**	1.000
		Sig. (2-tailed)	.002	.001	.010	.002	.001	.
		N	24	24	24	24	24	24

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

*. Correlation is significant at the 0.05 level (2-tailed).

Fig. 6. The correlation analysis outcome

4 Conclusion

In conclusion, the study has identified and thoroughly analyzed six key attributes within the onboarding framework. The survey results have revealed a notable deficiency in the aspect of "connectedness" during the current onboarding process. Furthermore, our analysis has demonstrated a strong association between "connectedness," "directedness," and "engagement," suggesting that these three attributes are pivotal factors influencing students' experiences throughout their Open and Distance Learning (ODL) journey. Therefore, it is imperative to prioritize the enhancement of these specific attributes to elevate the effectiveness of our existing onboarding procedures. This improvement endeavor should concentrate on fostering a sense of connection among students, enabling them to feel directed and engaged in their ODL experiences. The responsibility for implementing these improvements extends across all supporting departments and faculty members. By collectively contributing to the enhancement of "connectedness," "directedness," and "engagement," it can be assured that the continued success and quality of the ODL program, ultimately providing a more enriching and fulfilling educational journey for ODL students.

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Implementing DT Methods in ICT Courses: UNITEN Experiences

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Abstract. This paper describes the pilot project of implementing Design Thinking (DT) method in the teaching and learning of selected Information and Communications Technologies (ICT) courses in a private university in Malaysia specifically Universiti Tenaga Nasional (UNITEN). It is a collaborative three-year project between UNITEN and eleven higher learning institutions from six other countries. This project focuses on modernizing ICT education with the introduction of DT as its teaching and learning method. The project aims to enhance higher education capacity in ICT across Asia, harness students' innovation potential and enable them to implement their ideas. It involves seven lecturers teaching eleven ICT courses with 771 undergraduates' involvement in a duration of four semesters. The paper explains the process of the implementation from identification of a course to expert evaluation.

Keywords: DT Method · ICT Courses · Undergraduate Students

1 Introduction

The rapid growth of the Malaysian ICT sector, driven by industry demands and economic transformation, necessitates the development of ICT education that fosters students' innovation skills for creative problem-solving [1, 2]. Integration of ICT in teaching has reduced research time, enhanced instructor-student communication, and promoted independent study, research, exploration, and problem-solving [3]. Design Thinking (DT), as an iterative, human-centred approach to problem-solving, aligns with Education 4.0 [4].

To address the need for creative and innovative graduates, incorporating DT into ICT education is vital [5]. Despite Malaysia's earlier interest in developing DT through Genovasi Malaysia in 2012, there remains a gap in equipping instructors with both ICT knowledge and DT skills [6]. The existing ICT programs often lack time for teaching critical job-seeking skills [2].

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To produce job-ready graduates with creative and innovative skills, a significant overhaul of ICT teaching and learning is imperative [7]. Instructors' competencies are critical for transferring innovative skills through ICT knowledge [8]. The integration of DT into ICT courses poses an additional challenge for instructors [4]. Currently, there is no systematic approach to introducing DT into Malaysian higher education institutions.

2 Objectives

This research aims to assess the current state of creativity and innovation in ICT education, especially in response to findings indicating limited creative thinking among teachers. The primary objective is to introduce a systematic methodology that fosters creative thinking, problem-solving, and innovation in the teaching and learning process, with a focus on enhancing the quality of ICT instruction. The central goal is to promote creativity and innovation among undergraduate students, recognizing the demands of the future job market and Industry 4.0. The project seeks to systematically integrate DT into the curriculum to consistently instil critical and creative thinking skills across ICT courses.

Instructors received DT training and workshop to effectively integrate it into their teaching methods. This training covered the principles, tools, and techniques of DT, as well as how to apply it in the educational context of ICT courses. Robust evaluation mechanisms will assess the impact of DT on students' creativity, problem-solving abilities, and overall learning experiences. Collaboration and knowledge sharing will be essential when facilitated through a digital platform.

3 Method

3.1 Selection of Instructors/Courses (Identification of Pilot Instructors)

Identifying suitable pilot instructors is a crucial initial step. The first phase of this research involved identifying the ICT courses offered at the institution. To determine the suitability of these ICT courses for the integration of DT, the research involved assessing their learning objectives and associated assessment methods.

Following the assessment of course suitability for DT integration, instructors were invited to participate in an introductory workshop where they were introduced to DT principles and the ICT-INOV DT platform. Familiarity with the DT concept and confidence in implementing DT were assessed through self-assessment. This assessment provided insight into their perceived deficiencies in DT expertise. In addition, instructors were requested to develop plans for how they intended to integrate DT into their ICT courses. The comprehensiveness and alignment of these plans with DT principles were then evaluated. A lack of depth or clarity in their plans might suggest a gap in expertise. Instructors with over five years of experience in teaching ICT courses but lacking DT expertise were selected. They were committed to participating in the project for three years and received incentives for implementing DT in their ICT courses. As a result of this workshop, 11 instructors voluntarily registered themselves to be the pilot instructors. This participation includes 11 courses spanning from foundation, diploma, and degree levels.

3.2 Support Group (Engagement Sessions, Scaffolding, Helpdesk/One Stop Centre and Peer Evaluation)

Throughout the project, project members facilitated multiple engagement sessions with pilot instructors. These sessions served as a platform for instructors to share their plans, strategies, experiences, and challenges. Project members also provided guidance as scaffolders to help instructors understand DT principles and effectively use the designated ICT platform.

During these sessions, instructors evaluated and offered feedback on each other's work to ensure alignment with DT principles and course objectives. Peer reviewers could provide feedback on the presence or absence of DT elements. In essence, project members functioned as a comprehensive support hub, addressing both technical and non-technical issues encountered by instructors.

3.3 Training Series (DT Method, Implementation and Platform)

The project conducted a series of six instructional training sessions over two and a half years. The first session, held in June 2021, introduced the DT method as a teaching and learning strategy. As a pivotal step in the research process, a renowned expert in the field of DT was invited to lead and facilitate a workshop for pilot instructors. The session focused on the philosophy of DT and its practical implementation in course assessment methods. Its aim was to deepen instructors' understanding of DT principles and assess their mastery. The workshop provided comprehensive insights into the principles and practical applications of DT within the context of ICT education.

Subsequent sessions in July 2021 brought another expert in the field of DT to provide comprehensive insights into understanding DT tools and explore how to incorporate DT principles into the measurement and evaluation processes within their courses. The workshop aimed to offer a deep understanding of the theoretical underpinnings and pragmatic utilization of DT principles within the realm of ICT education.

The third session, held in March 2022, required instructors to incorporate DT principles into their course outlines, student activities, and class assessments. In July 2022, the fourth session provided instructors with a platform to share their experiences in implementing DT strategies with their students.

The fifth session in August 2022 oversaw student activity volume on the platform. The final session in April 2023 introduced a new digital tool (sketchpad) to enhance interactivity, enjoyment, and creativity in teaching and learning experiences.

The selection of Sketchpad as a tool is based on its user-friendly interface, which can be easily navigated by both instructors and students. The tool is designed to eliminate steep learning curves, allowing users to focus on content and creativity rather than struggling with technicalities. It offers a range of drawing and design tools, as well as features for saving, exporting, and collaborating. Sketchpad is also compatible with the existing technology infrastructure at the institution, making it possible to integrate it with the learning management system (LMS) or digital platforms used for the courses.

3.4 Use of the Platform (Institutional Level, National, Global)

The project's digital platform plays a pivotal role. It has been purpose-built with features that emphasize DT and guide instructors. It ensures adherence to DT principles and progression through phases.

The platform offers interactive student activities, enables sharing and collaboration with partners across six countries, and operates at multiple levels. Collaborating partners can access it for insights at https://ictinov.e-ce.uth.gr/#/.

3.5 Evaluation of Both Students and Instructors (DT Assessment, Survey, and Expert Evaluation)

To ensure teaching and learning quality, the project connects ICT courses with end-of-semester objectives, cross-referencing them with students' feedback. Additionally, two DT experts evaluated its implementation during an instructional session, enhancing the project's commitment to ICT education excellence.

4 Results

The implemented methodology at Universiti Tenaga Nasional (UNITEN) spanned four semesters, allowing for a comprehensive assessment of DT's impact on ICT courses (Fig. 1).

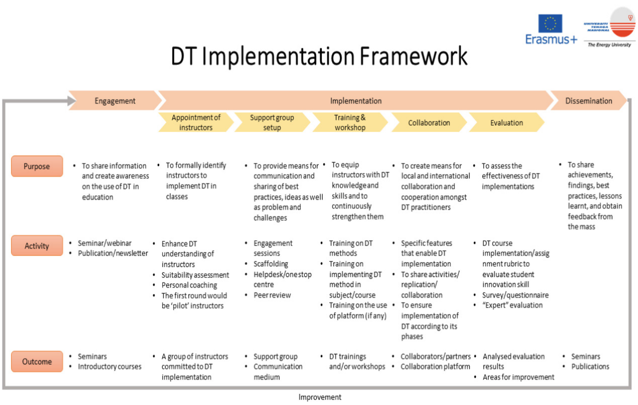

Fig. 1. Simplified DT Framework through UNITEN Experience

The results of the evaluation indicate a significant achievement in course outcomes for all participating ICT courses, exceeding an impressive 80%. Integrating DT into the ICT curriculum at UNITEN has proven highly effective, positively impacting learning objectives. Students overwhelmingly favour the DT methodology over traditional teaching methods. DT activities have equipped them with crucial creativity and innovation skills that enable them to creatively tackle real-life problems while developing practical, feasible solution.

Students' ability to apply creativity and innovation to real-world challenges is a vital learning outcome. The DT approach prompts students to create prototypes and proposals as solutions to authentic ICT course challenges. This hands-on experience not only fosters creativity but also encourages the formulation of practical, implementable solutions, emphasizing the importance of creativity and innovation skills for preparing students for Industry 4.0.

Despite these achievements, the results underscore the need for further training and exposure to develop competent instructors proficient in both ICT knowledge and DT skills. Continuous instructor development is essential, given their pivotal role in guiding students in applying DT methodologies [9].

The rationale behind the imperative for further training and exposure can be elucidated by considering the complexities and evolutionary nature of DT. Instructors must not only possess a foundational understanding but also be adept at adapting and applying DT principles in their specific ICT courses.

Specific areas within the project's phases may underscore the need for enhanced training and exposure:

4.1 Initial Training Exposure

While instructors were committed to the project and received initial training, the results may reveal aspects where this training proved inadequate in conveying the nuanced concepts of DT comprehensively. Instructors might have faced challenges in grasping the intricacies of DT, potentially hampering its effective integration into their teaching methodologies. These indications are based on several observations and findings from the project's implementation where there were mixed levels of DT implementation across different courses and instructors. Some instructors fully integrated DT into their teaching methods, while others partially applied it, and some did not implement DT techniques at all.

4.2 Course Implementation

During the course implementation phase, instructors were tasked with infusing DT principles into their teaching practices. If the results indicate discrepancies or difficulties in executing this integration, it suggests a requirement for supplementary training and support to facilitate a more seamless alignment of DT concepts with specific ICT course content. The presence of discrepancies in varying levels of DT implementation among the instructors suggests that some instructors may have encountered difficulties aligning DT concepts with their specific ICT course content.

4.3 Student Engagement

Variations in student engagement levels and the outcomes of DT activities may surface in the results. Instances where instructors and students did not fully embrace DT concepts or where the outcomes did not align with project expectations could signify the need for additional training to enhance the efficacy of DT-based pedagogical approaches.

5 Contribution

DT has been shown to enable students to create practical, sustainable, and cross-disciplinary solutions [10]. DT cultivates flexible thinking, enabling diverse approaches such as abductive, inductive, and deductive reasoning. DT practitioners generate multiple innovative alternatives and readily propose entirely novel solutions. [11]. Implementing DT method can lead to heightened innovation and creativity among students [12].

The project underscores the imperative to enhance awareness and knowledge of DT within the academic community, particularly at UNITEN. Expanding DT integration into more ICT courses can involve a larger number of students and instructors. Dissemination efforts encompass a variety of avenues, including seminars, webinars, forums, and both physical and online knowledge-sharing events. Wider dissemination can be facilitated through newsletters, articles, and academic journals.

Moreover, the project recommends institutionalization of DT across various courses, recognizing its versatility beyond ICT. Formal documentation of DT courses ensures accessibility for new instructors. Establishing support groups for DT instructors is pivotal, given the inherent challenges of implementing DT in academic teaching.

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Music Matters: The Role of Background Music in Improving Students' Attention and Learning Outcomes

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Abstract. This paper investigates the impact of background music on students' cognitive performance in the classroom environment, aiming to enhance attention and improve learning outcomes. The study conducted an experiment with 100 design students from MMU, randomly dividing them into treatment and control groups. The treatment group listened to background music genres such as Lo-fi and modern classical remix, while the control group experienced silence. The effects of background music on cognitive performance were analyzed and compared. The comprehensive literature review highlights the potential of background music to positively influence cognitive functioning and learning outcomes in specific contexts. The study employed a mixed-method research design, combining qualitative data from online open-ended question surveys and quantitative data from Likert scale questionnaires. The experiment utilized pre-test and post-test measurements, with participants allocated to controlled and treatment groups using a random sampling technique. Positive findings emerged from the analysis, indicating significant improvements in attention, concentration, focus, motivation, memory, and mood among students exposed to background music. However, the study acknowledges limitations such as the small sample size and specific research context, calling for further studies with larger and more diverse samples to enhance generalizability. These findings emphasize the potential of background music to positively impact cognitive performance and contribute to enhancing students' learning experiences.

Keywords: Background music · student attention · learning outcomes · cognitive performance · classroom environment · mixed-method research design

1 Introduction

In the modern classroom, students often struggle to maintain focus and attention, leading to potential obstacles in their learning process. A survey conducted by Johnson et al. [1] revealed that a significant number of students, up to 65%, Reported feeling distracted during classroom learning. This alarming statistic highlights the urgent need for effective strategies to enhance students' attention and improve their overall learning outcomes (Fig. 1).

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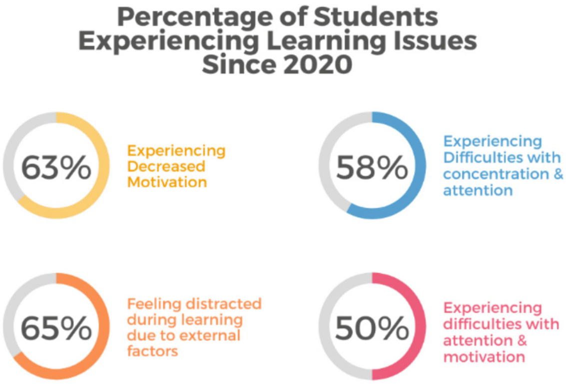

Fig. 1. Diagram on the percentage of students experiencing learning issues since 2020.

One potential solution that has gained attention in recent years is the incorporation of background music into the classroom environment. Background music has shown promise in influencing cognitive performance and creating a conducive learning atmosphere [16]. The aim of this study is to delve into the impact of background music on students' attention and learning outcomes, specifically within the context of the classroom. By examining the effects of background music on student engagement and academic performance, this research aims to provide valuable insights into the potential benefits and limitations of integrating background music as an educational tool [17]. Understanding how background music affects students' cognitive processes can contribute to the development of effective strategies for enhancing attention and optimizing learning outcomes. Through this investigation, we hope to shed light on the role of background music in shaping the classroom environment and facilitating students' educational experiences.

In the landscape of prior research, this study stands out by focusing on a distinct facet of the relationship between background music and cognitive performance. Unlike previous literature that largely examines the general impact of music, this study specifically targets design students. This novel approach seeks to unravel how background music uniquely influences the attention and learning outcomes of this specific group within an educational context. By honing in on design students, I acknowledge the inherent cognitive demands of their field, where creativity, critical thinking, and concentration intertwine. This tailored perspective allows me to delve into a previously unexplored territory, shedding light on how background music can be harnessed as a strategic tool to enhance attention and optimize learning experiences in this specialized demographic. My commitment to investigating the potential benefits of background music in the realm of design education sets this study apart from existing literature and contributes valuable insights to this evolving field.

2 Literature review

One theory of learning that is relatable and significant to your research is the Cognitive Load Theory. Proposed by Sweller, van Merrienboer, and Paas [1], the Cognitive Load Theory explores how the cognitive load imposed on learners during the learning process affects their ability to acquire and retain information. According to this theory, the human cognitive system has a limited capacity for processing information, and when this capacity is exceeded, learning becomes less effective. In the context of your research on the impact of background music on students' cognitive performance, the Cognitive Load Theory can provide valuable insights. The theory suggests that the presence of background music may influence the cognitive load experienced by students. If the background music adds an additional cognitive load, it could potentially hinder their ability to focus and process the educational content effectively. On the other hand, if the background music is carefully selected and designed to support the learning process, it may help reduce extraneous cognitive load and enhance students' attention and learning outcomes. By considering the principles of the Cognitive Load Theory, you can investigate how background music affects students' cognitive load, information processing, and attention in the classroom environment. This theory provides a framework for understanding the potential mechanisms behind the impact of background music on cognitive performance, allowing you to draw meaningful conclusions and provide practical recommendations for educators and learners alike (Fig. 2).

2.1 Cognitive Theory of Multimedia Learning by Mayer

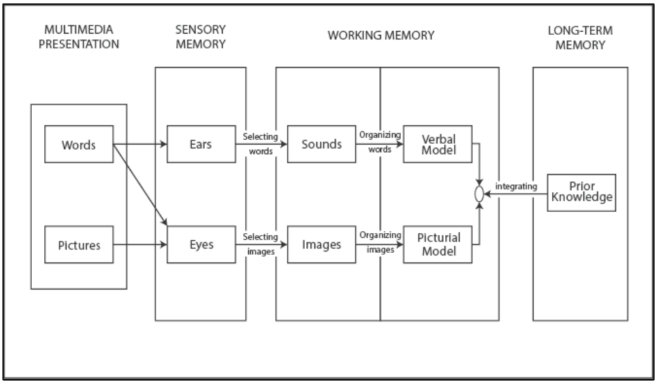

Fig. 2. Cognitive Theory of Multimedia Learning by Mayer

This model is based on the three assumptions primarily made by Mayer [2]:

a) Visual and auditory experiences and information is processed through separate and distinct information processing channels.
b) Each information processing channel is limited in its ability to process experience and information.
c) Processing experience and information in channels is an active process designed to construct coherent mental representations.

The Cognitive Theory of Multimedia Learning, developed by R. Mayer in 2001, focuses on how people process information in multimedia formats. It underscores using separate visual and auditory channels for effective learning. Key principles include the Dual Coding Principle (combining visual and auditory information), Modality Principle (essential information presented visually), Coherence Principle (eliminating extraneous information), and Redundancy Principle (minimizing redundant information). The Spatial Contiguity Principle highlights presenting related visuals and text together. Applying these principles enhances instructional design and learning outcomes.

2.2 The Effect of Adding Relevant Music and Sound Effects to an Audio-Only Narration

In recorded media presentations, the addition of music and sound effects has been explored as a means to enhance instructional narrations. A study conducted with college students (n = 143) aimed to compare the impact of music and sound effects to voice-only narration. Four groups of participants listened to a recorded short story and answered related questions. The control group received a voice-only narration, while the three treatment groups had their stories augmented with sound effects, music, or a combination of both. Statistical analysis revealed no significant differences in means between and within each group, indicating that the presence of music and sound effects in an audio-only presentation did not significantly affect learning outcomes [3].

2.3 The Effects of Classical Background Music on Moods and Concentration Levels

This action research study examined the impact of classical background music on third-grade students' moods and concentration during a six-week period in a suburban school. It investigated whether playing classical music during solo and group work could enhance students' mood and concentration. Data collection methods included pre- and post-surveys, student interviews, and observations, utilizing qualitative and quantitative approaches. The results showed that playing classical music improved student on-task behavior, creating a more comfortable and focused environment for projects. This suggests the effectiveness of using classical music as a classroom management strategy to enhance student focus and engagement [4].

2.4 The Impact of Music and Memory

Alzheimer's disease and related dementia pose significant challenges for older adults, including behavioral and psychological signs of dementia (BPSD) and concomitant medical disorders. Nonpharmacological therapies, such as personalized music and tablet engagement (PMATE) programs, have been shown to improve cognitive function, quality of life (QOL), and reduce BPSD. To assess the impact of PMATE programs in assisted living communities (ALCs), a study was conducted in six Wisconsin ALCs. The Music & Memories program, introduced in 2013, aims to enhance the lives of the elderly by providing personalized music experiences. The program utilizes digital music technology, customized playlists, and audio devices to evoke memories and improve quality of life [5].

2.5 Music-evoked Autobiographical Memories (MEAMs) in Alzheimer's Disease: Evidence for a Positivity Effect

This study aimed to examine the presence of the positivity effect in music-evoked autobiographical memories (MEAMs) among individuals with Alzheimer's disease (AD). The positivity effect refers to the preference for positive information over negative information in attention and memory, often observed in healthy aging. The study involved younger individuals, older adults, and adults with mild-to-moderate AD, who were asked to listen to familiar music and report any memories associated with the music. The findings shed light on the potential preservation of music-related memories in AD and their positive emotional impact [6].

2.6 Studies and Research on the Effects of Lo-Fi Music on Cognitive Performance

Kim and Kim conducted a study to investigate the effects of music on cognitive performance among office workers. The results revealed that listening to music, regardless of the genre (classical, K-pop, or lo-fi), had a significant positive impact on cognitive performance compared to the absence of music. The study suggested that incorporating music into the workplace environment can be beneficial for enhancing cognitive performance [7]. Pei et al. conducted a study examining the effects of lo-fi hip-hop music on sustained attention and academic performance in college students. The findings demonstrated that listening to lo-fi hip-hop music during a reading task led to significantly higher scores in sustained attention and academic performance compared to the absence of music. The study indicated that lo-fi hip-hop music could enhance cognitive performance in college students [8]. Yu investigated the effects of lo-fi music on cognitive performance in reading and writing tasks among high school students. The study found that listening to lo-fi mu-sic significantly improved performance in the reading task compared to white noise or the absence of sound. However, no significant differences were observed in the writing task. The research suggested that lo-fi music has the potential to enhance cognitive performance in specific tasks, although further investigation is required [9].

2.7 Benefits of Listening To Music

The practice of listening to music while studying or working is a widespread phenomenon, often attributed to various underlying motivations. Music's capability to establish a pleasurable and enjoyable ambiance can imbue tasks with a sense of vitality and engagement, transcending monotony [28]. It also functions as a motivating force, elevating our vigor and aiding in sustaining concentration. Additionally, background music has the aptitude to subdue external diversions, facilitating improved focus and heightened productivity [29]. Comprehending the motivations behind this prevalent practice holds profound implications. Unraveling the rationale behind individuals' inclination to incorporate music into their study routines offers valuable insights into its potential advantages [30]. This investigation into the reasons underpinning this practice affords a deeper comprehension of how background music might positively impact students' attentiveness and overall academic achievements, consequently illuminating a path for the formulation of more efficacious educational approaches (Fig. 3).

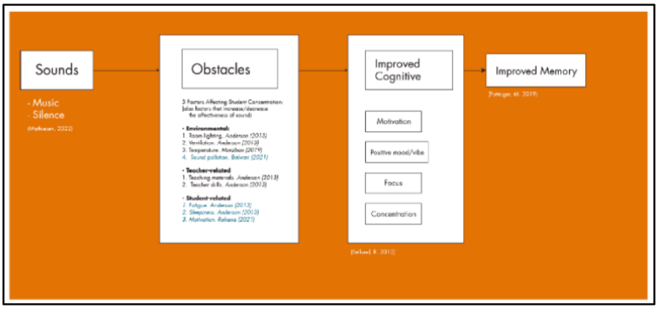

Fig. 3. Conceptual Framework of The Relationship between Sound and Cognitive Im-provements

3 Conceptual Framework

In this study, a conceptual framework was developed that explored the interplay of music, emotion, and cognition. The premise of the framework was that if music can positively affect human emotions, it may have the potential to redirect those emotions from obstacles and distractions, ultimately improving cognitive performance in terms of motivation, mood, focus, and concentration. The ultimate goal was to enhance memory performance [10]. To investigate this, two types of sounds were employed: music known for its impact on human emotions [11], and silence, which was utilized in a previous study examining the effects of diverse sound environments on mealtime experiences, food intake, evaluations, and responses to the sonic eating environment [11]. Obstacles, in the context of this research, refer to any factors that hinder students' concentration in the learning environment. These obstacles, including sound pollution, fatigue, sleepiness, and motivation, can determine the effectiveness of the sounds used in the experiment. Although obstacles can manifest in various forms, this study specifically focuses on these factors while categorizing them into three main areas: environmental, teacher-related, and student-related factors [12]. The aim of this research is to address these obstacles and mitigate their impact by utilizing a specific type of music known as Lo-fi hip hop or Chill hop [13]. This genre of music, which is primarily disseminated through the internet, is designed to stimulate cognitive processes, and enhance the learning and studying experience. Notably, there is a dearth of academic research on this particular genre [14].

Within the scope of improving cognitive performance, the study seeks to stimulate students' motivation, mood, focus, and concentration, with the ultimate objective of investigating whether these enhancements result in improved memory outcomes by the conclusion of the experiment [15]. Choi and Kim conducted a study with 40 students in an EFL (English as a foreign language) classroom. They found that students who listened to classical music while doing a reading comprehension task performed better than students who did not listen to music. However, there was no difference in performance between students who listened to classical music and students who listened to pop music [18]. This research shows that music does have a significant impact on students performing comprehension tasks.

In this study, we explore how background music influences student attention during lectures. Research suggests that background music's impact on cognitive processes varies; it can enhance creativity but impair reading comprehension and memory [20]. Background music may improve comprehension for high working memory capacity learners but not for those with low capacity [21]. Additionally, it can boost task-focus by reducing mind-wandering during sustained attention tasks [22]. The effects depend on lecture content, learner characteristics, and music type. This experiment assesses background music's role in overcoming distractions and improving student attention during lectures. We measure this by comparing pre-test and post-test scores in both treatment and control groups to evaluate changes in learning outcomes (Fig. 4).

Fig. 4. Diagram on the student samples and music genres used for treatment group

4 Methodology

In this study, an experiment was conducted to examine the effects of background music on cognitive performance among a sample of 100 design students from MMU. The participants were randomly assigned to two groups: the treatment group and the control group. The treatment group was exposed to background music from genres such as Lo-fi and modern classical remix, with a tempo ranging from 60 to 90 beats per minute (bpm) [20]. On the other hand, the control group experienced a simulated silent environment, like a normal classroom setting [11]. My findings underscore the significance of music genre and tempo in augmenting students' attention. Specifically, for this study, we selected Lo-Fi music and a modern classical music remix [25]. In the realm of slower tempo music, the recommended range of 60 to 80 BPM (beats per minute) proved conducive to studying [24]. This genre exudes a calming and soothing ambiance, fostering relaxation and heightened focus during study sessions [23]. On the slightly brisker end, tempo variations of 80 to 100 BPM offer a moderate pace that upholds a gentle and uplifting backdrop, ideal for sustaining concentration and engaging in cognitive tasks [24]. It's vital to acknowledge the variance in individual preferences, as some students may gravitate towards specific tempos that align with their study environment [27]. Central to this is the art of selecting music that harmonizes with the task at hand, striking a balance that avoids undue distraction. My research accentuates the efficacy of instrumental music with slower tempos for tasks demanding unwavering attention, while quicker-paced melodies prove advantageous for exercises necessitating swift thinking and problem-solving. Armed with this insightful understanding, educators can wield background music strategically, cultivating an optimal learning atmosphere.

This experiment aimed to assess whether background music enhances students' cognitive performance and learning outcomes. By comparing results between treatment and control groups, the study examined music's impact on cognitive abilities and academic performance. Participants in both groups completed cognitive tasks, such as memory tests, problem-solving exercises, or creative thinking tasks. Tasks assessed attention, information processing, and problem-solving skills. To ensure validity, carefully selected background music conducive to concentration was played for the treatment group, with controlled tempo [19]. Participants received standardized instructions and equal task time. Data collection included accuracy, response time, and task completion. Additionally, questionnaires or interviews captured participants' subjective experiences and perceptions of background music's impact on cognitive performance, providing deeper insights (Fig. 5).

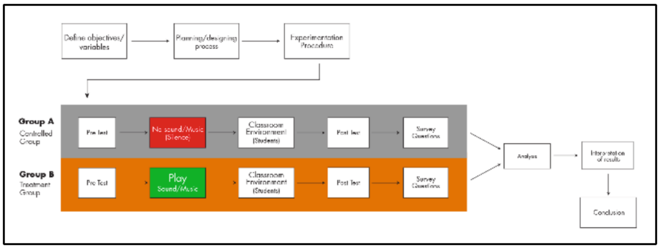

Fig. 5. Experimental Design Diagram on the procedures of the data collection

This diagram explains the flow and procedures of how the experiment was conducted for the purpose of the data collection for this research (Fig. 6).

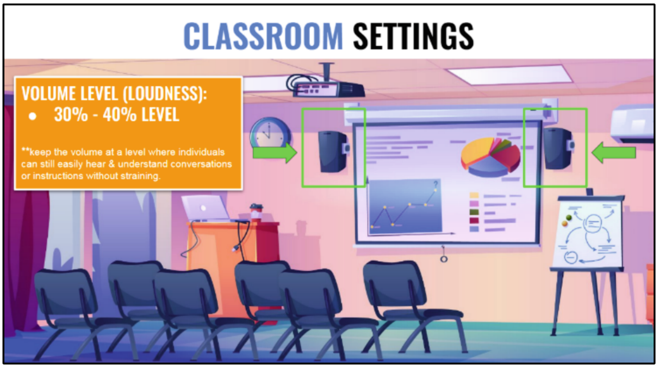

Fig. 6. Classroom Setting of How The Monitor Speakers Were Positioned and Volume Level

In the classroom setting, two audio monitor speakers were strategically positioned on both the left and right sides. Determining the optimum volume level for playing background music, while avoiding distractions, is contingent upon individual preferences and contextual factors. Generally, the volume should be set at a level that doesn't overpower the primary task or activity. The music should create a gentle and unobtrusive ambiance, offering a soothing backdrop without diverting excessive attention or hindering focus. An effective guideline suggests maintaining the volume at a point where conversations and instructions can be heard comfortably without straining, typically within the range of 30% to 40%. Moreover, the preferences and comfort of the occupants must be considered, recognizing that an acceptable volume for one person might be disruptive for another. The aim is to achieve a harmonious balance between the background music and the learning environment.

The process of data collection encompassed both a pre-test and a post-test for each group. These tests comprised 20 questions related to a subject matter that was introduced during the experiment's lecture. Specifically, a topic from sound design, which had not been covered in prior classes, was chosen. Each question assessed cognitive abilities, demanding critical thinking for addressing problem-solving inquiries. The time intervals between the pre-test and post-test essentially doubled as memory assessments, gauging whether students' recollection of lecture content was influenced by the presence or absence of background music during the learning experience.

After data collection, a rigorous analysis was conducted using appropriate statistical methods. An independent t-test was employed to compare the cognitive task performance of the treatment and control groups, focusing on identifying significant differences in cognitive abilities. This allowed the study to assess the potential effects of background music. To enhance the validity and reliability of the findings, triangulation was used as a complementary analytical approach. Triangulation involves utilizing multiple data sources, methods, or perspectives to validate research outcomes. In this study, both quantitative data (performance measures like accuracy, response time, and task completion rates from cognitive tasks) and qualitative data (participants' subjective experiences and perceptions gathered through questionnaires or interviews) were integrated. This combined approach aimed to provide a comprehensive and robust analysis, strengthening the validity of the findings and offering a deeper understanding of background music's potential effects on cognitive performance in this context.

This study investigated the influence of background music on cognitive performance in design students through an experiment with a treatment group exposed to music and a control group without music. The findings can inform educators about the role of background music in optimizing students' cognitive abilities in educational settings (Fig. 7).

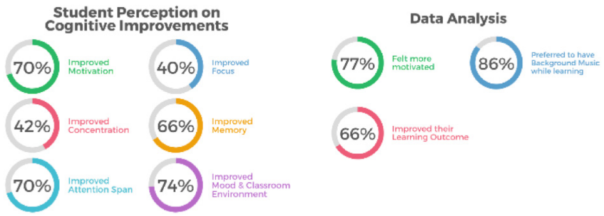

Fig. 7. Diagram for the findings on students' perception on cognitive improvements

5 Results and Discussion/Data Analysis

The findings of the study suggest that background music can have a positive impact on cognitive performance. The type of music listened to during studying was found to significantly influence memory recall and overall task performance. Specifically, instrumental music with a slower tempo was found to be most effective for tasks that required sustained attention, while faster-paced music was more beneficial for tasks that necessitated quick thinking and problem-solving skills. By selecting the appropriate background music for different tasks, individuals can enhance their focus and productivity. In addition to the quantitative analysis, student perceptions regarding cognitive improvements were gathered. The results revealed that a majority of students reported experiencing positive changes in various cognitive aspects. Specifically, 70% of participants reported improved motivation, 42% reported enhanced concentration, 70% reported an increase in attention span, 40% reported improved focus, 66% reported better memory, and 74% reported an improvement in mood and the overall classroom environment. 70% of the students managed to improve their attention span from the usual 20–30 min duration and up to 1 h attention span. 66% of them improved their learning outcome based on the improvements of their post-test performance scores. These findings highlight the potential benefits of incorporating background music into learning environments. The positive impact on motivation, concentration, attention span, focus, memory, and mood reported by the students suggests that background music can contribute to a more conducive learning atmosphere. These improvements can have a cascading effect, leading to enhanced academic performance and overall learning outcomes.

It is important to note that individual preferences for background music may vary, and it is necessary to consider personal musical preferences when implementing this approach. Furthermore, further research is warranted to explore the specific mechanisms through which background music influences cognitive performance and to identify optimal music characteristics for different types of cognitive tasks. In summary, the findings of this study indicate that background music can have a positive influence on cognitive performance. The reported improvements in motivation, concentration, attention span, focus, memory, and mood provide valuable insights into the potential benefits of incorporating background music into educational settings. By understanding the impact of different music characteristics on cognitive tasks, educators and students can leverage this knowledge to create an environment that fosters improved focus, productivity, and overall learning experiences.

6 Conclusion

In conclusion, this research aimed to investigate the impact of background music on cognitive performance among design students. The study employed a quantitative approach, utilizing an independent t-test to compare the performance of a treatment group exposed to background music and a control group without background music. Additionally, triangulation was employed to complement the quantitative findings with qualitative insights gathered from participant questionnaires and interviews. The findings of the study indicate that the presence of background music during cognitive tasks did significantly enhance students' cognitive performance compared to the control group. The results of the independent t-test revealed there are significant differences in performance measures, such as understanding and accuracy of answers, between the treatment and control groups. The qualitative insights obtained through triangulation provided additional depth to the findings. Participants' subjective experiences and perceptions regarding the impact of background music on their cognitive performance were collected. Although most participants reported a positive influence of background music on their focus and mood, these individual experiences did translate into measurable differences in performance when compared to the control group.

Based on these findings, it can be concluded that in the context of this study, background music does appear to have a significant impact on cognitive performance among design students. It is important to note that these findings are specific to the genres and tempo ranges of background music utilized in the study and may not generalize to other music genres or tempo variations. Future research in this area could explore the effects of different genres, tempo ranges, and individual preferences of background music on cognitive performance. Additionally, investigating the potential influence of background music on specific cognitive processes or tasks could provide further insights into the relationship between music and cognition. Overall, this study contributes to the existing body of knowledge on the effects of background music on cognitive performance and provides a foundation for further exploration in this field.

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On the Integration of Standards Education into Electrical and Electronic Engineering Curriculum in Malaysia

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Abstract. Engineering education in Malaysia is strictly regulated to ensure that quality graduates who are competent for the industry are developed. Yet, the unemployment rate of engineers is still at a worrying level. One of the reasons is that the industry deemed engineering graduates to be not industry-ready. Electrical and electronic engineering is a sizable industry; therefore, the country offers many electrical and electronic engineering programmes. In this paper, the integration of standards education into the electrical engineering curriculum is proposed. The aim of such integration is to provide early exposure to electrotechnical standards, which are pertinent technical documents referenced and used in the industry. The framework of how such integration can take place is proposed. The benefits of standards education are discussed.

Keywords: Engineering Education · Standards Education · IEC · ISO · ITU

1 Engineering Education in Malaysia

Engineering education is a learning programme designed to train engineers. The very first engineering education in Malaysia began in 1956 [1]. About 5 decades later, Outcome-Based Education (OBE) was made compulsory in all institutions of higher learning under the Malaysian Qualification Agency (MQA) Act 2007 [2]. Since then, the spirit of OBE and alignment of course learning outcomes to Bloom's Taxonomy has been engrained in engineering education in the higher education providers in Malaysia. The prerequisite for registration as a graduate engineer under the Registration of Engineers Act 1967 (revised 2015) is a qualification in an engineering programme recognised by the Board of Engineers Malaysia (BEM) [3]. The Engineering Accreditation Council (EAC) ensures the quality of engineering programmes is in check.

Desirable attributes such as critical thinking and problem-solving skills, effective communication capability, and the ability to work collaboratively in a team while observing professional ethics are nurtured in engineering students. While the assessment component of engineering education is strongly guided by ensuring that the learning outcomes are constructively aligned by coordinating with Bloom's Taxonomy, the engineering education pedagogy is somewhat not as structured. A quick look in the literature

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yields several fascinating approaches of engineering education pedagogy. For instance, a mixed pedagogy combining kinaesthetic learning, flipped classroom, mastery-based learning and project-based learning was proposed to enhance engineering students' online learning experience [4]. A framework to integrate humour in the teaching of engineering courses was mooted in [5, 6]. There was also a call for smart mobile pedagogy in engineering education, as presented in [7].

An engineering curriculum is usually an intersperse of lectures, laboratory experiments and simulations, design projects, independent research projects and industrial training programmes. As OBE is practised in Malaysia, students' learning outcomes are measured upon completion of each subject. While there are many variations of engineering disciplines being offered as an undergraduate programme, the main branches of engineering education are typically mechanical, civil, electrical, chemical and computer engineering.

Globally, and especially locally in Malaysia, there has been a sharp decline in the interest level of the youth towards taking an engineering course over the past five years. This situation was further exacerbated by the lockdown induced by the COVID-19 pandemic, which resulted in the explosion of social media influencers, many portraying living a successful life as one [8]. The recent "Jurutera Miskin" hoo-hah has rubbed more salt into the wound as it portrays the ugly truth of a relatively abysmal and stagnant starting salary for engineers in Malaysia, and this has since prompted the BEM to establish a task force to look into this matter [9]. While there might be a certain degree of truth, it could also be the case of industries demanding engineers who are competently trained with sound familiarity with industrial practices.

Many headlines in the major news media have been highlighting the issue of the un-employability of local engineering graduates. The industries seem to find fresh engineering graduates incompetent and have to allocate additional resources to train them to meet their requirements [10]. Electrical and electronics (E&E) is one of the major sectors identified as the National Key Economic Area in Malaysia. The industry's total sales value is estimated at RM483.2 billion in 2021 [11]. Hence, it is no surprise that as many as 152 Bachelor of E&E engineering programmes recognised by the Malaysian Qualification Agency are offered in the country to produce graduates to meet the industrial talent needs [12]. Noting the significance of the E&E industry, this paper attempts to integrate standards education into the E&E engineering programme in Malaysia. It is hoped that the proposal in this paper will pave the way for integrating technical standards into other engineering disciplines.

2 Standards Education

Standards education is about creating awareness amongst the intended audience of the importance of standards. The intended audience shall encompass every tier of society, starting from schools, universities, industrial practitioners and public users. Standards are established to ensure that life's quality and safety are safeguarded. The key stakeholders in standards education shall be the learning institutions, government, business, standards organisation and academia.

In the Joint Statement of the 18th Asia-Pacific Economic Cooperation (APEC) Ministerial Meeting held in 2006, the APEC ministers recognised the importance of standards education. Hence, they encouraged the development of reference curricula and materials to address the significance of standards and conformance to trade facilitation in Asia Pacific [13]. As a result, the APEC Strategic Standards and Conformance Education Programme was initiated in 2007. However, it must be acknowledged that the presence of standards education in the engineering programmes in the Association of Southeast Asian Nations (ASEAN) is still low, even though a few APEC members are also in ASEAN countries.

Globally speaking, South Korea is one of the pioneering nations that puts into place a conducive environment for the propagation of standards education. Table 1 summarises the ecosystem established by the Korean Standards Association to drive standards education [14].

Table 1. Standards education ecosystem in South Korea [14]

Trainees	Content
Elementary Schools	Standardisation education sessions
Middle & High Schools	-International standards Olympiad -Chapters in the technology textbook
Universities & Colleges	University Education Programme on Standardisation (UEPS)
Industries	Standards professionals, international standardisation, standards management strategy guide
Consumers	Nationwide standards education for the public to raise awareness

As clearly visible, every standard stakeholder is engaged in a systematic framework. One particular interest is the University Education Programme on Standardisation, which puts the curriculum for standards education at the university level into place.

In Germany, the German Institute for Standardisation (DIN) has been proactively instilling standards awareness amongst the youth. For instance, students from Grades 10 to 13 were tasked to develop their own standards in a simulated standards committee meeting [15]. The primary motivation behind this activity is not to build or enhance the students' technical knowledge but to expose them via a participatory activity to how standards are being developed. This will also indirectly cultivate negotiating skills to achieve a consensus, a crucial stage of standards development.

At ASEAN, in line with the adoption of the Master Plan on ASEAN Connectivity 2025, the ASEAN Engineering Inspectors (Electrical Installation) or AEI-EI has embarked on contributing towards the mobility of engineers. To establish an ASEAN baseline standard for the engineering profession leading towards the mobility of ASEAN engineers, the AEI-EI has coined the vision of harmonising standards and codes for electrical installations of buildings in ASEAN. To realise the vision, the strategic plan of the AEI Electrical Blueprint was outlined in [16], as shown in Table 2. The AEI Electrical Blueprint was also aligned to focus on strategies to catalyse the adoption of the developed ASEAN electrical standards within the curricular framework of the higher learning institutions within the ASEAN region.

Table 2. Core domains of AEI Electrical Blueprint [16]

Domain	Strategic Objectives
Trade Facilitation	- To obtain the potential intra-ASEAN trade in electrical installation services - To look at the barriers of cross-border ASEAN trade in electrical installation services - To create an ASEAN value chain for electrical installation
Awareness and Promotion Education	- To reach out to all relevant parties about the benefit of harmonisation of electrical installation services - To reach out to students/lecturers on the importance of standards usage - To nurture early awareness of standards
Stakeholders Engagement	- To engage further stakeholders at the district/province level, governmental agencies and related NGOs among ASEAN Federation of Engineering Organisations members
Utilisation of Standards and Guidelines	- To review the differences between the various ASEAN Country standards and identify the potential harmonisation components - To narrow the gap between the ASEAN region in standards utilisation
Registration	- To look at a database of electrical engineers/workers of ASEAN Country - Registering the database based on the qualification

As presented in Table 3, the first stage of the AEI-EI education plan focuses on engaging with institutions of higher learning (IHL) offering electrical engineering programmes in Malaysia. This shall be done by leveraging the Institutions of Engineers Malaysia (IEM)'s close connection, especially with several universities that have signed an MoU. IEM Student Chapters may also be engaged to support organising university roadshows. The purpose of the roadshow is to create awareness of the AEI-EI initiatives and goals for ASEAN amongst not only academics but also engineering undergraduates. This stage is deemed complete once the AEI-EI Standards Education Committee is established in Malaysia.

The next stage shall focus on developing scholarly material, namely the syllabus and curriculum centring on AEI-EI standards education. Engagement will also be initiated with IHL in ASEAN via the AFEO's network of connections. Once the scholarly material and committees are in place, the next stage is to develop the Train-The-Trainer programme to amplify the dissemination of AEI-EI pedagogical approach and knowledge to engineering students. As highlighted earlier, standards are widely perceived as being dull and dry. Therefore, it is crucial for the trainers, most likely the academics, to adopt the right pedagogy to educate their students on standards.

Moving on, a mobility programme for academics to promote the exchange of ideas in promoting standards education shall be developed in parallel with a cross-border internship programme for participating higher learning institutions. The latter is crucial

Table 3. AEI-EI education plan [16]

Stage	Milestone
1	- Engagement with IHL in Malaysia - Formation of AEI-EI Standards Education Committee (Malaysia)
2	- Development of AEI-EI scholarly material - Engagement with IHL in ASEAN
3	- Development of Train-The-Trainer programme for the dissemination of AEI-EI knowledge to engineering students
4	- Development of a mobility programme for academics - Development of a cross-border internship programme for participating IHL
5	- Intergovernmental initiative - Link with national qualification framework

to provide early exposure for engineering students to acclimate to the hosting country's local practices. Ultimately, an intergovernmental initiative has to take place to drive this AEI-EI initiative effectively. With the establishment of a strong linkage between standards education and the national qualification framework of each ASEAN member state, the ultimate goal of the AEI-EI Education Plan is deemed to be finally achieved.

3 Integration of Standards Education into Engineering Education

According to the literature, most attempts to relate technical standards to engineering education occurred in the software engineering domain. An attempt to teach Programmable Logic Controllers with IEC61131 standard language was reported in [17]. A simulation-based game for supporting the learning/teaching process of the standard ISO/IEC 29110 was proposed in [18]. A Smart-Grid test bed aimed at teaching the IEC 61850 standard to students was presented in [19].

To successfully integrate standards education into the E&E engineering curricula, the course instructors need to have a sound understanding of electrotechnical standards. In this paper, a survey was conducted to gauge the level of awareness among academics teaching E&E engineering courses. 35 responses were collected, and 97.1% of them are aware of electrotechnical standards such as IEC, ITU, ISO and IEEE. However, only 68.57% manage to relate electrotechnical standards to their course delivery.

Besides, awareness talks on standards were also conducted for electrical engineering students nationwide since 16 May 2019, covering more than 25 IHLs. Based on the feedback collected after the talks, most students commented that they had never learned about standards in their studies. This seems to contradict the survey findings as aforementioned, whereby most of the surveyed academics attempted to relate electrotechnical standards to their course delivery. After attending the talk, 380 students from the whole country provided feedback that they only knew about the existence of international electrotechnical standards such as IEC, ISO and ITU. A closer inspection of the programme structure of all universities offering the electrical engineering programme suggests that standards education is not at all emphasised. This is indeed worrying as early exposure to standards is crucial to prepare graduates before joining the workforce.

The Electropedia developed by the International Electrotechnical Commission (IEC) contains all the terms and definitions of electrotechnology, which are standardised across the globe. It is noted that electrotechnology refers to the technology of the practical applications of electric, magnetic and electromagnetic phenomena. In other words, electrotechnology is E&E engineering.

The Engineering Accreditation Council (EAC) Programme Standards 2020 outlines the details for the accreditation of an engineering programme in Malaysia. Table 4 shows the key areas for an electrical engineering programme according to the EAC Programme Standards 2020 and the relevant electrotechnical standards that can be mapped to each area.

Table 4. Proposed Mapping of Electrotechnical Standards to Key Areas in EAC Programme Standards 2020

Electrical Engineering Areas as per EAC Programme Standards 2020	Relevant electrotechnical standards
Circuits and Signals	Fundamental subject
Electromagnetic Field and Waves	IEC61000 series
Instrumentation and Control	IEC61869 series
Digital and Analogue Circuits	Fundamental subject
Machines and Drives	IEC 60034 series
Power Electronics	IEC 62477 series
Electrical Power Generation and High Voltage Engineering	IEC 60076 series, IEC 60071 series
Communication System	ITU-T Recommendation Series
Power System Analysis	IEEE 3002 series
Electronic Drives and Applications	Fundamental subject
Electrical Energy Utilisation	IEC 60364 series, IEC 62305 series

Awareness of standards can be cultivated effectively via the Industrial Training programme, which is compulsory for all universities offering programmes recognised under the Washington Accord agreement. The assessment rubric should place greater emphasis on the ability of the students to relate their work experience with relevant standards and codes. In the Final Year Project, students should be encouraged to identify related standards and codes to their work. The assessment rubric could be redesigned to incorporate scoring criteria for referencing associated standards in the student's project. The following electrical codes and regulations should be exposed to electrical engineering students:

- Electricity Supply Act 1990

- Electricity Regulations 1994
- MS IEC 60364 (Low Voltage Electrical Installations)
- MS 1979 (Code of Practice for Electrical installations of buildings – Domestic installations)
- MS 1936 (Code of Practice for Electrical installations of buildings – Commercial installations)
- MS IEC 62305 (Protection against lightning)
- MS 1525 (Energy Efficiency and use of renewable energy for non-residential buildings)
- MS IEC 60038 (Standard voltages)
- MS ISO 50001 (Energy management)
- MS IEC 61537 (Cable management - Cable tray systems and cable ladder systems)
- MS IEC 61439 (Low-voltage switchgear and control gear assemblies)
- MS IEC 61643 (Low-voltage surge protective devices)

Note that other notable standards such as BS 7430, IEEE 80, IEEE 81 and IEEE Power Series should also be referenced when topics on wiring, grounding and power system analysis are being taught to the students. During lab experiments, students can be exposed to the concept of calibration of lab equipment and ISO-related standards. Electronic engineering students specialising in telecommunication should be exposed to ITU standards.

Mock standards development meetings can be conducted to immerse the students into a meeting environment meant to develop standards. They can be tasked to assume the role of different stakeholders in standards development, namely the regulator, industry, academia, testing and users. Table 5 summarises how electrotechnical standards can be integrated to assist engineering students in achieving the programme outcomes as specified in EAC Programme Standards 2020.

It is imperative for electrical engineering students to gain early exposure to technical standards due to several reasons. Firstly, standards are safety-driven, which is the fundamental principle of any engineering design. These standards provide guidelines for engineers to meet minimum safety requirements when proposing engineering designs.

Next, technical standards emphasise the importance of interoperability and compatibility. This encourages students to think at a systemic level by understanding how each component must be able to cross-communicate across different platforms to function effectively. Electrotechnical standards are also built upon the principle of creating quality and reliability solutions. By familiarising students with the relevant technical standards, they are able to gain a clear idea of the expectation level of products of industrial standards. Early exposure to electrotechnical standards catalyses the transition of engineering students towards becoming actual engineers as they are able to familiarise themselves with "jargon" and global norms and practices.

Finally, standards drive the mobility of engineers. As engineering students are familiar with IEC standards, they can practice engineering in more than 90% of the world which uses IEC standards in their industrial practices.

Table 5. Proposed Mapping of Electrotechnical Standards to the Programme Outcomes in EAC Programme Standards 2020

Programme Outcome	Integration of Electrotechnical Standards
Engineering Knowledge	Technical standards are developed by utilising engineering knowledge. Without sound engineering fundamentals, students would not be able to comprehend technical standards
Problem Analysis	Students have to be trained to analyse complex engineering problems, and this ability can be cultivated by going through technical standards as they are usually drafted to solve specific problems
Design of Solutions	With early exposure to standards, students can be guided to formulate solutions to industrial problems
Investigation	Students can be given assignments which require them to conduct research supported by existing standards and documents
Modern Tool Usage	Some technical standards require users to use specific simulation software for problem analysis
The Engineer and Society	Applying technical standards is part and parcel of professional engineering practice to solve complex engineering problems
Environment and Sustainability	Standards that promote sustainability, such as ISO 50001 (Energy Management), can be exposed to the students
Ethics	The students can be exposed to Standards promoting ethics, such as ISO/IEC TR 24368 (Information technology - Artificial intelligence - Overview of ethical and societal concerns)
Individual and Teamwork	Students can be tasked to participate in a mock standards committee meeting to fully embrace the spirit of consensus among various stakeholders in standards development
Communication	Communication is key in standards development as one must convince the rest of their viewpoint
Project Management and Finance	ISO 21500 (Project Management) can be exposed to the students
Lifelong Learning	Standards are "live" document which requires periodic revision. Hence, students should be made to realise this

4 Conclusion

In this paper, a framework to integrate standards education into engineering education in Malaysia was proposed. The potential benefits of doing so were discussed. It is hoped that universities offering E&E courses can consider integrating standards education into their existing curriculum.

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Towards Education 4.0: Exploring the Potential of Project-Based Learning Through Student-Centric Assessment at Universiti Teknologi PETRONAS

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Abstract. Project-Based Learning (PBL) emerges as an innovative pedagogical approach, developing 21st-century skills through active engagement with real-world challenges. This research aims to comprehensively evaluate the effectiveness of PBL in the context of the Scientific Inquiry subject at Universiti Teknologi PETRONAS. The objectives include assessing student satisfaction, experiences, outcomes, and challenges related to PBL. A survey-based methodology involving 62 participants was employed, and a rigorous analysis. Key findings indicate a highly favorable view of PBL, with mean ratings consistently approaching the highest possible score, signifying effective engagement, clear communication of objectives, and a collaborative learning environment. PBL significantly enhances problem-solving skills (mean rating of 3.94/5), teamwork abilities (mean rating of 3.95/5), and aligns with course objectives (mean rating of 4.03/5). However, challenges include time management, team dynamics, assessment certainty, and research experience. This research underscores the relevance of PBL in Education 4.0, equipping students with essential skills. Its significance lies in providing valuable perspectives for optimizing PBL implementation and enhancing the overall learning experience in the context of modern education.

Keywords: Project-Based Learning · Scientific Inquiry · Statistical Analysis · Education 4.0 · Modern Education

1 Introduction

Education 4.0 represents a transformative shift in the field of education, characterized by the integration of advanced technologies, personalized learning experiences, and a focus on equipping learners with 21st-century skills. It leverages the power of digital tools, artificial intelligence, and data analytics to create dynamic and adaptive learning environments, preparing students for an ever-evolving future [1, 2].

In the realm of education 4.0, Project-Based Learning (PBL) has emerged as a dynamic and innovative pedagogical approach that empowers students to actively engage

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with complex real-world problems [3]. It is designed by John Dewey in 1959, an educator at the University of Chicago. This approach not only cultivates critical thinking and problem-solving skills but also nurtures creativity, collaboration, and communication abilities, making it a cornerstone in contemporary educational practices [4].

Over the past few decades, PBL has garnered significant attention from educators and researchers alike [5–8]. Its efficacy in acquiring deep understanding and long-term retention of knowledge has been widely acknowledged. Furthermore, PBL has been praised for preparing students to thrive in an ever-evolving, knowledge-driven world by emphasizing practical application, interdisciplinary learning, and adaptability [9–11]. Educational institutions worldwide have been embracing PBL as a transformative method, integrating it into various subjects and disciplines [12–14]. This widespread adoption stems from the recognition that traditional lecture-based approaches often fall short in delivering the skills and competencies needed in today's rapidly changing job market.

The implementation of PBL within the context of the Scientific Inquiry subject at Universiti Teknologi PETRONAS (UTP) represents an innovative approach to higher education. However, there is a need to comprehensively evaluate the effectiveness and impact of PBL in this specific academic setting. As educational paradigms shift towards more student-centered and experiential learning models, it is essential to understand the student perspective on PBL in terms of satisfaction, experiences, outcomes, and challenges. This will provide valuable information for optimizing pedagogical practices and ensuring that PBL aligns with the educational goals and needs of both students and institutions.

In the upcoming sections, we will address various aspects of our research. We introduce our teaching system during the Scientific Inquiry subject. Then, the methodology section will provide insights into research design, data collection methods, and evaluating PBL outcomes. We will then present our research findings and discuss their implications for both PBL implementation and educational practices.

2 Teaching and Assessment Methods

2.1 Introduction to the Scientific Inquiry Subject

The subject of Scientific Inquiry is designed to provide students with a comprehensive understanding of the fundamental principles and methodologies that drive scientific investigations. With a focus on both local and global issues, this course aims to equip students with the skills and knowledge necessary to engage in scientific inquiry effectively. Over the course of two 90-min sessions per week, students will embark on an exploration of the scientific method, observation techniques, hypothesis development, data analysis, and communication of findings – all critical components of the inquiry process.

Our objectives for this course are multifaceted. Firstly, we seek to expose students to the major principles that underlie scientific investigations, shedding light on the challenges and complexities inherent in the pursuit of scientific knowledge. Additionally, we aim to demonstrate the practical application of scientific inquiry methods, showcasing their relevance in addressing both local and global issues. Ultimately, our goal is to foster the development of students equipped with the skills necessary to conduct meaningful scientific investigations.

By the end of this course, students will emerge with a newfound appreciation for scientific inquiry's role in addressing real-world problems. They will have the capability to conduct investigations, formulate hypotheses, develop research instruments, analyze data, and effectively communicate their findings. Through a combination of teaching sessions and hands-on training in proposal writing, inquiry execution, and report writing, students will actively engage with the subject matter, developing a deeper understanding of the scientific inquiry process. This course promises to empower students to synthesize the outcomes of their inquiries and derive appropriate, evidence-based conclusions, preparing them to make valuable contributions to the scientific community and beyond.

2.2 Assessment

The assessment method for the Scientific Inquiry subject comprises two key components. The individual assessment, accounting for 40% of the overall grade, includes two multiple-choice tests: Test 1 (15%) and Test 2 (25%). These tests evaluate individual understanding of scientific inquiry principles and critical thinking within the context of real-world issues.

The remaining 60% of the assessment focuses on group work, which includes the Research Proposal (15%) and Research Project Conduct and Presentation. The Research Project encompasses the Video Presentation (10%) and Final Report (35%) which involves students aligning their research theme with one of the United Nation's Sustainable Development Goals. This comprehensive group assignment not only tests their ability to formulate proposals but also assesses their capacity for teamwork, communication, and the practical application of scientific inquiry methods to address global challenges. This assessment method maintains a balance between individual comprehension and collaborative skills, ensuring students not only grasp essential concepts but also develop the practical abilities needed for impactful scientific inquiry.

3 Methodology

We designed and conducted a survey to assess PBL, as represented in Table 1. This survey covers various variables that influence the effectiveness of this pedagogical approach. Our survey included participation from a group of 62 individuals who had attended the Scientific Inquiry subject. Using the statistical analysis tools of Microsoft Excel, we rigorously analyzed the students' assessments. We explore critical aspects such as student engagement, project complexity, collaboration, teacher facilitation, and assessment methods. Through the carefully crafted questionnaire, students' perspectives on these variables are captured, providing valuable information about their level of enthusiasm, the depth of projects, group dynamics, the, and the fairness of assessments within the PBL context.

Furthermore, the survey seeks to evaluate the impact of PBL on learning outcomes and students' long-term trajectories, addressing variables related to skill development and motivation. It also takes into account the challenges and barriers encountered during

PBL implementation, offering a detailed examination of factors that may hinder or enhance the effectiveness of this learning approach. The ratings were given from 1 o 5, with 1 indicating very low and 5 indicating very high.

By aligning the survey questions with these essential variables, educators and institutions can gain a comprehensive understanding of their PBL practices, enabling them to make data-driven decisions to improve the overall learning experience for students and maximize the benefits of Project-Based Learning.

Table 1. Questionnaire

PBL Experience	1. How would you rate your overall experience with the Project-Based Learning (PBL) class? 2. Did you find the project-based learning approach engaging and motivating? 3. How clear the project objectives and expectations were communicated during of the class? 4. How adequately were you supported by the instructor and your peers throughout the project 5. How do you rate your project's connectivity to the real world? 6. How do you rate the collaborative learning?
Learning Outcome	1. To what extent do you believe the PBL class improved your problem-solving skills? 2. How did the PBL class impact your ability to work in a team and collaborate with peers? 3. Were the learning outcomes of the PBL class aligned with the course objectives?
Challenges	Please rate how challenging you found the following aspects of the PBL class on a scale of 1 to 5, with 1 indicating "Not Challenging" and 5 indicating "Very Challenging." 1. Time Management 2. Team Dynamics 3. Assessment Certainty 4. Research Experience

4 Results and Discussion

4.1 Students' Experience During PBL

The statistical analysis of the survey assessing students' experiences during their PBL class (Table 2 and Fig. 1) reveals several key insights. First and foremost, the mean ratings for various aspects of the PBL experience consistently indicate a highly positive impression. The overall experience received a mean rating of 4.048, suggesting that, on average, students held a favorable view of their PBL class. This positive sentiment is mirrored in the mean ratings for motivation and engagement (4.081), clarity of project objectives (4.048), support from instructors and peers (4.065), connectivity to the real world (4), and collaborative learning (4.129). These mean scores, clustering close to the highest possible rating of 5, emphasize the effectiveness of the PBL approach in engaging students and fostering a positive learning environment.

Additionally, the survey data exhibits characteristics such as skewness and kurtosis values, which offer further insights into the data distribution. The negative skewness values suggest a slight leftward skew, indicating that, while most students provided favorable ratings, a few lower values pull the distribution in that direction. Simultaneously, negative kurtosis values indicate that the data distributions are platykurtic, implying that they are less peaked and flatter than a normal distribution. This suggests that the responses are concentrated around the mean, with fewer extreme values or outliers. These statistical parameters collectively underline that the dataset displays relatively symmetric and moderately dispersed distributions, showcasing a degree of consensus among students' perceptions.

Moreover, the standard error values, ranging from 0.093 to 0.213, emphasize the precision of the sample means as estimates of the population means. Smaller standard error values imply greater precision in estimating the true population mean. With these low standard errors, we can have confidence that the reported mean ratings accurately reflect the broader student population's sentiments regarding their PBL experience. These findings collectively affirm that the PBL approach employed in this course effectively engaged students, provided clear communication of objectives, and fostered a collaborative and relevant learning environment, as evidenced by both the mean ratings and the characteristics of the data distribution.

4.2 PBL's Outcome

The statistical analysis of students' assessments of the outcomes of their PBL experience yields significant findings, as indicated in Table 2 and Fig. 2. First, students reported a mean rating of 3.94 for improved problem-solving skills, indicating a positive impact on their ability to tackle complex challenges. Second, teamwork ability received a mean rating of 3.95, suggesting that students felt their collaborative skills were enhanced through PBL. Lastly, with a mean rating of 4.03, students perceived a strong alignment between PBL outcomes and course objectives, underscoring the effectiveness of PBL in achieving its intended learning goals.

In addition to these mean ratings, low standard error values, ranging from 0.0887 to 0.2003, highlight the reliability of the reported means as representative of the broader student population's perceptions. Furthermore, skewness and kurtosis values suggest that the data distributions are relatively symmetric and moderately dispersed, emphasizing the overall consensus among students regarding the benefits of PBL.

Overall, the statistical analysis affirms that PBL contributes positively to students' problem-solving skills and teamwork abilities, with strong alignment between PBL outcomes and course objectives. These findings, supported by low standard errors and characteristics of the data distribution, underscore the effectiveness of PBL in achieving its intended educational objectives.

4.3 Challenges

The statistical analysis of students' assessments on challenges during PBL is represented in Table 2 and Fig. 3. Students reported moderate challenges in several key aspects. Time management, with a mean rating of 3.47, emerged as a notable challenge, indicating that some students faced difficulties in effectively managing their PBL tasks within the given timeframes. Similarly, team dynamics, also rated at 3.47, pointed to challenges in collaborative aspects of PBL, highlighting the importance of developing effective teamwork skills within PBL projects.

Furthermore, students expressed concerns about assessment certainty, yielding a mean rating of 3.29. This suggests that some students felt uncertain about the evaluation criteria or grading processes in PBL, potentially affecting their confidence in the assessment outcomes. Additionally, challenges related to research experience received a mean rating of 3.60, implying that students encountered moderate difficulties during the research process within their PBL projects.

The median values for each challenge category closely align with their respective mean ratings, reaffirming the central tendency of students' assessments. Moreover, the standard deviation values, ranging from 0.80 to 0.99, indicate moderate variability in students' responses, with the majority of responses clustering around the mean ratings.

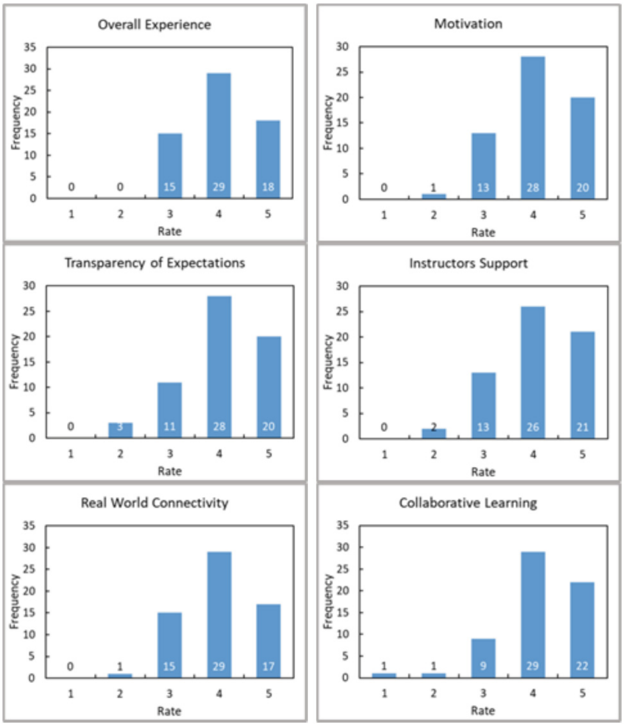

Fig. 1. Experience of students during the PBL class

These insights into the challenges students face during PBL, as reflected in the median and standard deviation values, offer valuable guidance for educators. Understanding both the central tendency and variability of students' perceptions regarding specific areas of concern allows for targeted efforts to enhance the PBL experience and address these challenges effectively.

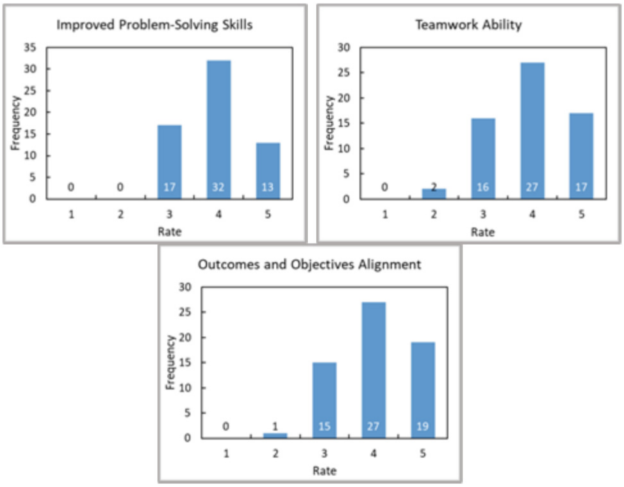

Fig. 2. The outcome of PBL class: Improvement of students' capabilities and alignment of their learning out-comes to the course objectives

Table 2. Statistical analysis of the survey's response

Question Category	Project-Based Learning Experience						Learning Outcomes			Challenges			
Question Number (Based on Table 1)	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*1*	*2*	*3*	*4*
Mean	4.048	4.081	4.048	4.065	4	4.129	3.935	3.952	4.032	3.468	3.468	3.290	3.597
Standard Error	0.093	0.098	0.106	0.105	0.098	0.107	0.089	0.104	0.100	0.119	0.125	0.101	0.116
Median	4	4	4	4	4	4	4	4	4	4	3.5	3	4
Mode	4	4	4	4	4	4	4	4	4	4	4	3	3
Standard Deviation	0.734	0.775	0.838	0.827	0.768	0.839	0.698	0.818	0.789	0.936	0.987	0.797	0.914
Sample Variance	0.539	0.600	0.703	0.684	0.590	0.704	0.488	0.670	0.622	0.876	0.974	0.636	0.835
Kurtosis	−1.103	−0.603	−0.130	−0.484	−0.661	2.085	−0.893	−0.626	−0.780	0.233	−0.122	−0.506	−0.094

(*continued*)

Table 2. (*continued*)

Question Category	Project-Based Learning Experience						Learning Outcomes			Challenges			
Question Number (Based on Table 1)	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*1*	*2*	*3*	*4*
Skewness	−0.076	−0.360	−0.611	−0.482	−0.224	−1.111	0.088	−0.280	−0.265	−0.461	−0.330	0.024	−0.163
Minimum	3	2	2	2	2	1	3	2	2	1	1	2	1
Maximum	5	5	5	5	5	5	5	5	5	5	5	5	5
Count	62	62	62	62	62	62	62	62	62	62	62	62	62
Confidence Level (95.0%)	0.186	0.197	0.213	0.210	0.195	0.213	0.177	0.208	0.200	0.238	0.251	0.202	0.232

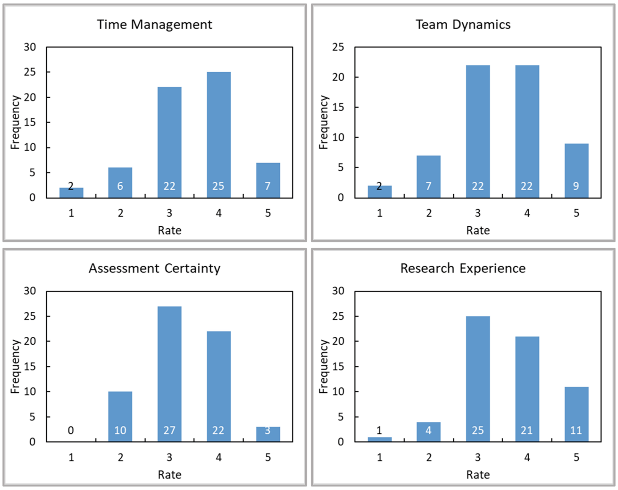

Fig. 3. PBL Challenges, with 1 indicating "not challenging" and 5 indicating "very challenging".

5 Conclusion

Our findings reveal that students at UTP hold a highly positive view of their PBL experience, with mean ratings consistently approaching the highest possible score. This indicates that PBL effectively engages students, provides clear communication of objectives, and fosters a collaborative and relevant learning environment. The assessment data also shows that PBL positively impacts problem-solving skills and teamwork abilities, aligning well with course objectives. However, challenges such as time management, team dynamics, assessment certainty, and research experience were identified. These insights offer opportunities for targeted improvements in the PBL implementation to enhance the overall learning experience and mitigate these challenges effectively. Our research underscores the relevance and effectiveness of PBL in Education 4.0, highlighting its potential to prepare students for an ever-evolving future by equipping them with essential 21st-century skills and practical problem-solving abilities.

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Transforming Petroleum Engineering Education: A Practical Industry-Oriented Capstone Project

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Abstract. The Engineering capstone project offers students the opportunity to apply the knowledge they have acquired during their undergraduate studies and develop practical solutions for complex engineering problems. This project serves as a platform for developing transferable skills like teamwork, effective communication, and lifelong learning. However, there is a scarcity of literature specifically focused on capstone projects in the field of petroleum engineering. To address this gap, a capstone project course was introduced in the petroleum engineering curriculum. The project involved the development of a large-scale oil and gas field based on a real case study, requiring a creative solution that encompassed four major disciplines of petroleum engineering: formation evaluation, reservoir engineering, drilling engineering, and production technology, along with other related sub-disciplines. A distinctive aspect of this project was the incorporation of an original technical concept, aligned with industrial practices. The organizational aspects of the project were also discussed, considering the assessment quality and the competency requirements for successful completion. Despite encountering certain challenges throughout the semester, the project proved to be an invaluable exercise in simulating the working environment of petroleum engineers. Furthermore, it provided a comprehensive, contextualized, and realistic proposal for the field of petroleum engineering.

Keywords: Undergraduate capstone project · petroleum engineering · assessment tools · original concept

1 Introduction

Capstone project is a compulsory feature of all accredited engineering programs [1] and there are many variations depending on the multidisciplinary involvement, the project job scope, the number of participants, the teamwork responsibilities, the coordination organization and the assessment process [2]. Most of it are undertaken in the final semester of the program. The projects are often extended over two semesters or the whole

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final year period [3, 4]. The capstone project is also an exercise in team management, soft skills, communication, and leadership. In view of their comprehensiveness, capstone projects serves as a concluding focal point, encouraging students to tie together the knowledge, skills and abilities they have developed during their learning experience from the syllabus at the university and often require the acquisition of complementary technical expertise not covered in the official curriculum [5]. It consequently drives creativity and stimulates unsupervised learning by experience.

The ideal concept of the capstone in petroleum engineering (PE) is most commonly a large scale oil and gas field development project. Aspired by the real oil and gas industry experiences, it requires a creative solution and involves four main disciplines of PE namely formation evaluation, reservoir engineering, drilling engineering, production technology, and other sub disciplines such as petroleum geology, petroleum geosciences, facilities engineering and petroleum economics [6]. By definition, field development project is a comprehensive process to develop a field in an optimized manner by using the latest technologies with considerations of economics and health, safety and environmental (HSE) issues [7, 8]. An ideal capstone project also includes significant demands in terms of management, planning, logistics and scheduling and incorporates ethical, environmental and social issues. With all of the aforesaid principles in mind, the Petroleum Engineering Department of Universiti Teknologi PETRONAS (UTP), Malaysia has developed and implemented a Capstone project course for its graduating students since 2010. It sets out to introduce students to professional engineering practices, to demonstrate the consummation of engineering knowledge and soft skills, to allow students to harness technical knowledge and capabilities and to provide an appreciation of the societal context of engineering.

The purpose of this paper is to highlight the uniqueness of a petroleum engineering capstone project undertaken by the graduating class students. The project resulted in the creation of detailed and comprehensive field development proposals by each technical group in the class. The technical conceptualization and organizational structure of the project are presented, and the professional advantages for the students are discussed. Furthermore, the project outcomes are compared to the competencies recommended by the Society of Petroleum Engineers (SPE) for graduating students [9].

2 Petroleum Engineering Capstone Project Characteristics

Based on series of workshops and exhaustive discussion among the academicians, industry experts and stakeholders, it is concluded that the capstone project should have the following key characteristics:

- Serve as a final platform to consolidate and contextualize the acquired knowledge.
- Offer opportunities to explore and evaluate diverse solutions to an open-ended problem.
- Exhibit complexity that encompasses the breadth and depth of all major disciplines within Petroleum Engineering and other relevant technical domains.
- Incorporate conflicting requirements, such as adhering to scheduling and public policies, budget constraints, and addressing health, safety, and environmental (HSE) issues.

- Enable students to demonstrate their ability to contribute effectively within a team.
- Provide avenues for exhibiting professional and ethical behavior.

In order to encompass the ideal capstone project's scope, the following requirements were established:

- The project should be undertaken by a group of students.
- It should involve teams of lecturers with diverse areas of expertise as supervisors.
- External practicing engineers should be engaged in evaluating the project.
- Ample opportunities for unsupervised learning should be incorporated.

Quite significantly, the SPE Talent Council study, The SPE Technical Knowledge for Graduating Engineers Matrix [9], would later confirm the rationality of these characteristics. The study concluded that it is clear that petroleum engineering graduates must have a solid foundation in breadth knowledge and engineering skill sets. It also recommends the students to have practical knowledge of field practices and operations, as well as working knowledge of the foundations of petroleum engineering—drilling, production, and reservoir engineering—as well as petroleum geology and geosciences, economics, technical writing and technical presentations.

3 Capstone Project-Field Development Project Approach

In order to meet the technical and academic standards set by department professors, industry advisory panels, and expert panel workshops, a major focus was placed on addressing a challenging oil and gas field development problem in UTP. This approach aimed to ensure that educational offerings remain aligned with industry practices, foster stronger collaboration with industry players, and adapt to the evolving needs of the sector. The project's problem statement and scope were designed to allow for customization, enabling the exploration of various potential outcomes and the attainment of a comprehensive feasibility demonstration for the final concept.

Field development plan (FDP) is a normal practice in the oil and gas operators like Shell, ExxonMobil, Hess, Statoil etc. to develop any typical oil or gas reservoir after the exploration activities (Fig. 1). In the event of the discovery, after comfortable information about the reservoir has been gained from the exploration wells, an FDP report will be submitted to the appropriate national and local agencies for approval. FDP comprises of different phases starting from petroleum geological studies until field abandonment (Fig. 1). The document would detail the company's plans on the field including the geological understanding, resource assessment, depletion strategy, proposed well locations, production optimization, development concept, sustainability issues, uncertainties and economic analysis and abandonment plan. It is a complex and integrated engineering practice in order to come out with a reasonable and reliable FDP report that satisfies the needs of high-level management in making decision of the proposed field development.

In order to offer an effective resolution to the issue, it is necessary to conduct a functional analysis of two key components (Fig. 2). The first component is the 'reservoir issues', especially in early geology, geophysics, formation evaluation and reservoir engineering. The second component is the 'development issues', using the integration of drilling engineering, production technology, facilities engineering, economics and commercial negotiations, reservoir management and monitoring and HSE/sustainable developments to optimize the final development design. Through this complete development process, the students would apply their technical knowledge and their ability to engage advanced commercial simulations, design and project management tools.

3.1 Project Details and Deliverables

All groups were referring to a case study based on a real oil and gas field known as "GMF". Geographically, the "GMF" field is an offshore field located in Sabah waters, off the Malaysian coast, approximately 43 km from Labuan and 130 km from Kota Kinabalu in the Sabah Basin block owned by PETRONAS, the national oil company of Malaysia. Two exploration wells had been drilled so far and hydrocarbon reservoir was encountered as predicted at certain intervals. In the case study, each group was acting as the company who operated the field and needed to come out with their own FDP report.

The initial real industry dataset representing "GMF" field provided to the class is directly related on how to solve the two analysis components namely reservoir issues and development issues that have been discussed in the previous section. For the reservoir issues, the dataset included top structures of all reservoir layers, a set of wireline logs from the exploration wells, and pressure/MDT data. Every team was expected to start their project with geological studies as well as to solve the volumetric calculation by using the given structures map and the logging data. In the geological and petrophysical evaluation, it is very important to solve the type of depositional environment in the area, the size of the reservoir, the quantity of hydrocarbons in place, and the reservoir's producing capabilities. In determining the pay zones, several important parameters are required such as net thickness, lithology, porosity, shale volume, type of fluid and water saturation. These data will be used for economic evaluation of the reservoir and planning for optimum recovery method.

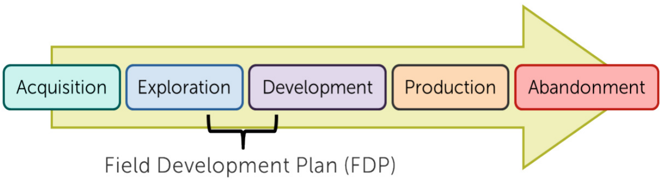

Fig. 1. A typical oil and gas field life phases and field development plan period

Besides that, the reservoir properties data were also given to the teams namely core analysis report, fluid analysis report and well test data. This data is useful to understand the reservoir issues especially to build a static three-dimensional (3D) geological model and a dynamic geo-cellular model of the reservoir by using commercial software such as PETREL and Eclipse. Later, the models were used for reservoir simulation studies. The main purposes of the simulation were 1) to predict reservoir performance, reserves, and production profile, 2) to evaluate the impact of key uncertainties on the development plan (e.g., offtake rates, timing of injection strategy, and aquifer strength) and 3) to determine the optimum number of well and depletion strategy. Apart from the reservoir engineering, the teams were also expected to outline reservoir management plans to ensure the field sustainability during the production period.

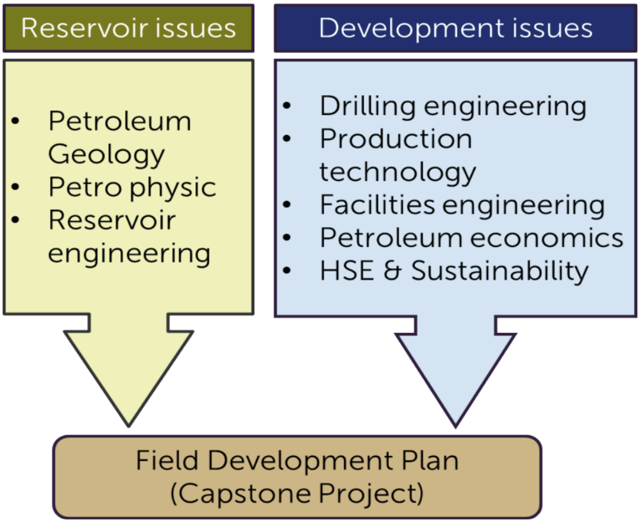

Fig. 2. Main phases in Field Development Plan and Integration of petroleum engineering sub disciplines in the capstone project

On the other hand, another set of data were given to solve the development issues component consisting of well test data, drilling information, well completion/configuration information of the exploration wells, cost information and contractual arrangements. By integrating the static and dynamic model as result of the later component and these set of data, it will enable the group to produce the development concept of the field. The concept is an integration between choice of recovery mechanism (number of well/slots, production optimization, need for injection or processing etc.) and the choice of development concept (steel or concrete structures, subsea solutions, floaters, ship, facilities etc.). However, they need to have a good understanding of how the risks and uncertainties will affect the physical reservoir size, architecture, reserves, throughputs (e.g., lateral reservoir extent, aquifer support, connectivity). Besides that, they also need to consider the impact of choosing a suitable development concept, with its associated capital expenditure (CAPEX) and operating expenditure (OPEX) estimates compared to the forecast hydrocarbon production. A clear identification and understanding of key uncertainties are key to an optimum development concept.

3.2 Capstone Course Coordination

Before the semester commenced, all 63 final year students were divided into groups which consisted of seven members. The project demanded every group member to play a role in every sub discipline in PE to improve the work efficiency and to complete the project within the given time. Each group was adequately supervised by three lecturers as the project supervisors to monitor the progress of the students as well as to provide guidance especially on the technical aspect of the project. The supervisors have different petroleum engineering sub-discipline backgrounds.

Within the first week of the semester, the kick-off briefing was conducted to the students. The briefing included the objectives, roles of team members, deliverables for each phase, and the milestones of FDP project. The FDP dataset is handed to the students during the meeting.

To ensure industry participation in the project, two seminars were conducted in the early of the semester by inviting industrial experts to deliver the required technical expectations for the project. This is to give a better perspective for the students on the guidelines and on reaching the expected outcomes of every sub discipline.

3.3 Course Assessment

Producing a fair individual evaluation considering personal contributions to the collective final project was indeed a challenge. Table 1 summarizes the components of the evaluation and their contributors. The documents produced by the class (Interim Report and Final Report) accounted for 40% of the total course mark. Besides that, the capacity of the students to defend their project in the Final Oral Presentation and their ability to address issues raised by the assessors at the session contributed another 30%. The final report and final oral presentation were evaluated by the three project supervisors as well as by the technical experts. The interim report, however, was evaluated by the three project supervisors alone. One outcome of the capstone project was to demonstrate teamwork capabilities; hence, part of the total marks was reserved to evaluate cooperation. Group participation based on logbook reports and meeting participations was evaluated at 15% by the project supervisors.

Awarding the same grade to a group of students for group work assignments, regardless of the contribution made by each group member, is always a dilemma since it often is not a fair reflection of individual efforts. Numerous methods have been introduced to deduce individual performance from group efforts [10]. Accordingly, in this capstone project, we used peer assessment to factor in the contributions of individual group members.

In general, the students themselves determined 15% of the final marks, without involvement from the course coordinators. The coordinators' role was limited to compiling procedural documents created by the technical and team members.

The majority of the total marks, specifically 70%, were the same for all students. However, the remaining 30% allowed for differentiation based on individual participation. Interestingly, when individual students assessed their peers through peer review, the marks showed a wide range of distribution. On the other hand, the marks given for group participation had a narrower distribution. The students tended to be more critical of their colleagues compared to the project supervisors, who only interacted with the group during the weekly meetings.

Table 1. Types of course assessments

	Type of Evaluation			
	Technical Content	Team and Individual Participation		
Assessment	*Professional Engineers*	*Project Supervisors*		*Group Members*
Interim Report	-	10	-	-
Final Report	15	15	-	-
Final Oral Presentation	15	15	-	-
Group Participation	-	-	15	-
Peer Review	-	-	-	15
Total (%)	30	40	15	15

4 Capstone Project Competencies

In order to conduct a comprehensive evaluation of the competencies displayed by students in the project, it is essential to employ an unbiased frame of reference. To facilitate this process, the SPE Technical Knowledge for Graduating Engineers Matrix, published by SPE in 2010, serves as a valuable resource. It provides a 'set of technical knowledge' that Petroleum Engineering graduates should possess based on surveys conducted on numerous university curricula as well as industry expectations from more than 50 oil and gas companies [9]. The study proposes 43 components applicable to petroleum engineering program, and the required level that should be attained by the graduating student. The required levels were categorized as (1) required, (2) valued and (3) not required. Thus, the capstone project in the petroleum program has been set to meet the required level to ensure the competencies of the student upon graduation.

Besides that, the Petroleum Engineering program in UTP is accredited by the Engineering Accreditation Council (EAC), the 13th signatory member of Washington Accord [11, 12]. Hence, it is compulsory for the program to comply with all the requirements set by the accreditation council. At that time, the EAC has set 11 criteria for program outcomes that has to be met by all accredited institutions of higher learning [13]. Hence, both documents have been used as the main basis to map the capstone project's course outcome. The evaluation approach relies on Bloom's taxonomy principles, which establish six levels of competencies to guide learning, teaching, and assessment. [14–16].

Table 2 indicates the mapping of the capstone project to the EAC Program Outcomes and the SPE Graduating Engineers Matrix. The left axis is the Capstone Project: Field Development Plan's Course Outcome (CO). It adopted the Bloom's taxonomy principles by using appropriate terminology to describe the level of competency that was actually achieved by the students in the capstone project [17]. On the top axis, the middle column lists all the 11 Program Outcomes (PO) that should be met for the engineering accreditation. Finally, the right axis indicates the components of SPE Graduating Engineers Matrix (EM). Out of the 43 proposed components in the EM, 36 closely associated with the Field Development Project were selected for assessment and are listed in Table 2.

The EM components have been associated with the four levels of CO (Course Outcomes) based on their evaluations, which can be in the form of a written submission or a public presentation that undergoes formal assessment. Additionally, to enhance the EAC (Engineering Accreditation Commission) accreditation, the manual assigns four different levels of emphasis to all 11 criteria: High emphasis (3), Medium emphasis (2), Low emphasis (1), and No emphasis (0). It is mentioned in the EAC manual that the remaining criteria are applicable to other activities or courses within the bachelor program.

Clearly, Table 2 presents the conclusive findings regarding the optimal outcomes of the UTP-Field Development capstone project. These findings provide evidence that the FDP concept has enabled the final year students to showcase their utmost level of excellence. By referring to the CO's taxonomy level, the capstone project has effectively motivated the students to apply competencies ranging from levels four to six for the selected technical attributes. The highest level of competence was observed in the "Evaluate" criterion. This implies that the students were able to form informed opinions and make value-based decisions regarding complex field development issues. They were also capable of assessing conflicts with established standards of practice and relevant constraints by utilizing engineering principles and research-based knowledge.

The capstone project incorporated various features that, in hindsight, appeared to address the concerns of the engineering regulatory body. It took into account the guidelines set by the EAC, which emphasize that engineering programs should encompass not only the acquisition of scientific knowledge, engineering fundamentals, and technical expertise but also the development of communication skills, teamwork, leadership abilities, and an understanding of social, cultural, global, and environmental responsibilities towards society. Moreover, the project integrated the requirements for sustainable development, the promotion of lifelong learning, and the incorporation of professional and ethical responsibilities. In some way or another, all these aspects were integrated into the capstone project.

Table 2. Course outcomes mapping

Capstone Project: Field Development Plan Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	SPE Technical Knowledge for Graduating Engineers Matrix (EM)
	Petroleum Engineering & Engineering Accreditation Outcome (PO)											
Generate a field development plan for a hydrocarbon prospect.	1	1	1	2	2	1	0	0	0	0	1	EM 1, EM 2, EM 3, EM 4, EM 5, EM 6, EM 7, EM 8, EM 9, EM 13, EM 14, EM 31, EM 32, EM 37, EM 38, EM 40, EM 43
Perform adequate analysis on field data by using software and manual calculations	3	3	3	2	1	0	0	0	0	0	0	EM 11, EM 12, EM 15, EM 16, EM 20, EM 21, EM 22, EM 25, EM 29, EM 30, EM 34, EM 39
Produce and present technical reports on petroleum geology, static model, dynamic model and reserves.	0	0	0	0	0	0	3	3	3	3	3	EM 10, EM 19, EM 23, EM 24, EM 26
Demonstrate teamwork capabilities.	0	0	0	0	0	2	2	2	3	3	3	EM 18, EM 42

5 Difficulties Encountered and Solutions

Throughout the implementation of the capstone project, some problems related to the coordination and supervisory efficiency must be considered. Firstly, in terms of FDP project supervision, the supervisors had various perspectives on the expectations of the project. To avoid that, a technical seminar has been conducted by inviting professional engineers in the industry to explain the scope of work and the deliverables of the FDP.

This is to ensure the coordinator and supervisors have a clear overview of the project and fully understand the deliverables of each phase. They must be familiarized with the dataset given to the students and should be able to guide the data analysis as required in the guidelines.

One more restriction in the FDP capstone project revolves around the availability of technical software. It is expected that teams utilize appropriate modern engineering software during most of the FDP phases while being aware of its limitations. The usage of software holds great importance in validating manual calculations, as well as simulating and modeling reservoirs and development criteria. However, due to a limited number of available software and licenses dedicated to the FDP project, teams had to share the same resources. Consequently, only a few students in each group had the opportunity to use the software, while the rest relied on the software's output for result analysis. To address this issue, the department took immediate action by collaborating with software providers like Schlumberger, Halliburton, and Weatherford. This collaboration aimed to obtain more free licenses and technical support for their software. This approach served as a mutually beneficial marketing strategy for the university and the companies involved, as students became more familiar with and exposed to their products.

Additionally, managing student complaints posed a significant challenge. Initially, students failed to appreciate the purpose of the FDP and the added technical value of the capstone project, as they believed they had already learned the basics in other petroleum engineering courses. Furthermore, students argued that they lacked sufficient time to focus on the FDP due to their other major courses. Consequently, the coordinator faced difficulties in convincing the students. To address this, monthly engagement sessions were conducted with all groups to discuss the rationale behind the capstone project and its benefits for the students, in addition to facilitating the coordination process.

Addressing the challenges and academic limitations necessitated collaborative efforts from all involved parties. In this undertaking, it was imperative for the coordinator, project supervisors, and all teams to acknowledge the diverse expertise within each department and assign tasks accordingly. Each obstacle mirrored real-world work scenarios, resulting in diverse team dynamics. Ultimately, the capstone project served as a valuable learning experience for instructors, while enabling students to appreciate the significance of recognizing the competencies, strengths, and limitations of every team member in order to achieve the objectives of the FDP project.

6 Conclusion

This paper presents the implementation of a novel approach for the capstone project course in the Petroleum Engineering program at UTP. The graduating cohort of 63 students was divided into teams and organized as an operational oil and gas company. Their main objective was to collaborate on designing a comprehensive and integrated field development plan, which would be presented to the technical review committee. A notable aspect of this project was the introduction of an original technical concept based on industrial practices. The paper also discusses the organizational aspects, considering the assessment quality and project competency requirements. Although the semester presented some challenges, the project proved to be a highly valuable exercise, effectively simulating the real working environment for petroleum engineers and offering a complete, contextualized, and realistic proposal.

The administration of the capstone project, as described in the preceding sections, turned out to be more demanding than initially anticipated. While the project drew inspiration from a real case study, it was adapted to include specific questions covering various disciplines such as geology, geosciences, petrophysics, reservoir engineering, drilling engineering, production technology, facilities engineering, petroleum economics, and HSE. Providing adequate technical support across these multidisciplinary areas posed a significant challenge throughout the semester. However, the Petroleum Engineering Department acknowledges that this experimental capstone project was an excellent means of integrating knowledge and simulating a real-life atmosphere for the graduating class. Most importantly, ongoing improvements in the implementation of the capstone project will further enhance the students' skill set, with reports on these enhancements expected in the future.

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Learning Beyond Classroom

Augmented Reality (AR) Technology for Procedures and Standards of Process Instrument in Chemical Engineering Studies

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Abstract. Augmented Reality (AR) is a transformative technology that has the potential to revolutionize engineering practices. By combining virtual information with the physical world, AR enables engineers to visualize complex designs, simulations, and data in real-time, leading to improved decision-making and problem-solving. AR facilitates design prototyping, training, and maintenance activities by overlaying virtual models onto physical environments, reducing iterations and enhancing efficiency. This work focuses on the utilization of Augmented Reality (AR) technology as a tool for providing Standard Operating Procedures (SOP) and guidelines for the maintenance and operation of level transmitters instrument in chemical engineering studies. The project aims to develop an AR-based application that overlays step-by-step instructions, safety guidelines, and relevant information onto the physical level transmitter instrument, aiding students in performing maintenance tasks effectively and ensuring compliance with industry standards. By leveraging AR, the project seeks to enhance training efficiency, reduce human errors, and improve the overall operational performance of instruments in chemical engineering studies.

Keywords: Augmented Reality (AR) · Process Instruments · Chemical Engineering

1 Introduction

Augmented Reality (AR) technology has gained significant attention in recent years due to its potential to revolutionize various industries, including the chemical process industry. AR offers a unique way to blend virtual information with the real world, providing users with an enhanced perception and interaction experience. In the context of chemical processes, AR has the potential to improve safety, productivity, and efficiency by overlaying critical information, real-time data, and virtual representations onto the physical environment.

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The safe operation of chemical engineering equipment, including level transmitters, is of paramount importance in ensuring the well-being of users and the prevention of accidents. Safety data, such as Hazard Identification, Risk Assessment, and Risk Control (HIRARC) and Job Safety Analysis (JSA), play a crucial role in mitigating risks and promoting a safe working environment. This project aims to incorporate safety data like HIRARC and JSA into augmented reality (AR) technology, providing users with real-time safety information and guidelines directly within their field of view. By integrating safety data into AR, users will have immediate access to critical safety information related to the operation and maintenance of level transmitters. The AR system will overlay virtual cues, alerts, and visualizations onto the physical equipment, highlighting potential hazards, risk areas, and safety protocols. This real-time visual representation will enhance user's situational awareness, enabling them to make informed decisions and take appropriate safety measures.

2 Literature Review

2.1 Problem Statement

The current approach to safety data management involves separate documents or systems that users must reference often causing distractions and delays. Users must navigate through various sources of information to assess risks, identify hazards, and determine appropriate safety protocols. This disjointed process can lead to errors, misinterpretations, and a lack of real-time awareness of safety hazards. Integrating HIRARC and JSA data into AR technology offers a promising solution to address these challenges. By incorporating safety data directly into the AR interface, users can access real-time safety information and guidelines without diverting their attention from the level transmitter. The AR system will overlay virtual cues, visualizations, and alerts onto the physical equipment, providing users with immediate visibility of potential hazards, risk levels and step-by-step safety protocols.

Another crucial aspect is the interaction between the operator and the AR system. The AR application should support user-friendly interfaces, such as gesture recognition or voice commands, to ensure users can navigate through safety data effortlessly. The users should be able to interact with the AR system to access specific safety information, view detailed risk assessments, or retrieve step-by-step safety procedures. Users need comprehensive training programs to familiarize themselves with the AR system, understand the visual representations of safety data, and learn how to effectively incorporate it into their workflows. In house training should emphasize the importance of following safety protocols, utilizing the AR system as a safety tool, and fostering a safety-conscious culture.

3 Objective and Methodology

3.1 Objective of Project

The incorporation of HIRARC and JSA data into AR will enhance the risk management process associated with level transmitter operations. HIRARC provides a systematic approach to identifying hazards, assessing risks, and implementing control measures.

The AR system will integrate this data, enabling users to visualize and understand potential hazards specific to level transmitters. They can also view risk levels associated with different tasks or operating conditions, empowering them to make informed decisions that prioritize safety. To successfully implement the integration of safety data into AR, the project will involve the development of a robust content management system. This system will compile and organize the HIRARC and JSA data specific to level transmitters, ensuring that the information is readily available for AR display. The content management system will also allow for updates and revisions to the safety data, ensuring that users have the most current information at their clearance.

3.2 Methodology of Project

There are 4 stages for an AR technology to function which are sensing, modelling, enhancing and display. For the first process, sensing, its function is to combine the physical world with digital objects with a device that already has the model of the physical world. The achievement made through the array of sensors typically includes standard cameras (light sensors), depth sensors, gyroscopes and GPS. The second process, modelling, takes the sensory information from the first process as an input. The device then will process the information to get physical model of the real world which it already has in its database. This will have many additional features that are added to a 3D positional model. The common machine learning models applied here are instance segmentation and object detection. The third process, enhancing, is a process where the device used will enhance the model that is taken from the second process to create a combination of the physical world and the digital world. This is achieved by using technology that has an addition of software assets, which can range from simple counters to interactive dinosaurs. The last process, display, is the process when the model created by the device is displayed to the end of the user. This is usually displayed through a smartphone, tablet, or even glasses.

Since it involves chemical engineering studies, it includes the safety data sheets used in the laboratory such as the SOP, HIRARC and the JSA. Before that, there are five software required for the project which are the Adobe Aftereffect, Unity 3D, Agisoft Metashape, Meshroom and the Blender. First, the chosen prototype is the Level Transmitter. The images and the videos shot of every angle of the prototype is captured using a 4k quality mobile phone. Then, the images and videos are transferred into the Agisoft Metashape software for aligning and 3D modelling purposes. After the 3D model is obtained from the software, it is necessary to clean up the model by using the blender software. On the other side, the incorporation of the safety data is the main and most important task in this project. Besides the features that will show in the screen after scanning the prototype with the app, the extra information which are the different safety data will be incorporated into the main screen. With that, the users can view and refer to the safety data by scanning the prototype instead of reading the manual guides. Therefore, some changes will be made in the program codes for the app to make the safety data incorporation. By following these steps, the safety data can be incorporated into the AR for the level transmitter.

4 Recommendation

Further research will be conducted to enhance the quality of the AR system and safety process in the project. Furthermore, suggestions from industrial experts can be considered to gain the best outcome for this project.

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Clinical Legal Education Using Metaverse - Opportunities and Challenges

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Abstract. There have been various paradigm shifts in the higher education sector due to massification. Legal education is undergoing a steady shift away from the traditional professional self-regulation, towards regulation by market forces. Technological innovations and globalisation have remoulded the market force, thus, changing the mode of delivery and accessibility of professional legal services. Such technological developments have introduced new ways of accessing legal information, support and advice. In preparation of this gradual technological shift that external market forces are gravitating towards, legal academics have discussed the possibility of integrating various technologies and educational applications into their teaching pedagogy. However, law schools are sceptical and partially resistant as to which Metaverse pedagogy can be incorporated into the clinical law programme post-pandemic. This research will examine the possible manner of integrating Metaverse pedagogies in clinical legal education. Law schools can leverage the collaborative capabilities of virtual worlds - from enabling virtual client meetings and conferences, to the use of Avatars for virtual court hearings, and the interactive use of virtual libraries for research and enhancement of legal knowledge. The paper will specifically explore the various types of Metaverse applications and their use in different aspects of the clinical legal module. This will be done by highlighting the benefits and limitations of the individual Metaverse applications, followed by some suggestions to mitigate and/or eliminate its adverse effects. This research will be valuable to legal academics, law students, educational institutions and educational technology providers.

Keywords: Clinical Legal Education · Metaverse · Market Forces

1 Introduction

There have been various paradigm shifts in the higher education sector due to massification. The ease with which higher education is attainable by the masses has intensified the ‘friendly competition’ amongst institutions to widen the student recruitment pool and inflate institutional revenue. Additionally, legal education is undergoing a steady shift away from the traditional professional self-regulation, towards regulation by market forces. Technological innovations and globalisation have remoulded the market force, thus, changing the mode of delivery and accessibility of professional legal services. Such technological developments have introduced new ways of accessing legal information,

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support and advice. In fact, technological changes and the internet is revolutionising the way in which legal professionals conduct research, interact with their clients and colleagues, and how legal firms are managed. In preparation of this gradual technological shift that external market forces are gravitating towards, legal academics have discussed the possibility of integrating various technologies and educational applications into their teaching pedagogy. However, law schools are sceptical and partially resistant as to which Metaverse pedagogy can be incorporated into the clinical law programme post-pandemic.

This research will examine the possible manner of integrating Metaverse pedagogies in clinical legal education. It is submitted that law schools can leverage the collaborative capabilities of virtual worlds - from enabling virtual client meetings and conferences, to practising advocacy skills using simulations, and the interactive use of virtual libraries for research and enhancement of legal knowledge. The paper will specifically explore the various types of Metaverse applications and their use in different aspects of clinical legal modules. This will be done by highlighting the benefits and limitations of the Metaverse application, followed by some suggestions to mitigate and/or its adverse effects. This research will be valuable to legal academics, law students, educational institutions and educational technology providers.

2 Clinical Legal Education

Over time, many academics have attempted to provide a cohesive definition of CLE that encapsulates what it does and how it does it. The relevant literature largely agrees that there must be a practical or applied component through which the student experiences law and legal processes. Today, authors believe CLE have gone beyond just doing and have started to include what can be summarised as a deconstruction experience process. Amsterdam classifies it as a technique designed to educate students through systemic exposure to experience. While, Giddings' definition includes a wider array of key features or characteristics including but not limited to intensive small group or individual work, personal (student) responsibility for the work carried out, supervisor collaborations, constructive feedback, reflections, interactions and consideration of ethics. A similar definition can be found in the UK pioneering works of Brayne, Duncan and Grimes. Recently, Kerrigan and Murray provide a succinct definition- 'learning through participation in real or realistic legal interactions coupled with reflection on (the) experience'.

Evidently, CLE is a type of hands-on learning opportunity coupled with an analysis and deconstruction of what has occurred. Learning through experience, and reflection based on that experience is ubiquitous in many fields of study from teaching at hospitals to the science laboratory. However, legal educators, especially in Malaysia, have been relatively slow in using experiential learning in their curriculums. Rather, legal academics have dominated formal legal learning with a curriculum delivered primarily through lectures, where students are merely passive learners and recipients of knowledge. However, with massification and the shift towards market force regulation, the responsibility to educate lawyers has become the primary preserve of universities and other legal education providers. If legal education is to meet the needs and demands of the legal profession, and serve the career aspirations of contemporary society, then a holistic legal education framework, containing the knowledge, skills and values needed for the industry must be developed by education professionals.

There are various models of clinical practice, where students under the requisite supervision, engage in real or realistic casework in order to comprehend relevant content such as legal doctrine, lawyering skills and/or professional and ethical considerations. There are many benefits to CLE and these anecdotal claims include, power of the model pedagogically, impressive student performance, positive feedback from various stakeholders. There is also sufficient evidence in academic writings on the benefits of CLE in terms of high levels of engagement and motivation, opportunity for holistic development, chance to apply theory to practice, community service, new generation of teaching material based on actual case work, well-equipped graduates and development of lawyers committed to pro bono and 'legal aid' work.

Regardless of the abundance of benefits, it was difficult to reap the aforementioned benefits during the pandemic when the entire world was forced to maintain social distance and live in isolation. Initially, running legal clinics and carrying out 'legal aid' work was difficult to conduct since collaborative work was hinged upon face-to-face meetings to dole out advice and confer with clients (neutral venue needed), attain constructive feedback from supervising lawyers, and interact with other law clinic personnel. Most education providers were unprepared and did not have a structured framework in place for online collaborative work. As we adjusted to the pandemic, there was a strong reliance on online meeting applications such as Zoom, Google Meet and Microsoft Teams to carry out legal clinic activities. Although we are physically able to carry out such activities once more, legal education institutions and academics must accept that the technological and online aspect of legal clinics should not be eliminated entirely.

The author believes that the pandemic merely propelled and cemented the use of technology in the legal profession as many facets of the legal industry have incorporated the use of the internet and technologies in terms of client conferencing, electronic contracts, and even online proceedings pre-pandemic. Court systems have also changed drastically over the last 20 years in their use of communication and document management technologies. For example, Malaysian courts have now introduced an e-filling system that allows advocates and/or solicitors to electronically lodge applications and other documents. Additionally, case management has also been facilitated by the use of e-kehakiman, an online case management system. Virtual proceedings have and continue to take place post-pandemic as well and most recently, AI sentencing has been introduced in Malaysia. Thus, rather than eliminating the online aspect of CLE, institutions should embrace such technology and take the opportunity to create unique programmes that allow the graduate to be technologically-abled.

This can lead to additional benefits such as increasing the employability rate of graduates with 21st century transferable skills, thus creating 21st century ready-lawyers to be absorbed into the legal industry. This is because law students need not only core legal skills but also digital skills to respond to the technological change. In fact, Generation Z, those born between 1997 and 2012, are now entering law school as digital natives, born into the mobile revolution and having grown up exposed to high levels of technology. The motivations and skills of this generation is important in understanding how important it is to take legal education to the next level in response to digital transformation.

3 Client Meeting and Conferencing

Client interviewing or conferencing is the starting point for most lawyers as it is during this client meeting, whether face-to-face or online, that lawyers can obtain valuable information to gauge what the client needs and start the initial prep work for the cases. The interview is pivotal to helping identify what the clients' wants and needs are, to assist them in making sound legal and non-legal decisions (where relevant), create a sense of confidence and competence whilst building a trusting relationship to ensure recurring work and client satisfaction. It is important to prepare the student well for this task as a client interview requires the lawyer, in this case the student, to maintain their emotions, avoid arguments with the client and to ensure that the student does not convert the interview into a debate to show off their oratory skills. To avoid these rookie mistakes, students should be exposed to client interviewing and conferencing during the CLE. Appreciating the do's and don'ts of this task will prepare the student to be better aids to their lay clients who may be emotionally exhausted and lack the requisite knowledge to understand legal jargon. What they require is a solution to their problem (legal or otherwise-alternative dispute resolution(ADR)) and a firm yet understanding hand of their situation.

As such communication skills, social cues, body language reading and eye contact is key to creating a safe space, understanding the severity of the situation and being able to act with the correct response to the clients' specific complaints. This task may seem rather simple but can be rather daunting for the first timer. In a face-to-face setting, the client interview or conference will take place in a neutral venue (law clinic) and proper refreshments will be available. Students will have to prepare a notebook and pen to note down any important information that is dictated by the client.Often the supervising lawyer will be present next to the student, to oversee and advise when necessary. In an online setting this is achieved using online meeting applications such as Zoom, Google Meet, Microsoft Teams, etc. These applications can be classed within the Metaverse.

The origins of Metaverse technologies trace back centuries to rudimentary sensory illusions and to recent advancements in computing. For decades Extended Reality (XR) and 3D technologies have contributed to the advancements in many scientific fields. However, the term Metaverse became popular with the recent announcement by Mark Zuckerberg to rebrand Facebook with the name 'Meta'. The hype surrounding this phrase led to the development of many metaverse technologies as curious technophiles have attempted to utilise the existing Metaverse applications and maximise its benefits in the commercial, non-commercial and educational realms. Metaverse is a nascent concept that is continuously evolving and every Meta-user, and developer interpret the term differently in accordance to their personal development, use and perception. It may be easier to understand the term Metaverse by examining its etymology. Metaverse is a combination of the Greek word 'Meta', which signifies 'transcendence' or 'beyond', and the word 'verse' or 'virtuality' which represents 'universe' or the 'totality of something'. Hence 'Metaverse' is an amalgamation that reflects the interactions or engagements users have that transcend or go beyond the universe. Metaverse alters the human experience fundamentally, using technology that goes beyond our physical reality. This definition depicts an earth that is digitally expressed through the internet, smartphones and other media technology. In 2006, the Acceleration Studies Foundations (ASF), conducted research and released a metaverse roadmap. The roadmap classifies metaverse into four types, which include augmented reality (AR), lifelogging, mirror world and virtual reality (VR). The research proposes that Metaverse should be perceived as a connection point or an amalgamation of the real world and virtual reality.

The 'mirror world' on the other hand, is a Metaverse application that involves replication or 'mirroring' of the physical world. It appears in an enhanced virtual model as a reflection of the real world, as if reflected in a mirror. Google Earth, Maps and Waze are good examples of this application. Although Google Earth solely emulates geographic information systems, research has proven that interactions can also take place in the mirror world through virtual educational spaces. These include the use of MS Teams, Zoom, Google Meet and other Learning Managements Systems (LMS) where classroom interactions operate in real time. All these applications have been extensively used by educators and educational institutions during the pandemic, including Malaysian law schools. In these virtual meet applications, it is not the physical world that is mirrored, rather it is the interactions that are reflected. For instance, dissemination of legal knowledge and interactions between peers in the physical lecture hall is replicated during the lecture sessions on Google Meet.

Lifelogging is a type of Metaverse that captures synchronous or asynchronous interactions displayed on the Internet such as Instagram and Facebook 'live' and 'stories', TikTok reels, YouTube etc. The projection of the live or recorded interactions is an augmentation of oneself and can be considered to be part of the metaverse realm. It is proposed that students can conduct Instagram or Facebook Live and answer basic questions or queries on legal matters. This will allow the advice to be given out immediately in real time and allow for further engagement with potential clients as well. Such exposure is essentially a marketing gimmick that allows the general public to be aware of such legal aid services that are easily accessible for them. Clearly, the downside is that the advice given should be generic for privacy and confidentiality reasons, and to appease the masses on the Live streaming. Evidently, the client interviewing and conferencing skills can be mirrored on these online applications. The advantages include accessibility, time-saving and maintenance of mental health.

Accessibility meaning that such conferences and queries are not hindered by geographical/physical location concerns. It is also cost-effective, as no venue would mean no extra resources such as refreshments, air conditioning, tables, chairs etc. It is also time-saving as sometimes clients merely need a considerate ear rather than an exact legal solution. Even in terms of legal solution, the meeting can take place at any moment so long as there is a stable internet connection and laptop or smartphone, or tablet device, this means that there might be lesser waiting times as well. Clients can attain immediate advice and start legal proceedings or other next steps immediately. Many young lawyers have also commented that having online applications can also create a much-needed distance between the client and lawyer since these online meetings must be set up in advance at a certain period of time. Unlike mobile phones that allow immediate access including odd hours or on off days. As such, mental health is maintained as well.

Despite these benefits, there are also adverse effects to online applications. The primary being the effect these applications may have on the students' communication skills and emotional intelligence. Since online applications do create some distance between the client and the student, it may be difficult to create environments where emotions can be well perceived. The client may feel emotionally distant and as such may disengage from the student. Online applications may also make it significantly difficult to read social cues. Without excellent internet connection and 4K resolution screens or devices, it may be difficult to attest the body language and eye movements of the clients. The problem may be further exacerbated if poor internet connection causes any of the participants to disconnect from the meeting and are forced to reconnect. The few seconds or minutes of disconnection can create distance as well. As such online applications should be used sparingly and expectations of both the student and client should be managed accordingly to ensure a smooth meeting. Academics should work with the supervising lawyers to produce a conducive framework for the use of online applications and a guideline similar to the one in call centres for the students, in order to ensure the client's needs are met while minimising the adverse effect of online applications.

4 Avatars in Simulations and Virtual Hearings

Virtual reality (VR) technology is a type of Metaverse application that is part of the Metaverse technology that allows for the possible manner of integrating Metaverse pedagogies in clinical legal education. This can be illustrated via the usage of avatars. Peterson stated that avatars can be described as "online manifestations of self in a virtual world, and are designed to enhance interaction in a virtual space."

The new VR tools go beyond many traditional limitations and now allow multiple participants to freely interact with each other in the similar 3-D computerized environment. In many cases, computer networking capabilities have dramatically increased to the point where users can now run complex 3-D VR simulations in the field using a laptop connected to the Internet. Training with VR allows large numbers of law students to interact in a simulated face-to-face environment with other distant students from various law schools or institutions through the Internet, and with judges, civilians, and even medical personnel units, providing a training experience for advocacy skills that is increasingly effective, but at a much lower cost than would be required for assembling these personnel for a real-life face-to-face training exercise.

VR technology offers a potentially effective and economically efficient tool for training law students to better deal with dynamic or potentially legal situations. VR participants use self-designed computer images called avatars that look and act like real people, and operate in virtual world environments that can have almost any combination of simulated characteristics. The resulting interactions can be unpredictable and can seem highly realistic to the individual operators involved. Some of the avatars can simulate local citizens and, when operated by real-life actors, can demonstrate culturally correct gestures, show facial expressions, and communicate emotions, which military personnel trainees must interpret correctly during these virtual world encounters.

Avatars can be used in a virtual courtroom and hearing during the virtual legal attachment period. Avatars could play various roles as seen in a physical courtroom scenario. Avatars could be judges, lawyers, paralegals and other legal professionals in virtual courtrooms and hearings. By the same token, avatars can be used to represent lawyers, paralegals and other legal personnels in a virtual law firm. This could expose law students to discover and engage in mock trials and other legal proceedings to practise their advocacy skills that would make the virtual legal attachment more fruitful. Law students will be able to expand their legal knowledge and skills.

Moreover, legal academics can use avatars in their advocacy master class via simulations. For example, using an actual case, students are then required to assess legal writing from a judicial perspective. This suits students with different learning styles which entails oral and written components, as well as individual and group activities. This can be altered based on students' abilities and convenient class time. The use of avatars in a virtual legal attachment experience could help to create a more engaging and interactive learning environment for law students. By representing legal professionals, clients, and other parties in a virtual setting, avatars could help to prepare students for the real-world challenges of practising law. Avatars can provide a unique and engaging virtual experience, they may not be the most effective method for legal attachment experiences in law schools.

Despite attempts to minimise the possibility of interpersonal virtual harm, programmers cannot remove all possibility of online deviant behaviour. As Hunter and Lastowka put it, "If avatars find it amusing to make the lives of others miserable, they will find ways to do so. Moreover, a high degree of freedom amounts to a high degree of anonymity that reduces a person's sense of guilt. This reduction or elimination of guilt may create more avenues for 'Meta-bullying' to take place, similar to cyber-bullying. Bullying incidents can range from minor incidents to grievous or severe circumstances that may affect the character credibility and ethics of legal graduates. This may pose problems when it is time for the graduate to be admitted to their local Bar Council. There is a high probability that virtual spaces can develop into a lawless zone that may allow for the emergence of unpredictable, vicious and sophisticated crimes.

This may pose a significant risk to law students with insufficient social skills and unformed identities. Institutions and academics must vigilantly monitor student behaviour and have strong ethical user guidelines in place to reduce the impact of this challenge. Implementation of avatars for a virtual legal attachment experience using Metaverse is similar to any other educational technology requires copious amounts of money, effort and time in terms of educational costs, purchase and maintenance costs, and overall consumption of time that can lead to fiscal costs. Lastly, all the above-mentioned actions will be very time consuming and this may cause additional costs that can delay profits and make investors unhappy. A comprehensive grasp of the possible benefits and challenges of using Metaverse in clinical legal education may also provide a useful starting point for legal academics in drafting a practical, sustainable and functional action plan to ensure efficiency in the implementation process.

5 Virtual Law Libraries

Libraries, in general, exist to enhance the acquisition of knowledge through the provision of reading materials – book and non-book for the purposes of teaching, learning and research. Law library which supports legal transactions, learning and research activities of lawyers remains a heavily patronised information centre, where information is packaged in various formats to the advantage of the users. The value of the library collection depends not only on the quantity of information sources but on the effective ways and means of providing and interpreting them to users. A traditional law library is a physical library that houses a collection of legal resources, primarily in print format, to support legal research and study. Traditional law libraries are typically found in law schools, courthouses, law firms, government agencies, and other legal institutions. While traditional law libraries continue to play an essential role in legal research, they are increasingly complemented or even supplemented by virtual law libraries and online legal research platforms. These digital resources provide convenient access to a broader range of legal materials, advanced search capabilities, and remote accessibility.

While the Metaverse can be seen as a natural evolution of information technology and information communication technology, it also presents a whole new level of opportunity for creative content to further its potential and it also opens up the space for all segments of creative content to collaborate with these technologies. This includes a virtual law library.

A virtual library, also known as a digital library or electronic library, is a digital platform that provides access to a collection of electronic resources, such as books, journals, articles, databases, multimedia materials, and other digital content. It is a digital representation of a traditional library, offering online access to resources that can be accessed remotely via the internet. It is typically hosted on a web-based platform or a specialized software application. It serves as a centralized repository of digital materials, providing users with the ability to search, browse, and retrieve information electronically. Virtual libraries often incorporate features such as advanced search capabilities, user authentication, personalized interfaces, and interactive tools to enhance the user experience.

Virtual libraries may include both open-access resources available to the public and subscription-based resources accessible to authorized users, such as students, researchers, and library patrons. They can cover various subjects and disciplines, including law, medicine, science, humanities, and more. The advantages of virtual libraries include 24/7 access to resources from anywhere with an internet connection, the ability to conduct efficient searches across vast collections, remote access to resources, and the ability to leverage digital technologies for enhanced learning and research experiences.

Most of the law libraries today have gradually migrated from traditional mode of operation to digital heavens while others are still on the brink of conversion. There is also no doubt that many libraries choose to remain hybrid—a practice of combining traditional and digital library systems.

Flexibility and work-life balance considerations of virtual law libraries have made this new practice thrive over the traditional legal practice. Therefore, students and academics from the comfort of their homes or any location of their choice without necessarily having physical contact with librarians. Students have an opportunity to utilise the virtual library while having and practising in their physical classes. Academics at the same time may provide and share any information that is related to their classes or lectures because the virtual law library provides speedy and wide access to up-to-date legal information in a global manner and therefore, saves the time of their clients, in this case, the students and academics. Cloud-based technologies that facilitate quality service delivery to clients including data and software on a remote server enhance the practicability of the virtual law library. Cloud application involves the use of internet connection and browser for on demand and scalable access to a shared pool of resources hosted in a data centre at provider's site. Cloud technologies depend on web computing where shared servers give software infrastructure platform devices and other resources and hosting to clients in order to meet their needs. Cloud-based technologies are able to store a lot of data and information resources that can be accessed not only through computers but also through any electronic devices that support the technologies. It is an advantage where students and academics can communicate and discuss any relevant information at any spaces that they choose to have their conversation. Since the data and information are easy to access, it is also multi sharing. They are able to work at the same time and more adequately with less cost by sharing fundamental infrastructure utilising distributed computing.

There are challenges in maintaining the virtual library. Other than poor internet connectivity at the places, lack of competencies among students and academics in the use of online resources and digital platforms discourages the adoption of virtual law libraries. Even when the virtual library is available, if the users lacked the requisite competencies in utilising the resources, the objective of the library would be fulfilled. Thus, in maximising virtual law library features in Metaverse learning pedagogies, one needs to ensure that the users are able and have good understanding of the applications or any resources provided by the library.

6 Conclusion

It is indisputable that face-to-face interactions in physical settings provide higher pedagogical value. Often these interactions are difficult to replicate in online settings, but the integration of mixed-reality metaverse into clinical legal education can offer a rich alternative and an immersive learning experience. Law students appreciate the flexibility as well as the enhanced access it brings to legal education. Clinical legal education via online conferencing and meet-ups, skills training, the use of Avatars for virtual court hearings, and the interactive use of virtual libraries for research and enhancement of legal knowledge represent a major thrust in the direction of integrating law practice training into the law school curriculum. Law schools should be cautious but ready to embrace this new mode of online or Metaverse deliverance, to avoid being left behind. It seems apparent that these practice-oriented curricular programs are now firmly entrenched in the legal educational mainstream. Creating opportunities for learning how technology is shaping legal practice should be a priority for any school looking to provide a useful education for the lawyers of the present, let alone the future. For law schools, the choice is simple: adapt or disappear.

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Connecting Theory to Reality: Exploring Experiential Learning Through Field Trip

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Abstract. This paper explores the concept of experiential learning and its impact on teaching and learning outcomes, with a specific focus on the use of field trips as a valuable experiential learning tool. Field trips provide unique opportunities for students to engage in hands-on experiences outside the traditional classroom setting, therefore enhancing their understanding and retention of knowledge. Langkawi was chosen as a place for the field trip visit for Fundamental of Petroleum Exploration Engineering. The field trip visit covers the area of Setul Fomation in Kilim, Penarak, Pantai Pasir Hitam, Pantai Tengkorak and Pantai Tengah. The Kilim Karst Geoforest Park in Langkawi is a UNESCO Global Geopark. It offers opportunities for students to learn about geology, limestone formations, and the processes that shape the Earth's surface. The paper examines the benefits of experiential learning, highlights the role of field trips in facilitating this approach, and discusses strategies for maximizing the educational potential of field trips. Additionally, potential challenges and recommendations for successful implementation of field trips as experiential learning experiences are discussed.

Keywords: experiential learning · field trip · active learning

1 Introduction

Experiential learning through field trips is an effective educational approach that allows students to actively engage with real-world experiences, fostering deeper understanding and retention of knowledge. Langkawi, an archipelago in Malaysia, is an excellent choice for a field trip destination for various reasons. Langkawi Geopark is recognized by UNESCO for its unique geological features, providing students with opportunities to learn about geological formations and processes. Langkawi is home to diverse ecosystems, including rainforests, mangroves, and coral reefs, making it an ideal location for students to study biodiversity and ecological conservation. Incorporating these aspects, Langkawi offers a well-rounded educational experience for students across various disciplines, making it an excellent choice for a field trip destination.

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2 Objectives

The objectives of this Field trip have been aligned to the Course Outcome (CO) to provide students with real-world experiences and hands-on learning opportunities that reinforce and supplement classroom teachings. This will foster student engagement by exposing them to new environments, perspectives, and interactive experiences that spark curiosity and critical thinking. The field trips can encourage teamwork and social interaction among students through group activities, discussions, and shared experiences during the field trip.

3 Theoritical Framework

3.1 Definition of Experiential Learning

Experiential learning is an educational approach that emphasizes learning through direct, hands-on experiences and active engagement with real-world situations, problems, or activities. It is a learner-centered approach that encourages students to actively participate in their own learning process, gain practical knowledge, and develop skills by doing, reflecting, and applying what they have learned.

3.2 Key Principles of Experiential Learning

David A. Kolb is a psychologist and educator known for his influential theory on experiential learning. Kolb's theory, often referred to as the "Experiential Learning Theory" or the "Kolb Learning Style Inventory (LSI)," is based on the idea that learning is a cyclic process that involves four key stages or modes. These stages are often represented as a continuous cycle, highlighting how learners engage with and process experiences. The four stages in Kolb's theory are:

a) Concrete Experience
b) Reflective Observation
c) Abstract Conceptualization
d) Active Experimentation

Experiential learning is widely recognized for its effectiveness in promoting deeper understanding, retention of knowledge, and the development of practical skills and competencies. It encourages active engagement, critical thinking, problem-solving, and the ability to transfer learning to new contexts. This approach is often used in various educational settings, including classrooms, outdoor education, vocational training, and professional development programs.

3.3 Benefits of Experiential Learning

Experiential learning offers numerous benefits for learners of all ages and across various educational and professional settings. Learners are actively involved in hands-on experiences, making learning more engaging and enjoyable. Experiencing and doing things directly can lead to better retention of knowledge and skills compared to passive learning methods. Experiential learning promotes critical thinking and problem-solving skills as learners analyze and reflect on their experiences. Experiences create lasting memories, making it more likely that learners will remember and apply what they've learned over time. Experiential learning prepares individuals for the challenges and demands of the real world, including the workforce. The reflection component of experiential learning encourages learners to think critically about their experiences and make informed decisions. Learners tend to report higher levels of satisfaction with experiential learning experiences compared to traditional classroom-based learning. Experiential learning fosters a mindset of lifelong learning, encouraging individuals to continue seeking new experiences and knowledge throughout their lives. These benefits make experiential learning a valuable approach in education, training, and personal development, as it promotes holistic and meaningful learning experiences.

4 Maximizing the Educational Potential of Filed Trips

4.1 Preparation Before the Field Trip

Maximizing the educational potential of field trips requires careful pre-trip preparation to ensure that the field trip is not only enjoyable but also a valuable learning experience for students. The objective of the field trip is clearly communicated to students. Students are also aware that they need to prepare a field trip report that includes all outcrop visited during the field trip. The instructors arrange transportation, permissions, and necessary paperwork well in advance to get approval from the Petroleum Engineering Department. Students we divided into groups and assigned one outcrop in advance to get all information related and share with other students along the way. Students were provided with Field trip guide manual to ensure they have advance information before the visit.

4.2 During the Trip: Active Engagement Strategies

During the actual trip itself, students are involved actively engaging in the learning and discussion and making the experience as meaningful as possible. Students performed group discussion during the process identifying the dip direction, dip angle and strike angle. These activities ensure students understand the geological orientation of the rock layers. The strike refers to the compass direction of a horizontal line on the inclined bedding plane, while the dip indicates the angle at which the bedding plane slopes downward from the horizontal. These measurements help a lot in map and interpret the geological structures and formations present at Pantai Tengah Cenang.

4.3 Post Trip Reflection and Assessment

Post-trip reflection and assessment are crucial steps in ensuring that the educational potential of a field trip is fully realized. These activities help students consolidate their learning, provide feedback to educators, and guide future trip planning. A debriefing session was held after the field trip to make sure students get the appropriate understanding on the idea of the field trip visit. Students need to prepare a field trip report as part of the assessment of the course. Post-trip reflection and assessment are essential components of the learning process associated with field trips. They allow students to consolidate their knowledge, provide educators with valuable insights, and ensure that future trips are even more educational and enriching.

5 Conclusion

A field trip to Langkawi, the beautiful archipelago located in Malaysia, provides students with a unique and enriching educational experience. Langkawi's natural beauty, rich cultural heritage, and diverse ecosystems offer a plethora of opportunities for learning and personal growth. Students had a one-of-a-kind chance to discover and research the island's numerous natural formations during the field trip to Langkawi. This field trip's main goal was to give students practical experiences and chances for hands-on learning that would supplement and support their in-class learning. Being exposed to fresh settings, viewpoints, and engaging activities, the field trip was very successful in fostering student involvement. Students were encouraged to collaborate and engage in social relationships through group activities, conversations, and shared experiences, which promoted cooperation and improved their interpersonal skills.

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Detailed Documentary Review: An Approach to Enhance Students' Cognitive Skills and Raise the Awareness of Saving the Planet

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Abstract. This study proposes the application of detailed documentary review assignment as a comprehensive teaching and learning approach to elevate students' interests on the knowledge been taught. This method needs the students to perform in-depth research upon the specific documentary, whereby this allows the students acquire vast knowledge that is not limited to only from the documentary and lectures. Such approach has been implemented on several batches of Year 1 Geoscience students in Universiti Teknologi PETRONAS (UTP) via using a documentary film entitled "Mass Extinction: Life at the Brink". The primary focuses of this endeavor by using the specific documentary are to teach the students on the significant workflows and terms used in research methodology whilst conducting the assignment and nurture the awareness among them upon the importance of saving the planet Earth. Students' performance on this assignment was evaluated through their final slides presentation in groups. The outcomes have shown that such teaching approach have positively impacted the students' learning and cognitive skills in a way it helps to sharpen up the students' critical thinking ability by providing plausible solutions for saving the Earth and students were able to properly grasp the essential processes used research methodology in which this component is crucial for their future studies application.

Keywords: Documentary Review · Critical Thinking · Teaching and Learning Technique

1 Introduction

Watching documentary films has proven to enhance mental and brain health by psychologists. This study aims to implement the utilization of relevant documentary films as a medium of teaching and learning for students. Most students found that reading facts and theories consistently can be overwhelming at some point, thence watching documentaries is an excellent alternative to reading. Documentary films are rich with useful information and fact that can improve students' comprehension upon diverse and important subjects which are delivered by professionals and researchers. This study proposes a method of using documentaries as a teaching and learning endeavour via giving students an assignment which involves conducting an in-depth review upon a specific

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documentary. This technique requires students to conduct detailed research upon the specific documentary, hence students will gain more knowledge which is not strictly limited to the documentary. This approach has been implemented in several batches of Year 1 Geoscience students in Universiti Teknologi PETRONAS (UTP) whereby the documentary film used is titled "Mass Extinction: Life at the Brink".

This documentary explores the mass extinctions which occurred on Earth and the probabilities for a sixth mass extinction phenomena. It provides the students with awareness on the factors which had led and could lead to mass extinctions. Moreover, this teaching and learning activity requires the students to think of possible solutions for saving the Earth and preventing a sixth mass extinction from occurring. Such assigned activity has been received with positive feedback and responses from students, and essentially managed to nurture the importance of saving our planet Earth from destruction.

Objectives of this teaching and learning technique:

1. To utilize documentary film as a medium of teaching and learning for students.
2. To familiarize the students with the important processes and terms related to research methodology when conducting the in-depth documentary reviews.
3. To raise awareness among the youths upon the urgency to save the planet Earth.

2 Documentary Film-based Learning Theory

The documentary films are produced for inspiring and conjuring certain forms of intelligent and emotional reactions as they provide the audience to vital information regarding global, political, and social issues which some are not discussed during classes. The information shared via the film is a useful learning medium for elevating students' enthusiasm and attention [1]. Watching documentaries can help in regularly feeding students' minds with new, valuable knowledge and information that can lead to enhancement in mental's intelligence. However, it is important to note that not everything presented in a documentary is true. Thence, the students must always have a sceptical mind and think critically upon everything they learn to avoid misinformation. Hence, watching documentaries is effective in nurturing students' critical thinking skills [2]. The proposed teaching and learning technique using documentary films invites students to do in-depth research upon the information retrieved from the documentary.

Through documentaries, students will be able to improve their knowledge depth and connect themselves with the world, hence preventing them from isolation. Doing a documentary review (proposed method) allows students to integrate knowledge from diverse sources and put the newly gained ideas into application. Furthermore, the implementation of the proposed method will help educators to acquire the youths' attentions to experiencing the world. Therefore, such a method is beneficial to both the educators and students [3]. Documentaries are powerful tools to integrate global human values which are crucial to universal education.

2.1 Summary of Documentary Film Entitled "Mass Extinction: Life at the Brink"

The film documented the events of mass extinction which had occurred on Earth and provided conclusive evidence which proved such occurrences. It also highlighted about the possibilities for a sixth mass extinction to occur as well as identified several factors that may lead to the event. It was delivered excellently by highly professional researchers and scientists within the field and it also raised the awareness on the urgency to save our planet Earth from deterioration as there are actually many species are facing extinction due to humans' destructive activities. Such documentary film is very educative, compelling, and convincing. It delivered the knowledge regarding mass extinctions in a very detailed manner but yet easy to be understood. It is a high quality documentary as so much effort been put into it in order to make it a highly pedagogic and scientific broadcast. People are greatly encouraged to watch this factual film for gaining better insight about mass extinction as this is an important subject which has been frequently overlooked and forgotten by times (Fig. 1).

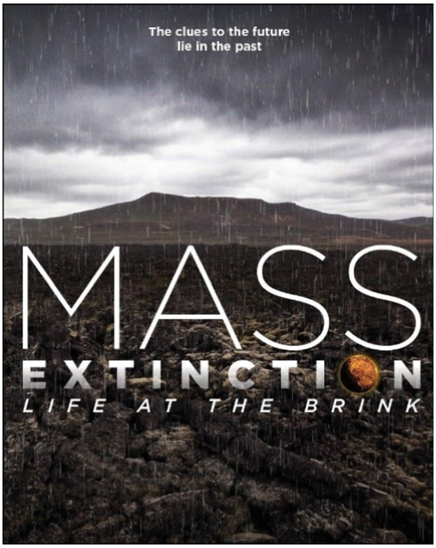

Fig. 1. The poster of the documentary movie entitled "Mass Extinction: Life at Brink" when it was released in 2014

3 Methodology

There are various techniques which can be applied when utilising a specific documentary film as a teaching medium. The most easiest and simplest way is to show the film during lesson periods and/or share the film with the students for them to watch on their own at any time. However, there is a likely high tendency that the students will not give their full attention and concentration to the documentary hence, the main message and knowledge from the film could not be properly addressed to them. The primary idea of this study is to extensively make use of the documentary as a helpful teaching and learning tool for improving the teaching experiences and elevating students' attentiveness towards specific lesson been taught.

First of all, the teacher or lecturer should wisely choose on which subject and subtopic which is suitable to use a documentary film as a teaching medium. Once decided, he or she ought to thoroughly search for a high quality factual film which is related to that particular subject or topic and study about the overall content of the programme. The aforementioned documentary film about mass extinction was used in Principal of Stratigraphy course whereby it is one of a mandatory subject that need to be taken by Petroleum Geoscience undergraduate students in UTP during their first year. The chosen documentary should be shared to the students through an easy online platform where the students can access the film without any difficulty.

The detailed documentary review assignment should be done in groups. Thence, the students would need to be assigned into a group of three to four persons. In order for them to complete the given assignment, they need to watch the film from beginning to the end attentively. Whilst watching the programme, the students are required to capture and extract all of the significant details and information from the documentary which are relevant to the main task. To help in broadening their scope of knowledge regarding the documentary, they would need to conduct an in-depth research upon the extracted info and study about the backgrounds of the professionals involved in the film. The ultimate outcome of this assignment include the students need to produce and perform a detailed and concise presentation on the gathered details regarding the factual movie.

Each student in one group should present his or her respective part about the documentary review. The content and flow of the presentation should be succinct and accordingly from one topic to another. Their presentation would be assessed and evaluated individually and in group by the lecturer. Marks would be given based on the students' performance during the presentation, emphasizing on their ability to grasp as much knowledge from the documentary and summarise them. Figure 2 displays the general workflow for the methodology proposed for detailed documentary review assignment.

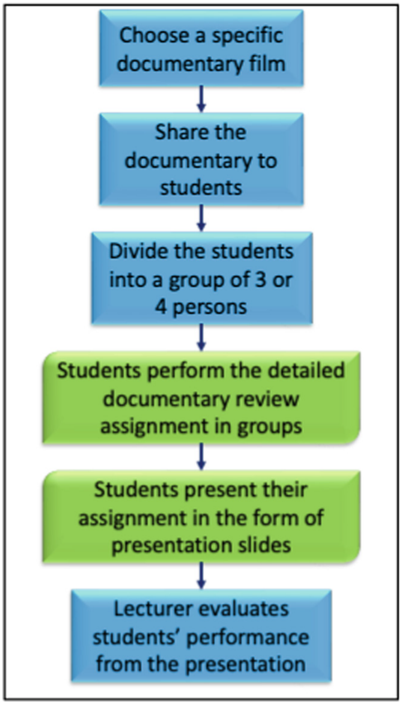

Fig. 2. The general proposed methodology workflow for the application of detailed documentary review assignment. Blue boxes are indicated for the lecturers whilst the green boxes are for the students.

4 Impacts of the Documentary Review Assignment

The given assignment has received positive responses and feedbacks from the students based on their completed and submitted works. They submitted the assignment in the form of PowerPoint presentation slides and presented the slides in groups. The outcomes of their works have shown that this technique of teaching and learning has impacted the students positively in the many ways. The documentary review assignment was able to open up the students' mind on what is currently happening around them without them realizing or noticing it as they tend to only focus on things which are significant to their own personal life. Hence, this assignment has managed to bring the students out of their boxes or comfort zones by showing them the good and bad realities of world which are occurring around them, making them understand and feel encouraged to adhere the responsibilities to saving our planet Earth from the sixth mass extinction.

Apart from that, the given task has positively impacted the students in a way they were able to develop and enhance their cognitive and critical thinking skills as they performed a detailed research upon the information and inputs which they have gained from the film. Their problem solving abilities were also improved since they analytically thought of plausible and intriguing solutions for solving the main critical issues which were identified in the documentary, i.e., how to prevent a sixth mass extinction event from occurring. Watching the documentary allowed the students to constantly absorb and be exposed to new valuable knowledge which is essential to keeping their minds sharp and active. As completing the documentary review assignment was a group work, it taught the students on the importance of teamworking, good communication skills as well as proper task delegations in accomplishing certain task. These would be reflected in their performances during the presentation.

In addition, as a young learner, the students often need an icon or someone whom they could look up to as an inspiration for them to strive their life goals. Through this given assignment, students could become greatly inspired by the experts who involved in the documentary as they performed detailed background research on each one of the professional. Studying about the experts' successes, achievements, and contributions in their own respective field or the world could highly motivate the students to be successful in the academy and career in the future. Students need this form of motivation from the people with strong and excellent educational backgrounds for encouraging them to pursue and complete their tertiary education level since the world needs more professionals with vast knowledge and skills who can give positive contributions towards the betterment of this Earth.

Furthermore, the detailed documentary review task has provided the undergraduate students with an early exposure to the processes involved in research methodology. When doing a research on a specific topic, a person is ought to identify the main issues that the topic has and performed detailed study or literature review to acquire an in-depth apprehension on the subject and its problems. The subsequent crucial step is to propose suitable solutions with detailed methodology workflow for encountering the problems in order to achieve the primary objectives of the study. Understanding the research methodology processes are vital for the students as these are the basic core steps which they would need to use in every research tasks during their studies and projects completion. Figure 3 shows the general flow of the research methodology. The students also learned how to extract and summarize the overall research about the acquired information from the film and produced a concise and presentable documentary review.

The significant and valuable inputs as well as messages which the students received from the documentary especially upon the urge and awareness to saving the Earth from the sixth mass extinction can be spread by them through any means. Word spread among people is like wildfire hence, the students could begin to share the awareness with the persons who are closest to them, i.e., families and friends who will then converse about it with their other relatives or contacts (Fig. 4). Student could also make use of the latest social media platform functions like Instagram, Twitter, TikTok, Thread, and more for sharing the cognizance among the netizens (Fig. 5). These platforms are the current fastest medium of transferring and spreading info in various creative forms like writing, images, videos, animations, and more. Certain information can be spread to the entire world with just one click. Therefore, through these ways, many people can gain the awareness and exigency about the present Earth condition and to prevent the occurrence of the sixth mass extinction.

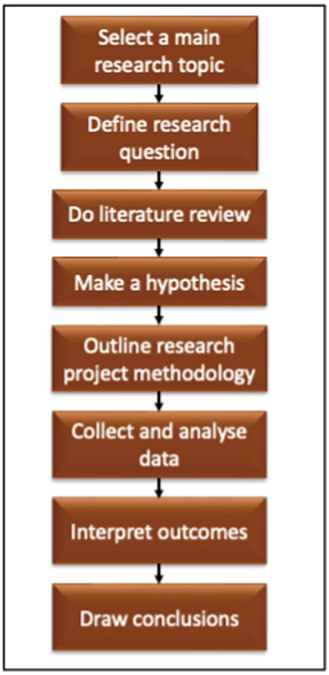

Fig. 3. The general workflow of research methodology processes

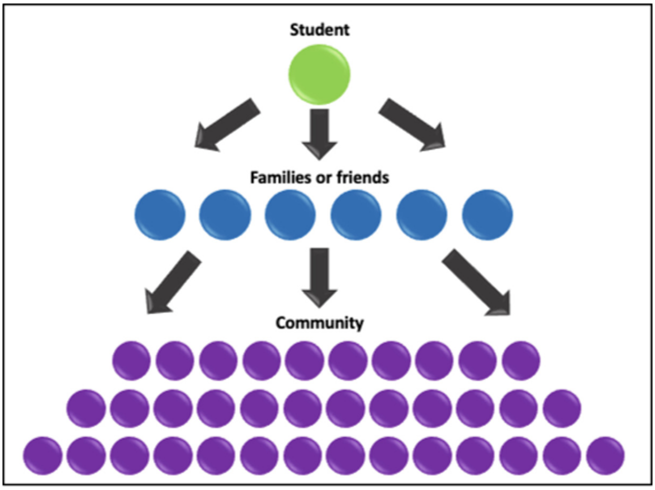

Fig. 4. An illustration of message delivery chain via word spread

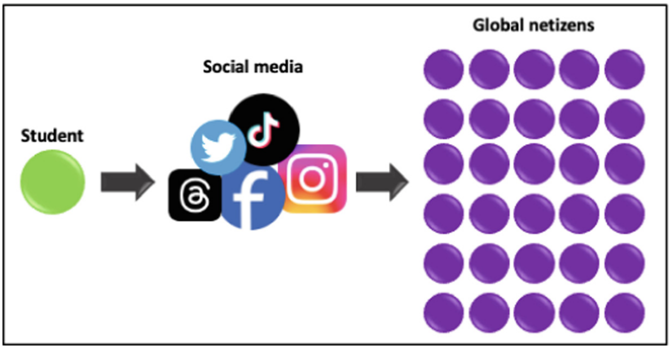

Fig. 5. An illustration of message delivery via social media platforms

5 Conclusion

In conclusion, the application of detailed documentary review assignment as a useful teaching and learning mechanism for lecturers and students is an effective approach towards advancing students' cognitive abilities. Students were able to gain many benefits from this assignment hence, proving it as an efficient alternative teaching technique that is able to elevate students' attentiveness in class. Other than that, such approach was very helpful in raising the awareness of saving the planet Earth among the students as it required the students to come up with creative and plausible resolutions to minimize the occurrence risk of sixth mass extinction. The evidences of world destructions as documented in the film has convinced the students and audiences on the importance of our role as a human being to taking care of the mother Earth. Nurturing the young learners with these knowledge is vital for encouraging them to becoming a better person who is passionate in contributing positively to other living beings as they are our future leaders and hopes. Thence, documentary films can be benefitted in numerous ways especially in striving the current educational demands. The proposed methodology of implementing the detailed documentary review assignment would greatly assist the lecturer and students to actively participate in the subject lesson.

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Effectiveness of Cooperative Learning Strategies in Improving Performance for Large Mathematics Classes

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Abstract. In the current university situation, lecturers are often required to teach large classes, particularly for common subjects such as engineering mathematics. Nowadays, a more modern view of learning is constructivism, i.e. where students are expected to be active in the learning process by participating in discussion and/or collaborative activities. Consequently, in this study, active learning (AL) based on cooperative learning (CL) techniques will be implemented and its effectiveness in large classes will be investigated. Two different techniques, i.e. Think-Pair-Share and Three-Minutes Review were considered in this study. This study will specifically target students majoring in Chemical Engineering (CE) who enrolled in the Engineering Mathematics II (EM II) course at Universiti Teknologi PETRONAS (UTP) during the January 2019 and September 2019 semesters. Data through class assessments (post-test) and survey questionnaire were gathered to obtain both quantitative and qualitative insights into the effectiveness and perceptions of CL techniques. Quantitative data were analyzed using SPSS software and students' participation during the learning process was closely observed. The findings highlighted that the implementation of CL techniques enhanced students' engagement in the learning process and promoted the development of self-directed learning.

Keywords: Cooperative learning · Think-Pair-Share · Three-Minutes Review · Large class · Engineering Mathematics

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1 Introduction

Teaching large classes, especially in higher education, has become a critical aspect of accommodating the increasing number of students enrolling in tertiary education worldwide over the past two decades [1]. This influx of students from diverse backgrounds poses teaching and learning challenges for both educators and learners. In such settings, students who are unprepared for the course often hesitate to actively engage in large class environments. Conversely, well-prepared students may lose interest and disengage if the course content remains at a basic level [2]. Traditional teaching methods, primarily focused on knowledge transmission with limited student interaction, make it challenging for students to stay engaged [3]. According to Massingham and Herrington [4] and Starenko *et al.* [5], the availability of lecture slides online can lead students to believe they can pass the course without attending lectures, even though course performance is closely tied to participation and attendance.

Consequently, active learning (AL) techniques have emerged as strategies or tools for instructors to foster engagement with both disciplinary content and the learning process itself [6]. The benefits of incorporating AL techniques into the classroom are manifold and integration of AL techniques into teaching creates a robust instructional model because it encourages the application of material as it is being presented [7]. Employing AL techniques not only aids students by providing opportunities for skill practice and questions but also benefits instructors by enabling them to assess students' comprehension of the subject matter. Bransford *et al.* [8] highlighted that class environments featuring AL actively engage students in their learning, promote understanding through hands-on experience, offer chances for students to revise and enhance their thinking (formative assessment), and facilitate the connection of classroom knowledge to real-world practice. Furthermore, AL immerses students more profoundly in the learning process by encouraging critical thinking and fostering self-directed learning [9, 10]. Consequently, this study aims to explore the effectiveness of incorporating AL using cooperative learning (CL) techniques within a large mathematics class setting.

2 Cooperative Learning

Cooperative learning (CL) represents a vital element of AL that can be implemented in both face-to-face and online educational settings. CL can be defined as a collaborative process through which knowledge is acquired via effective interaction among group members [11]. It encompasses various teaching methods wherein students collaborate in small groups to assist each other in comprehending academic content [12]. It is an approach to teamwork designed to minimize conflicts and maximize learning and satisfaction in high-performance teams [13].

The objective of CL extends beyond promoting academic achievement; it aims to nurture students into well-rounded individuals. In this process, students engage in a range of activities, including communication, observation, and mutual support. CL provides opportunities for fostering both peer-to-peer and faculty-student interactions, thereby positively influencing learning outcomes. It encourages positive interdependence, individual accountability, leadership, decision-making, communication, and conflict management skills among students [14].

Furthermore, research by Felder and Brent [13] suggested that CL enhances short-term mastery, long-term retention, understanding of course material, critical thinking, and problem-solving skills. While various CL strategies have been proposed in studies, many may not be suitable for large class sizes due to the large number of students. Felder [15] described that innovative techniques, including CL strategies, tailored for effectively teaching large classes. Generally, three types of CL groups are commonly recognized [16]:

i) Informal Cooperative Learning (ICL)

In ICL groups, students collaborate in ad-hoc groups, typically lasting for a single discussion or class period, to achieve shared learning objectives. ICL groups serve to focus student attention on the material, create an environment conducive to learning, ensure cognitive processing of the material, and provide closure to the instructional session.

ii) Formal Cooperative Learning (FCL)

FCL groups form the foundation for most routine CL applications. These groups are assembled for at least one class period and may persist for several weeks while working on extended projects. Students learn and become proficient in applying various cooperative techniques in FCL groups.

iii) Cooperative Base (CB)

CB groups are long-term, heterogeneous CL groups that endure for at least a semester or year, with a stable membership. Their primary responsibility is to provide each member with the necessary support, encouragement, and assistance for academic progress and cognitive and social development.

Also, four essential conditions define a CL setting [17]:

i) Small Group Learning

Students work in small groups consisting of two to six members.

ii) Positive Interdependence

Learning tasks necessitate students to rely positively on each other and the group's collective work.

iii) Equal Opportunity for Interaction

The learning environment enables all group members to interact regarding the learning tasks, encouraging various forms of idea communication.

iv) Individual and Group Accountability

Each group member has a responsibility to contribute to the group's work and is accountable for the group's learning progress.

Research also indicates that experimental small-group CL settings promote higher-level learning activities, as evidenced by classroom observations showing increased student engagement.

In the study by Garfield [18] for teaching Statistics subject, found that the implementation of CL strategies engaged and motivated students, fostering vibrant classrooms filled with statistical discussions. These well-designed CL activities stimulated discovery learning and enhanced statistical reasoning and thinking. Similarly, Armstrong *et al.* [19] investigated the impact of CL activities on student achievement and attitudes in large-enrolment introductory biology classes. They found that students taught using CL approaches demonstrated greater improvement in course material knowledge compared to those taught using traditional lectures. Encouraging small group work and improving feedback between instructors and students proved beneficial, even in very large classes. Asshaari *et al.* [20] investigated students' responses to CL as an alternative technique to improve learning in two different engineering mathematics subjects, Vector Calculus and Differential Equations. The findings indicated that students responded positively to CL, finding it beneficial for understanding and enhancing their learning process and generic skills.

Jordan and Metais [21] and Gillies [22] explored the effects of cooperative learning on students' social skills and behaviour, revealing improvements in interpersonal relationships and student behaviour. Meanwhile, Akinbobola [23] noted that students displayed a more positive attitude toward learning through CL compared to competitive and individualistic learning strategies.

Othman *et al.* [24] highlighted that CL contributes to the growth of social skills, fostering positive interpersonal relationships. It facilitates the development of individual and group work skills, enhancing student achievement. These findings align with the improvement in student behaviour and interpersonal relationships, as noted by Gillies [22]. CL encourages students to engage with one another, support each other's learning, and develop social behaviours that promote active group participation.

3 Methodology

3.1 Case Study

This study aims to assess the efficacy of CL techniques within the context of a large Engineering Mathematics II (EM II) course at Universiti Teknologi PETRONAS (UTP). EM II is a compulsory subject for all engineering students at UTP during their first year of undergraduate studies. Specifically, our investigation was concentrated on Chemical Engineering (CE) students who enrolled in this subject during the January 2019 and September 2019 semesters. The CE students across these two semesters were divided into two primary groups and, followed a similar curriculum and covered same topics over a 12-weeks period.

3.2 CL Techniques

In this study, the CL techniques based on Think-Pair-Share and Three-Minutes Review were implemented. Table 1 below shows the description of both techniques.

Table 1. Description of CL Techniques

CL Technique	Description
Think-Pair-Share	Involves a three-step cooperative structure. During the first step individuals think silently about a question posed by the instructor. Individuals pair up during the second step and exchange thoughts. In the third step, the pairs share their responses with other pairs, other teams, or the entire group.
Three-Minutes Review	Instructor stops any time during a lecture or discussion and give teams three minutes to review what has been said, ask clarifying questions or answer questions.

3.3 Group Design

The non-equivalent control group post-test quasi-experimental research design was implemented to identify the effectiveness of both techniques. The quasi-experimental research design compared a control group with an experimental group as described in Table 2.

Table 2. Non-equivalent control group posttest quasi-experimental research design

Semester	Group	CL Techniques	Post-Test
January 2019	1	Yes	Yes
	2	No	Yes
September 2019	1	Yes	Yes
	2	No	Yes

In this study, one of the groups (referred to as Group 1) was designated as the experimental group, whereas the other group (Group 2) acts as the control group.

3.4 Statistical Analysis

Quantitative data through class assessments were gathered, and subsequently, statistical analysis using the *t*-test to examine differences in mean scores between the two groups during both the January 2019 and September 2019 semesters was conducted. Below are the hypotheses tested for both semesters:

Hypothesis I

Null hypothesis	:	No difference of mean scores between groups 1 and 2 for January 2019 semester.
Alternative hypothesis:	:	Mean scores of group 1 is greater than group 2 for January 2019 semester.

Hypothesis II

Null hypothesis	:	No difference of mean scores between groups 1 and 2 for September 2019 semester.
Alternative hypothesis:	:	Mean scores of group 1 is greater than group 2 for September 2019 semester.

3.5 Questionaire and Observation

The questionnaire was developed to gather the information related to students' assessment of the course and perceptions of the CL techniques used for the teaching and learning. The comments (or feedbacks) from students on the implemented CL techniques were analysed. Also, the involvement of the students for both groups during the lecture was monitored.

4 Findings and Discussions

The statistical analysis for both hypotheses led to the rejection of the null hypothesis because the *p*-value was below 0.05. Consequently, it can be inferred that the utilization of CL techniques significantly enhances students' comprehension during EM II lectures. It becomes evident that the implementation of CL techniques effectively immerses students in the learning process and facilitates the cultivation of self-directed learning.

Furthermore, the observed improvement in student behaviour and interpersonal relationships underscores the potential of CL to foster a more collaborative and supportive learning environment. The development of skills such as positive interdependence, individual accountability, leadership, decision-making, and effective communication among students indicates a broader educational benefit beyond improved mathematical competence (Fig. 1).

Fig. 1. Involvement of students during the implementation of CL techniques

5 Conclusions

In conclusion, this study has provided valuable insights into the impact of CL techniques in the context of a large mathematics class. The findings suggest that the implementation of CL techniques (Think-Pair-Share and Three Minutes Review) can significantly enhance both the academic performance and overall learning experience of students in this challenging environment. From the statistical analysis, it showed that students who participated in CL activities not only achieved higher mean scores on assessments but also displayed a greater level of engagement and motivation. This positive shift in attitude towards mathematics and learning as a whole is a promising outcome, especially in a large class setting where student disengagement and passive learning can be prevalent.

Future research should delve deeper into the specific CL techniques that yield the most significant gains in large mathematics classes and explore strategies for effectively scaling up these approaches. Additionally, examining the long-term impact of CL on students' mathematical proficiency and retention of knowledge would provide valuable insights.

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English Language Educators' Motivational Strategies: Towards Career Advancement

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Abstract. This paper seeks to explore the motivational strategies employed by Malaysians English language educators to teach and learn the newly reformed English language syllabus. The new syllabus is aligned with the Common European Framework of Reference for Languages (CEFR). This is due to the fact that educators who have yet to achieve the required CEFR levels are facing issues especially related to their career advancement. The methodology used is interpretative phenomenological analysis (IPA). Data were fathered through intensive interviews. In this paper, the researchers only discussed data collected from three educators. The findings indicate that Malaysian English language educators are very positive about the new syllabus and are eager to reskill and upskill themselves. They used a variety of motivational strategies to achieve their goals.

Keywords: — Motivation · English language educators · energy · interpretative phenomenological analysis · CEFR

1 Introduction

This template, The principle of motivation is anchored in expectancy theory [1], which was first developed by Victor Vroom, Professor Emeritus of Management at the University of Yale in 1995. This theory is an authoritative theory on adult learning and human capital [1]. It predicts that people will be motivated to perform if they know that their extra performance is going to be recognized and rewarded [2]. Back in 1995, in his classic book, Vroom posits that there are three main factors contributing to one's motivation; they are.

1.Valence - the value a person places on an outcome.
2.Instrumentality - The probability that the valued outcomes will be received given that certain outcomes have occurred.
3.Expectancy - The belief a person has that certain effort will lead to out-comes that get.

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These three terms constitute the building blocks of the development of expectancy theory. The relationships among these three factors can be summarised and represented by the following figure (Fig. 1):

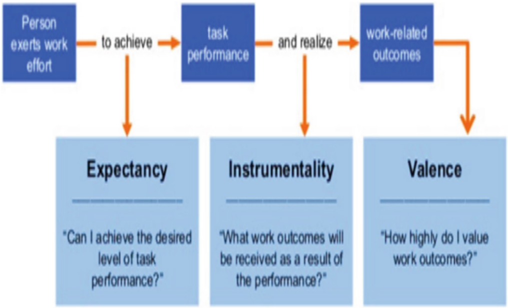

Fig. 1. Vroom's Expectancy Theory

Therefore, an organisation should make the reward system clear and fair, feasible and achievable in order to get the workers motivated. Knowle et al. [3] sum up the idea in the following statement: Adult learners will be most motivated when they believe that they can learn the new material (expectancy), that the learning will help them with a problem or issue (instrumentality), and that it is important in their life (valence).

2 Methodology

The research design for this study follows Creswell's research design [4]. Firstly, this interdisciplinary qualitative study employs interpretative phenomenological analysis (IPA) as a research method. IPAS was first developed by Smith, Larkin, and Flowers [5] and an updated version [6]. It is a widely used method [7]. The philosophical worldview is a worldview of social construction in which the context is juxtaposed with the reconstruction of society. Thirdly, the strategy of inquiry is qualitative in nature. This is due to the fact that the bulk of data comes from inter-viewing the sixth form educators, hence, a qualitative strategy is deemed a better modus operandi to yield fruitful data [8].

The methodological framework for this study is based on interpretative phenomenological study propounded by the qualitative methodology school of thought. The methodological philosophy of this study is a naturalistic interpretative study. This entails the rejection of the idea that human behaviour is predictable and governed by law, a realisation of the importance of understanding the social world of individuals involved in the study and an acknowledgement that the researcher is not objective in or entirely separated from research [9]. In other words, it simply means there is no absolute truth; instead there are multiple realities depending on the individuals, and the researcher plays an important part in the entire process.

Generally, the study utilises the hermeneutic phenomenological concept of 'themes' [10] to analyse the data. Specifically, this study uses Personal Experiential Themes (PETS) and Group Experiential Themes (GETS) to analyse the data [6]. These theoretical underpinnings are absolute and they are important to recognise and reconcile the reasoning for taking an interpretive approach and adopting a hermeneutic phenomenological theoretical framework to explore the sixth form educators' experiences in managing the CEFR and developing human capital.

With regards to data analyses, a qualitative data analysis software, known as ATLAS.ti, is used in analysing rich data captured from the FGDs thematically. This is to ensure the objectivity of the data analysis process (Fig. 2).

3 Findings and Discussion

Fig. 2. Thematic Analysis

For E1 (Imran), his motivation to learn and teach the CEFR-aligned MUET relies on his desire to complete his doctoral studies. What motivated him is that he believes he is young; hence he should try his best to grab opportunities that are available. He also cited his senior colleagues who are doing their PhD at the age of 50, who finds that the PhD journey drains their energy. He says that his colleagues advised him to embark on a PhD as young as possible. Many of them failed to complete their studies. The advice given to him is that he should continue his studies while he is young and energetic. He believes that it is wise to start as soon as possible. Besides, his long-term career plan is to be a lecturer. In the current education industry context, he will have to have a doctorate degree in order to be a lecturer at a public university. His PETS is MY MOTIVATION IS MY PhD. His experiential statement is as follows:

I told myself that after my PhD, I can be a lecturer. This motivated me a lot actually. (E1).

For E2 (Anwar), what motivates him is his professional career development. He linked the idea of professional career development to providing the best for his family. For instance, when he gets promoted, there will be an increment in his salary. A higher salary will give him the ability to provide the best for his family. He also noted that the current cost of living in urban areas of Malaysia is exorbitantly high. According to a statement published by the Central Bank of Malaysia (2022), “headline inflation is likely to have peaked for the year at 4.5% during the quarter (2Q 2022: 2.8%) while core inflation increased further to 3.7% (2Q 2022: 2.5%)”.

He added that at present, he is the sole breadwinner for his family as his wife is a homemaker. Hence, he needs more money for his family. He believes that one day he will pursue his doctoral degree. This is to set an example for his children, that lifelong learning is important. He places very little hope in the reward system at the ministry, but he is willing to try his best. His PETS is MOTIVATION IS TO GIVE THE BEST FOR MY FAMILY. His experiential statement is as follows:

I am always thinking about my career advancement. But of course, this is for my family. Perhaps one day I will do a PhD. To show my kids that I can be an educator and a learner at the same time. Basically, the career path motivates me to go further. I hope I can be somebody one day. (E2).

For E3 (Tang), his PETS is CAREER ADVANCEMENT MOTIVATES ME. At the beginning of the interview, he says that a postgraduate degree is not in his future plan as he sees little use for it. However, towards the end of the interview, he contradicts himself by saying that he might want to pursue a postgraduate degree so that he can climb the career ladder. The only thing he cited as being potentially instrumental in his career development is a postgraduate degree. This is perhaps due to his young age where his objective in life is still very flimsy. Besides, like E1 (Imran), E3 (Tang) also dreams of becoming a lecturer at a public university in the future. His experiential statement is as follows:

It is all these long-term plans that motivate me. For example, I may want to pursue my studies, and get a PhD, and perhaps I will be a lecturer. I mean all these, the career pathway, motivates me the most. (E3).

For E4 (Jaya), her PETS is BEING THE PERSON OF REFERENCE MOTIVATES ME. According to E4, she does not possess a doctorate degree, but her expertise and years of experience make her the person of reference for matters related to English language education in Malaysia. In fact, she was eligible to get her Jawatan Utama Sektor Awam (JUSA) – the grade equivalent to Professor – some years ago. However, one of the conditions is that she had to be transferred out from Kuala Lumpur and moved to a new college in another state. Therefore, she rejected the offer as her family commitments prevented her from accepting it. She was dismayed about the system as it had been unfair to her and her family. Fortunately, she is very optimistic and she believes that it is God’s plan. She is content in her current position. Her experiential statement is as follows:

I need to build that kind of reference point for the younger teachers who need help. I am not saying that I know everything, I am just saying that it is the idea of expertise, that I have become a key person in the implementation of the CEFR, that motivates me. (E4).

E5 (Dr Zurina), instead of career development, her motivation is the students. As a teacher, she believes that her mission is to educate, to help, and to change the students. Her PETS is STUDENTS ARE MY MOTIVATION. She says that undeniably, the reason for her to further her studies is partly related to the notion of career advancement: however, there is another side to it. She states that she would like to gain more knowledge and share it with her students. That is her biggest motivation. She feels satisfied when she sees that she has made tiny changes to a student's life. This is especially so since her students are mostly from the B40 group. According to the Department of Statistics Malaysia, the B40 group refers to the bottom 40 per cent of income earners with a monthly income of below RM4,850 (New Straits Times, 2022). E5 feels satisfied and the contentment is rewarding. Her experiential statement is as follows:

I always think of my students. That is how I motivate myself. The responsibility of a teacher is huge, you know, once we entered the profession, we must take up that responsibility. That is the motivation. (E5).

For E6 (Awi), DOING GOOD FOR THE NATION IS MY MOTIVATION. That is her PETS in relation to the question on motivation. E6 recollected that when she first came back from the UK, she was forced to take up an administrative post at a school in a rural area in Pahang, Malaysia. That was like an eye opener for her. From metropolitan to a small kampung (Malay word for a hamlet), that experience was indeed very enriching for her. It made her see the polarity of two sides of the world. That inspired her to help the nation through education. Besides, her role as a mother, a wife, an educator, a daughter, all provided different perspectives for her to view life and her job. Her experiential statement is as follows:

My perspectives are always larger in the sense that I fixate on the Malaysian education landscape, rather than focusing on individuality. But at the same time, I am also a mother. So, I guess I have the eagle's views and worm's eyes. Working for the nation, that is how I motivate myself. (E6).

For E7 (Diana), her PETS is MY MOTIVATION IS THE DESIRE TO LEARN. Although E7 is going to retire soon, she has the desire to keep on learning. For her, the desire to learn, to know more things, to explore different aspects of knowledge, all these are her motivation. The reason why she wants to learn is to impart the knowledge she gains to her students. She wants to do the best for her students. According to her, many of her students are from poor family backgrounds (mostly from the B40 group). They might not have sufficient financial assistance to buy reference books, to watch National Geographic, etc. Hence, educators are mostly the sole channel of knowledge for them. Hence, she feels that she has the moral duty to be the source of information for her students. Her experiential statement is as follows:

Keep learning. That is my motivational ideology. (E7).

For E8 (Afiq), his PETS is THE THIRST FOR KNOWLEDGE IS THE MOTIVATION. When he attended the very first meeting about the implementation of the CEFR to MUET, he was given four important books. Although he admits that he has never completed reading the books, he finds that there are gaps of knowledge that he is unaware of. After some cursory reading of the books, he felt that he had insufficient knowledge about the CEFR. He felt bad about it. He believes that since he is the chief examiner for MUET marking, he must be equipped with knowledge from various disciplines, such as assessment, technology-enhanced assessment, psychology, statistics, modelling, etc. According to him, he does not feel good when a junior educator asked him about something and he stumbles over the question and grasps for the answers. His experiential statement is as follows:

I start learning from the beginning, because I am involved. I read the 4 important textbooks given by Cambridge Assessment. Those books motivated me. Seriously, after reading, here and there, I feel that there are so many new concepts, theories, practices to be learnt. (E8).

For E9 (Deva), his PETS is PASSION TO READ AND ENTHUSIASM TO TEACH ARE THE MOTIVATIONAL STRATEGY. According to E9, he spent a lot of time reading. He reads whatever that is available: newspapers, magazines, books, journal articles, etc. He says that sometimes what he reads does not make sense to him. However, when he integrates the knowledge that he has gained, many things come to light. Hence, he believes that there is no boundary to knowledge. It is humans who created the boundaries. He says that his favourite analogy for the students is that in order to send astronauts to other planets, we need engineers, scientists, mathematicians for the technical issues. At the same time, we also need economists to estimate the return on investment (ROI), and psychologists to make sure that the astronauts could endure a lonely journey for a long duration of time. Upon sharing this story, a great number of his students started to see that multidisciplinary knowledge is needed for an important task. His experiential statement is as follows:

I think I always have clear mind, a clear direction about what I want. I am also an eager learner. There is no boundary in knowledge. So, it is my passion to read, my enthusiasm to teach. So that is my motivational strategy. (E9).

4 Conclusion

Based on the PETS, one GETS was developed. The GETS is SELF-DEVELOPMENT MOTIVATES ME. From the lived experiences analysed, the researcher found that the major theme on motivation that the educators utilise to motivate themselves to learn about the CEFR is related to their self-development. Self-development is an encompassing umbrella for career advancement, satisfaction, and many more.

It seems that the educators view career development as the major motivation for them to learn about the CEFR. However, what type of career development specifically? The data shows that apparently pursuing a doctoral programme related to the CEFR is to kill two birds with one stone. Many educators also cited their PhD as a motivational force. This coincides with the findings of [11] which show that educators tend to pursue their PhD in order to advance their career. This phenomenon is most likely due to the policy by the Ministry of Higher Education (through the MyBrain15 programme), whereby the ministry aims to produce 60,000 PhD degree holders by 2023. This is to produce more highly-educated people and meet the nation's need for research and innovation [12].

Besides, they have also cited their own enthusiasm about learning as well as the CEFR itself as the two major themes. This particular educator also cited his experi-ence working with examination bodies, such as the Examination Syndicate and Ma-laysian Examinations Council as an initial platform for him to learn about the CEFR so that he could progress in his career.

It is justifiable to say that career development is the main motivational strategy for the educators to further develop themselves. This is echoed in the findings of Wlodkowski and Ginsberg [13] and Tough [14], who believe that many adult learners learn in order to progress and develop in their own career.

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Enhancement of Students' Learning in Class Using Formal Cooperative Learning

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Abstract. Cooperative learning is one of the effective educational approaches used in engineering teaching to develop students' learning skills with outstanding teamwork abilities and creativity. A board game activity was conducted in engineering hydrology class based on the cooperative learning approach to improve creativity, profound learning and develop teamwork skills. The index of learning styles sur-vey was used to determine students learning styles such as active, reflective, verbal, visual learners etc. A personality test was conducted to recognize their char-acters such as introverts and extroverts. Based on the learning styles, different characteristics and personality test, heterogenous groups of students were formed. Proper instructions were given to the students for the development of a new board game in the form of a unified project. It was observed that the students are mostly reflective, sensing, visual and sequential learners which were exhibited from the board game activity as well through their excellent performance. The students reflected that the board game enhanced their time management, group work and communication skills and promoted their creativity. They highlighted that they learned beyond the classroom by playing this game which helped them to make better understanding about the course.

Keywords: Board game activity · cooperative learning · active learning

1 Introduction

University is one of the best places where formal training can be given to nurture the learners and develop creativity. The learning skills of teamwork abilities, connectivity and creativity require to be developed by teachers in 21st century to create skilled graduates to solve problems particularly engineering aspects and face the unresolved trials prior to arriving the joining industry [1, 2]. These skills are defined as the parts of the education design and developed by UNESCO [1]. Unfortunately, the faculty's teaching style worldwide is being sustained based on their research skills, traditional teaching way

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(chalk and talk) and teacher-centred learning instead of the student-centred learning [3]. Keeping in view of technological advancement and competitive environment, the modern world requires to produce graduates which could change the graduate role from a job hunter to a job maker. Significant attention and emphasis on the students-centred learning in advanced education is being promoted by the launched of Malaysian Higher Education Blueprint 2015–2025 (MHEB) [4]. One of the effective student-centred learning approaches as part of the instruction practices in the classroom is cooperative learning introduced by Sharan [5] approximately four decades ago.

All associates work closely to each other within and outside the classroom, via team activities [5] in the forms of small clusters consist of 4–5 members in order to attain the similar goals, maximize learning as a group [6] and reducing the number of free riders who claim the same mark in a team-work [7]. The combination of cooperative learning in the engineering-based training with learning activities has been suggested by numerous engineering education experts and evidenced to stimulate significance of these technique at the advanced education [8]. The importance of cooperative learning was further reinforced by a study in order to promote enhancing the students' involvement in the class academically and the establishment of social net-works among the classmates [8]. Therefore, its effects have been categorized into the aspects of academic achievement, relationships quality, psychological amendment, and positive approach about institution practice [8]. Formal and informal strategies were pursued as cooperative learning methods [3]. The cooperative work among the students in a classroom to achieve a temporary objective was considered as an informal learning strategy [7]. However, comparatively formal has been well structured that consists of the essential elements to promote the group to learn affectively [6]. Moreover, the engineering learners' creativities requires to be sparked and discovered not only paying attention to the mere typical lecturer presentation technique, but using game-based learning approach, websites utilization activities for group portfolio and video creation to support and enhance modern learning practice. Constructive and emerging educational computer games for game-based learning requires plentiful time and work, the instructors are suggested to use commercially accessible games [9, 10]. Contribution of this investigation is to promote the cooperative learning skill (active learning) among a group of the engineering hydrology students via improving a new board game named as bingo to increase the student's ability solving problems and effect of doing activity about this board game has not been reported yet. Therefore, this study intended to conduct a board game activity based on the cooperative learning approach to develop creativity, profound learning, and teamwork skills in engineering hydrology class.

2 Methodology

The students in engineering hydrology classroom was given two types of questionnaires to determine their (i) learning styles [11, 12] and (ii) personality [13]. The students' information about different other characteristics was also collected to form heterogenous groups. The students in the classroom were as-signed into groups, each group consists of 4 - 5 students considering a good combination of extroverts, introverts, genders, CGPA, and ethnicity (Malay, Chinese and international students) [2]. Proper instructions were delivered to the students for board game development activity. Guidelines were given to the students reflect different syllabus related topics in the activity and embed in their in-tended game development. Every group designed a new board game and prepared its rules and regulations for the activity. In this study, a new board game of bingo which was planned by the students' group and the prepared rules and regulations as well has been reported. The formation of heterogeneous groups with student's characteristics has been shown in Table 1.

Table 1. Characteristics of students group

Students	*Gender*	*Standing*	*Ethnicity*	*Primary Personality*	*Secondary Personality*
I	M	3.1	Chinese	Sanguine	Phlegmatic
II	F	3.55	Malay	Sanguine	Phlegmatic
III	F	2.89	Malay	Sanguine	Phlegmatic
IV	M	3.01	Malay	Phlegmatic	Melancholic
V	M	3.25	Malay	Sanguine	Phlegmatic

3 Results and Discussions

D. Analysis on students 'characteristics.

The students' characteristics were mainly analyzed by their learning styles and personality characteristics. The following Fig. 1(a)–(d) represent the students learning character. The results showed that the group of students are reflective, sensing, visual and global learners. These students are mainly considered as good in remembering by performing experimental and field works as approximately 80% of them are sensing learners (Fig. 1(b)) and they are also absolutely 100% visual learners (Fig. 1 (c)) so they can memorize good particularly through pictures, diagrams, flowcharts, films and demonstrations [11, 12]. Therefore, exposing the students to board game activity can help them in becoming more effective learners [14].

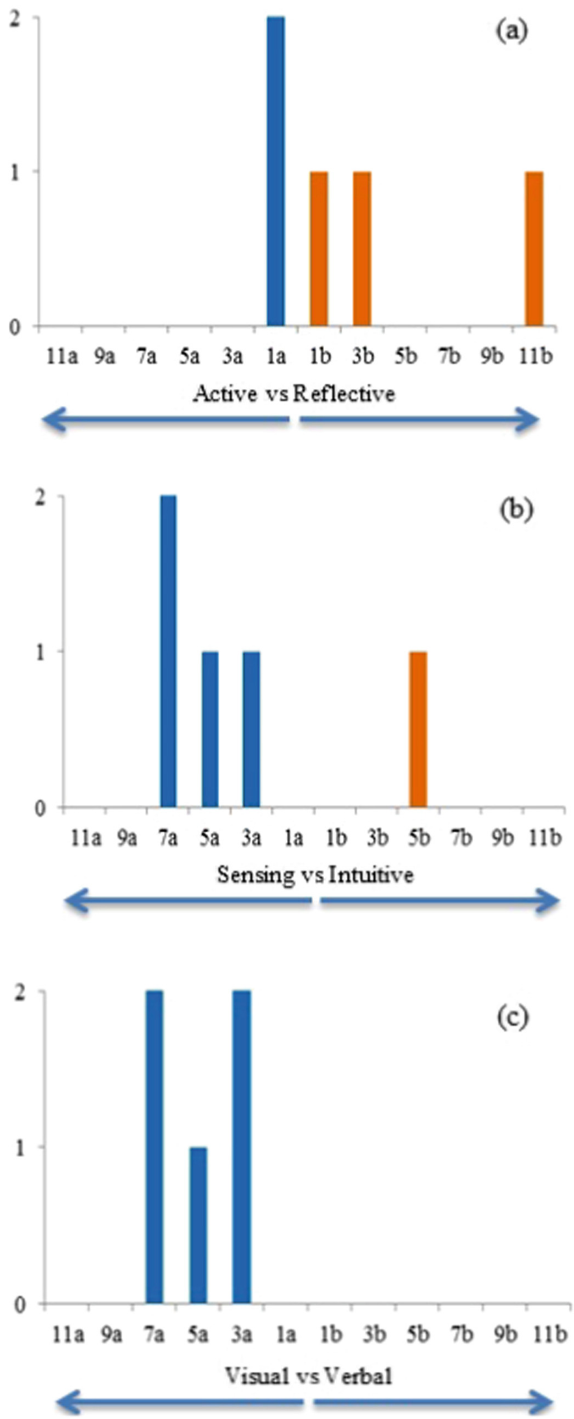


Fig. 1. (a)-(d) Students learning characteristics**.**

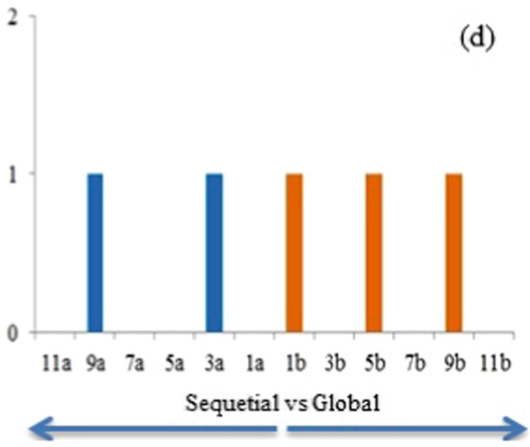
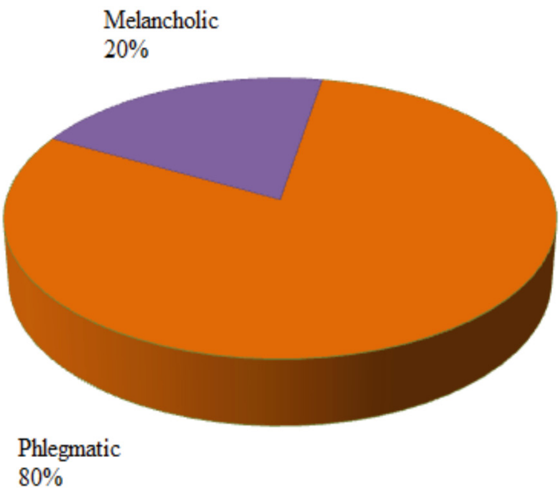


Fig. 1. (*continued*)

Figure 2(a) shows about 80% of the students in the group are extroverts and 20% of them are introverts as their primary personalities which observed that 80% of them are sanguine and 20% of them are choleric. It suggests that the group has creative characteristics and is full of innovative ideas. Figure 2(b) shows the secondary personalities of the students in the group which were observed that they are t introverts as 80% of them are phlegmatic and 20% of them are melancholic who can be decent supporters and show collaborative work capabilities.

E. Reflection on the collaborative activity.

The reflections were given by the students about what they had achieved from the board game project, and these are shown in Table 2. The students claimed that they found the activity interesting, and this has provided them with the opportunity to work with people who don't interact with them so much before due to having different types of personalities. The activity has made their communication sometimes challenging and interesting as well. They also learnt that they should not limit themselves to the lecture notes only and should try to learn beyond. The activity helped them to improve their understanding about the topics of hydrology by playing this game. They also mentioned that they gained something related to the subject while having fun. And it was clear that there was a significant learning regarding team cooperation during planning and finishing the board game.



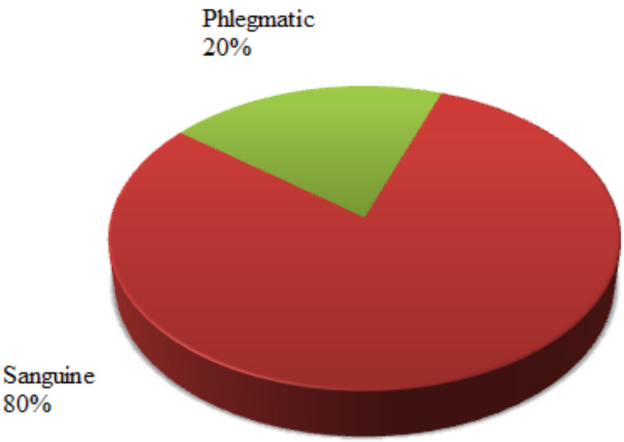


Fig. 2. (a)-(b). Primary and secondary personalities of the students group.

Table 2. Reflections regarding board game development

Student	***Gender/ethnicity***	***Reflection***
I	Male/Chinese	I feel that it is interesting to work with people that I don't interact with them so much before as all of us have different personalities which make our communication sometimes challenging and interesting. Overall, I like to experience making this Bingo board game with my teammates

(*continued*)

Table 2. (*continued*)

Student	***Gender/ethnicity***	***Reflection***
II	Female/Malay	Game is one of the significant way of learning the subjects. First of all, by making this board game, I learnt that we should never depend on the lecture notes and secondly, I understood the topic of hydrology better by playing this game
III	Female/Malay	This board game is the game that we can learn and gain something related to hydrology while having fun
IV	Male/Malay	This board game taught me to be open-minded on approach and hold our own genuine value to give the colours on the team
V	Male/Malay	There was a significant learning regarding team cooperation during planning and finishing the board game

4 Conclusion

A new board game of bingo was successfully developed by the students group. Generally, most of the students reinforced their collaboration skills. And experienced that this activity has improved their creativity skills and understanding about relevant subject matter. Besides the excellent learning, the students also had fun and entertainment evolving their own board game which reflect field related applications of the course they learnt. This activity gave them an opportunity to make a stronger connection and learn from each other.

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Enhancing Students' Engagement and Motivation: Exploring the Impact of Active Learning Approaches in Educational Settings

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Abstract. This investigation explores the impact of active learning approaches on student engagement and motivation in an educational context. A survey was conducted among 29 sophomore students studying petroleum engineering and taking the Formation Evaluation course during the May 2023 semester. The findings revealed that most participants expressed moderate familiarity with active learning strategies and reported frequent exposure to such methods. In terms of motivation levels, traditional lecture-based approaches fell short compared to active learning sessions, which demonstrated higher levels of motivation. The factors influencing motivation varied between the two approaches. Active learning sessions increased on student engagement with the material, while traditional lecture-based approaches provided a less pressurized environment for participation. Moreover, it was noted that weaker students leaned towards traditional lecture-based learning to draw upon their existing comprehension. The study underscores the efficacy of active learning, which is deeply rooted in constructivist theory, while emphasizing the importance of students' fundamental grasp of the subject matter for optimal effectiveness. Educators are advised to ensure that students possess a solid knowledge foundation before incorporating active learning strategies. This research contributes to our understanding of active learning and its relationship with constructivist theory, thereby offering valuable insights for instructional practices aimed at enhancing student engagement and motivation within educational settings.

Keywords: active learning · student engagement · motivation · traditional lecture-based approaches · constructivist theory · educational settings

1 Introduction

Active learning is increasingly acknowledged as an effective teaching approach that enhances student engagement, motivation, and deep understanding of the subject matter [1]. It actively involves students in the learning process, encouraging their participation,

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collaboration, and critical thinking skills, as opposed to traditional lecture-based methods [2]. Extensive research has demonstrated the positive impact of active learning strategies on student outcomes [2–4]. The concept of active learning emphasizes the creation of dynamic and exciting classroom experiences to foster higher levels of engagement and motivation among students [3].

Active learning exercises have been developed and implemented across various disciplines, including information systems and engineering education [4–6]. Constructivist teaching methods, which align with active learning principles, have been found effective in promoting student learning and engagement [7]. Collaborative learning, another integral aspect of active learning, has been widely recognized for its benefits in enhancing student learning experiences [9].

Despite the growing body of research, there is still a need for comprehensive investigations into the impact of active learning on student engagement and motivation in diverse educational contexts [10–12]. This study aims to address this research gap by examining the impact of active learning approaches on student engagement and motivation in comparison to traditional lecture-based approaches. Specifically, the study focuses on sophomore petroleum engineering students enrolled in the formation evaluation course. This course centers around evaluating subsurface formations to determine their potential for oil and gas production.

The study explores the students' familiarity with active learning strategies, their experiences with these methods in the formation evaluation course, and the factors influencing their motivation during active learning sessions. Additionally, it compares the level of engagement and motivation during traditional lecture-based approaches for comparative analysis.

By incorporating the insights gained from these investigations, educators can enhance their instructional approaches and create a vibrant and engaging learning environment that promotes student motivation, deepens learning outcomes, and prepares students for success in their academic and professional pursuits. By understanding the advantages and limitations of active learning approaches within the context of petroleum engineering education, educators can tailor their instructional strategies to create dynamic and engaging learning experiences for students in this field [8].

The findings of this study will contribute to the existing literature by providing empirical evidence on the impact of active learning strategies on student engagement and motivation specifically within the formation evaluation course for petroleum engineering students. These findings will have practical implications for educators and institutions to effectively incorporate active learning methods and create engaging learning environments in similar technical courses.

While active learning has shown potential benefits, there is a lack of comprehensive research examining its direct impact on students' motivation in the formation evaluation course for petroleum engineering students. Although existing studies have demonstrated positive associations between active learning and student engagement, few have delved into the underlying mechanisms that connect active learning and motivation, particularly within the context of petroleum engineering education.

Therefore, this study aims to bridge this gap in the literature by investigating the relationship between active learning and student motivation in the formation evaluation course for sophomore petroleum engineering students. Through a survey-based approach to evaluate the motivational outcomes of active learning in this specific course, we seek to gain deeper insights into how specific active learning strategies influence students' motivation and engagement in the petroleum engineering classroom.

A. Purpose of the Study.

The primary aim of this study is to investigate the impact of active learning on the motivation of sophomore petroleum engineering students enrolled in the formation evaluation course. By analyzing survey data collected from these students, the study seeks to identify the active learning strategies that have the greatest influence on student motivation within this specialized field. Through empirical evidence, this research aims to contribute to the existing knowledge base by establishing a link between active learning and student motivation specifically in the context of the formation evaluation course for petroleum engineering students.

B. Research Questions:

To guide the investigation, this study addresses the following research questions:

- What is the level of familiarity among sophomore petroleum engineering students with active learning strategies?
- How do these students perceive and experience active learning methods in the formation evaluation course?
- What factors contribute to motivation during traditional lecture-based approaches in the formation evaluation course?
- How does motivation during active learning sessions in the formation evaluation course compared to motivation during traditional lecture-based approaches?
- What factors contribute to motivation during active learning sessions in the formation evaluation course?
- How does overall engagement during active learning sessions in the formation evaluation course compared to engagement during traditional lecture-based approaches?
- What are the preferences of sophomore petroleum engineering students regarding active learning and traditional lecture-based approaches for promoting a deeper understanding of the subject matter in the formation evaluation course?
- What is the impact of active learning strategies on the overall motivation to learn for sophomore petroleum engineering students in the formation evaluation course?

C. Significance of the Study:

The findings of this study hold significant importance for educators, instructional designers, and policymakers in the field of petroleum engineering education. The outcomes can provide evidence-based insights into the impact of active learning on student motivation and learning outcomes within the formation evaluation course.

Furthermore, this study contributes to the understanding of the impact on engagement and motivation by exploring the engagement levels of sophomore petroleum engineering students during active learning activities compared to traditional lecture-based learning in the formation evaluation course. It also explores their perception of the impact of active learning on their motivation to learn. By investigating these factors, the study offers meaningful finding into the effectiveness of active learning in promoting student engagement and motivation specifically within the context of petroleum engineering education. Such understanding is crucial for designing learning experiences that encourage intrinsic motivation and active participation in this specialized field.

2 Concept of Active Learning

Active learning is a well-researched and widely acknowledged pedagogical approach that significantly enhances teaching and learning in higher education. It prioritizes the active participation of students in the learning process through various activities and exercises, promoting engagement, critical thinking, and a profound comprehension of the subject matter [1–3].

The implementation of active learning methods spans across different disciplines, including engineering education [1]. Extensive research has established positive correlations between active learning and student engagement, motivation, and academic achievements [2–5]. Active learning strategies create a dynamic and stimulating classroom environment that fosters heightened engagement and motivation among students [3]. These strategies encompass interactive discussions, problem-solving tasks, group work, hands-on experiments, and other participatory activities that encourage students to be actively involved [4].

The concept of active learning aligns harmoniously with constructivist teaching methods, which emphasize student-centered learning and the construction of knowledge through active engagement [7]. Collaborative learning, an integral aspect of active learning, has been recognized for its ability to promote student engagement and facilitate deep understanding [9].

Numerous studies have examined the impact of active learning on student engagement and motivation in diverse educational contexts, including information systems courses and engineering higher education [4, 6]. The successful development and implementation of active learning exercises have showcased their effectiveness in enhancing students' learning experiences [4]. Researchers have identified crucial criteria derived from literature reviews to characterize constructivist teaching, which can be applied to active learning approaches [7].

While active learning has been extensively studied, there is still a need for comprehensive investigations into its impact on student engagement and motivation in various educational settings [10–12]. Such investigations significantly contribute to the understanding of active learning strategies and their effectiveness in promoting student engagement and motivation.

3 Execution of Active Learning

As practitioner of active learning strategies, we understand the importance of meticulous planning and thoughtful execution. Throughout the implementation process, we placed utmost importance on the following factors to ensure effective active learning, with a particular focus on providing immediate feedback:

- Clearly Defined Learning Objectives: Our instructional approach involved establishing explicit learning objectives that were closely aligned with the curriculum and desired learning outcomes. By clearly defining these goals, we ensured that students were actively engaged in working towards specific learning outcomes.
- Varied and Engaging Techniques: To foster active participation and enhance student learning, we employed a diverse range of engaging techniques. These included stimulating group discussions, problem-solving activities, hands-on experiments, simulations, and the integration of technology to create interactive and dynamic learning experiences. These techniques facilitated immediate feedback, encouraging students to actively engage with the material.
- Collaboration and Group Work: We emphasized the importance of collaboration and group work as integral components of active learning. By promoting teamwork and creating opportunities for students to collaborate, we fostered a cooperative learning environment that facilitated peer interaction and the exchange of knowledge. Throughout these collaborative activities, we provided timely feedback, supporting students in their learning process.
- Supportive Facilitation: As facilitators of active learning, we actively guided and supported students throughout the learning process. We provided clear instructions, offered assistance when needed, and created a supportive atmosphere that encouraged students to actively participate and explore new ideas. Immediate feedback was provided during activities to address misconceptions and enhance students' understanding.
- Timely Assessment and Feedback: We designed assessments that aligned with the active learning approach, focusing on evaluating students' critical thinking, problem-solving skills, and application of knowledge. Crucially, we provided immediate and constructive feedback to students, enabling them to reflect on their performance and make necessary improvements promptly. This continuous feedback cycle enhanced the overall learning experience and facilitated ongoing growth (Fig. 1).

Fig. 1. Students are participating in group problem-solving activities

4 Methodology

This study utilized a quantitative research design along with a survey questionnaire to examine student motivation and the influence of active learning. The research aimed to investigate the correlation between active learning and student motivation while also exploring students' firsthand experiences and perspectives. By employing this methodology, the study aimed to gain a comprehensive understanding of the interaction between active learning and student motivation, shedding light on the factors that contribute to effective learning experiences.

A. Participants:

The participants in this study were undergraduate students enrolled in the Formation Evaluation course within the petroleum engineering program. A total of 29 sophomore-level students took part in the study. These students had already completed foundational coursework and were progressing towards more specialized studies in petroleum engineering.

The Formation Evaluation course holds significance within the petroleum engineering program as it focuses on the assessment and characterization of subsurface formations in the context of oil and gas exploration. Therefore, the participants in this study possessed specific academic backgrounds and a keen interest in petroleum engineering.

By selecting undergraduate students in their sophomore year, the study targeted a relevant sample for investigating the impact of active learning on student motivation within the specific context of petroleum engineering education. The experiences and perspectives of these participants provide valuable insights into the effectiveness of active learning strategies in fostering student motivation and engagement within this particular course and academic stage.

B. Survey Questionnaire:

A tailored survey questionnaire was designed to collect data on various aspects of student motivation and active learning. The questionnaire included items that assessed students' familiarity with active learning, their previous experiences with active learning methods, the level of engagement during active learning activities, and their perceptions of how active learning influences motivation, understanding, problem-solving skills, and collaboration. To ensure the reliability and validity of the questionnaire, established scales and validated instruments were incorporated when applicable. This approach enhances the quality of the collected data and strengthens the credibility of the study's findings.

C. Data Collection:

The survey questionnaire was administered to the participants using the online survey platform MS Form. Prior to their participation, the participants were provided with clear instructions for completing the survey and informed about the study's purpose. They were also assured that their responses would be kept confidential and anonymous.

D. Data Analysis:

The collected survey data underwent a process of cleaning and organization to prepare it for analysis. The analysis primarily involved descriptive data analysis, which focused on summarizing and interpreting the data.

E. Limitations and Ethical Considerations:

It is crucial to acknowledge the limitations of this study to ensure a balanced interpretation of the findings. Firstly, the sample size was relatively small, consisting of 29 undergraduate students enrolled in the Formation Evaluation course within the petroleum engineering program. While efforts were made to ensure representativeness within this specific context, the generalizability of the findings to a broader population may be limited. Additionally, relying on self-reported data from the survey questionnaire introduces the possibility of response bias or recall errors. Future research with larger and more diverse samples would help validate and generalize the findings.

Ethical considerations were carefully addressed throughout the study. Informed consent was obtained from all participants, ensuring they were fully aware of the purpose, procedures, and potential risks and benefits of their involvement. Participants were assured of the confidentiality and anonymity of their responses, and the data were handled securely and used solely for research purposes.

Despite these limitations, the study provides valuable insights into the relationship between active learning and student motivation. Future studies with larger sample sizes and diverse populations can build upon these findings and address the identified limitations to further enhance our understanding of the impact of active learning on student motivation and engagement.

5 Results

The visuals provided in this section serve as a graphical representation of the participants' viewpoints and encounters concerning active learning and its impact on motivation.

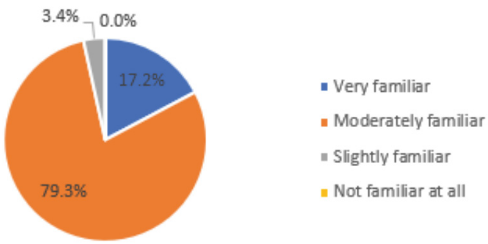

Fig. 2. Distribution of Responses for the Question "How Familiar Are You with Active Learning Strategies?"

Upon analyzing Fig. 2, it becomes clear that the respondents in this study have varying degrees of familiarity with active learning strategies. The majority of participants (79.3%) reported being moderately familiar, indicating a significant proportion with a reasonable understanding and knowledge of active learning approaches. A smaller percentage (17.2%) expressed being very familiar, demonstrating a higher level of familiarity and experience with this instructional method. On the other hand, a minority of respondents (3.4%) reported being slightly familiar, signifying a basic awareness but limited exposure to active learning strategies. Notably, none of the respondents indicated being completely unfamiliar with active learning strategies.

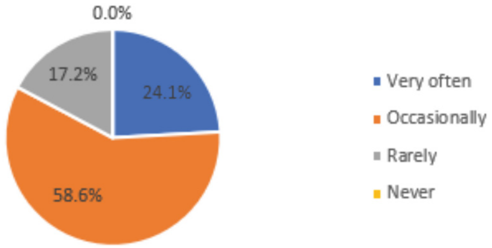

Fig. 3. Distribution of Responses for the Question "In your experience, how often have you been exposed to active learning strategies in your coursework?"

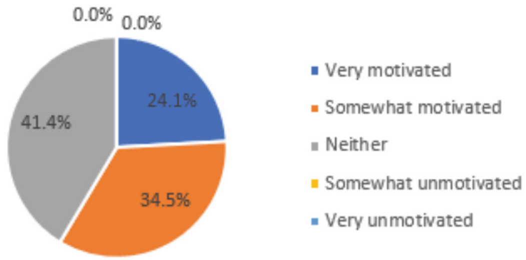

Fig. 4. Distribution of Responses for the Question "How motivated do you feel when participating in traditional lecture-based approaches?"

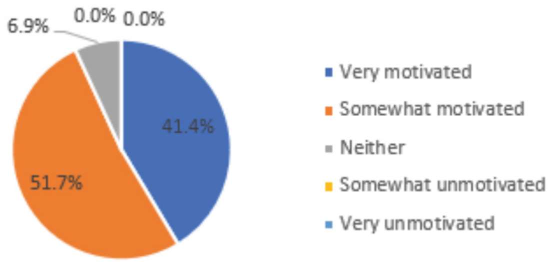

Fig. 5. Distribution of Responses for the Question "How motivated do you feel when participating in active learning strategies?"

The data from Fig. 2 suggests that the majority of respondents have at least a moderate level of familiarity with active learning strategies. This finding highlights the potential for effective implementation and integration of these approaches in educational settings.

Moving on to Fig. 3, the findings provide meaningful findings the experiences of respondents with active learning methods in their current courses or educational setting. The data reveals that a significant portion of respondents (24.1%) had frequent exposure to active learning, indicating a substantial engagement with these methods. Additionally, a substantial percentage (58.6%) reported occasional exposure, suggesting that active learning is implemented to a considerable extent in their academic environment. On the

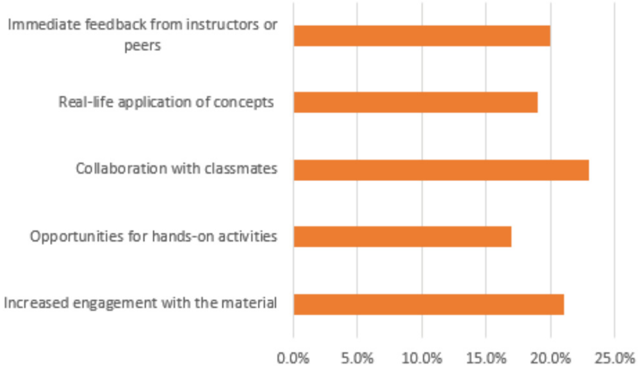

Fig. 6. Distribution of Responses for the Question "What factors contribute to your motivation during active learning sessions?"

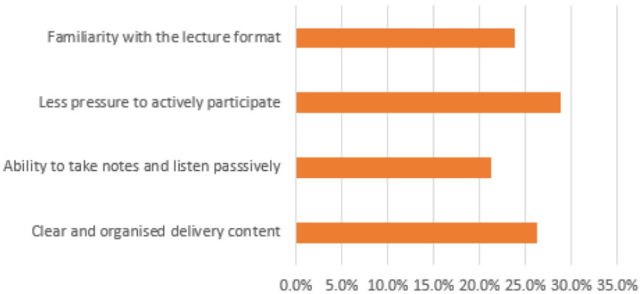

Fig. 7. Distribution of Responses for the Question "What factors contribute to your motivation during traditional lecture-based approaches?"

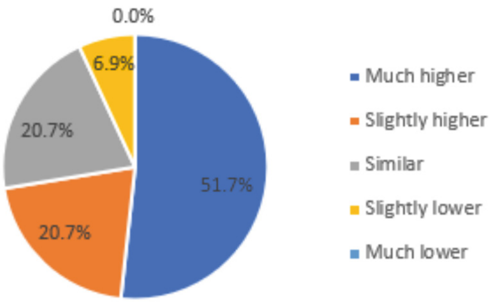

Fig. 8. Distribution of Responses for the Question "How would you rate your overall engagement during active learning sessions compared to traditional lecture-based approaches?"

other hand, a minority of respondents (17.2%) had rarely experienced active learning methods, indicating a lower frequency of engagement.

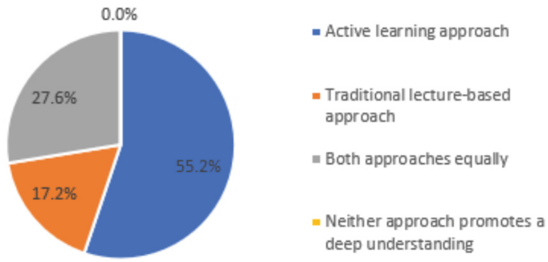

Fig. 9. Distribution of Responses for the Question "In your opinion, which approach (active learning or traditional lecture-based) promotes a deeper understanding of the subject matter?"

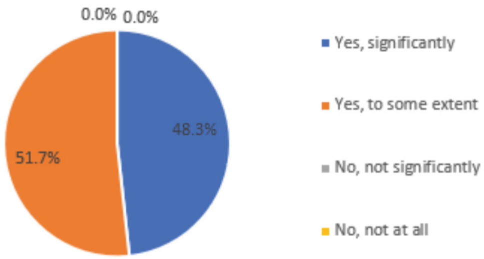

Fig. 10. Distribution of Responses for the Question "Do you believe that active learning strategies positively impact your overall motivation to learn?"

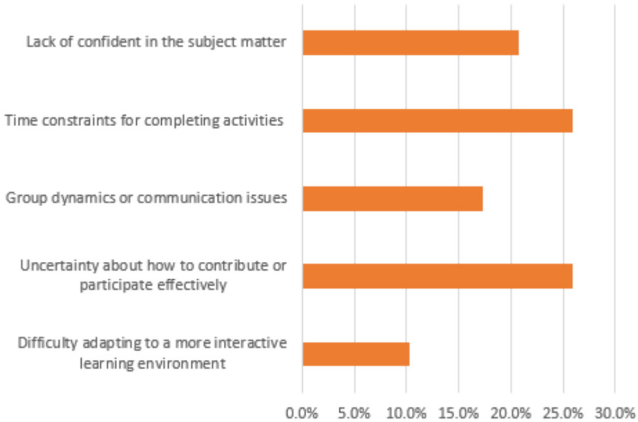

Fig. 11. Distribution of Responses for the Question "What challenges, if any, do you encounter when participating in active learning sessions?"

The distribution of responses in Fig. 3 points towards a relatively high prevalence of active learning practices within the respondents' academic setting, emphasizing the significance of incorporating these methods as a prominent instructional approach.

Figure 4 provides insightful information regarding motivation in traditional lecture-based approaches. The data reveals that a notable proportion of respondents (24.1%)

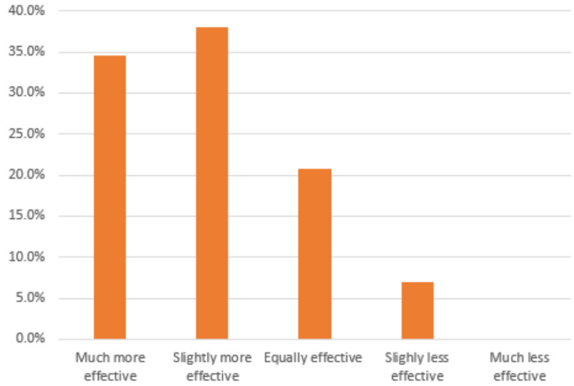

Fig. 12. Distribution of Responses for the Question "How do you perceive the effectiveness of active learning strategies in comparison to traditional lecture-based approaches?"

reported feeling highly motivated, indicating a positive level of engagement. However, a larger percentage (34.5%) expressed moderate motivation, suggesting a more neutral stance. Additionally, the majority of respondents (41.4%) reported feeling neither motivated nor unmotivated, indicating a lack of strong motivation in this context. These results, as illustrated in Fig. 4, imply that traditional lecture-based approaches may not consistently generate high levels of motivation among students. Importantly, none of the respondents indicated feeling slightly or not motivated at all, suggesting that the lecture-based approach maintains a certain baseline level of motivation.

Figure 5, we can examine the respondents' motivation during active learning strategies. The horizontal bar chart provides valuable insights into this aspect. In comparison to traditional lecture-based approaches, the findings reveal a more positive outlook for active learning. A significant proportion of respondents (41.4%) reported feeling highly motivated, indicating the significant impact of active learning approaches on their engagement and motivation levels. Moreover, the majority of respondents (51.7%) expressed a moderate level of motivation, suggesting a generally positive attitude towards active learning. The absence of respondents indicating slight or no motivation further emphasizes the motivational benefits associated with active learning strategies, as depicted in Fig. 5.

The distribution of responses in Fig. 5 highlights the positive motivational effects of active learning strategies, demonstrating their potential to enhance students' engagement and motivation.

Figure 6, which provides valuable insights into the factors that contribute to motivation during active learning sessions. Based on the data, 21% of the respondents identified increased engagement with the material as a significant contributor to their motivation. This emphasizes the importance of creating a learning environment that actively involves students and stimulates their interest in the subject matter. Moreover, respondents recognized several other factors that contribute to motivation, including hands-on activities, collaboration with classmates, real-life application of concepts, and immediate feedback from instructors or peers. These findings highlight the significance of incorporating interactive and cooperative learning experiences, practical applications, and timely feedback in active learning sessions to enhance students' motivation and engagement.

These results have important implications for instructional design and pedagogical practices. The data suggests that traditional lecture-based approaches could benefit from integrating elements of active learning to enhance motivation. By providing opportunities for active engagement, hands-on activities, collaboration, real-world connections, and timely feedback, instructors can create a more dynamic and engaging learning experience. This, in turn, can lead to increased student motivation and a deeper understanding of the subject matter.

Figure 7 explores the factors contributing to motivation during traditional lecture-based approaches. Based on the data, a significant percentage of respondents (28.8%) indicated that feeling less pressure to actively participate played a role in their motivation. This suggests that some students may find the passive nature of lecture-based approaches more conducive to their motivation. Additionally, factors such as the clear and organized delivery of content (26.3%), the ability to take notes and listen passively (21.3%), and familiarity with the lecture format (23.8%) were mentioned by respondents. These findings highlight the importance of well-structured and comprehensible lectures in maintaining student motivation, as well as the role of passive learning strategies in certain contexts.

Furthermore, the data from Fig. 7 also reveals insights into the level of engagement in active learning sessions compared to traditional lecture-based approaches. It indicates that active learning strategies have a positive impact on overall motivation to learn, as evidenced by the significant proportion of respondents who reported feeling highly motivated during active learning sessions.

Referring to Fig. 8, when comparing overall engagement during active learning sessions and traditional lecture-based approaches, we uncover intriguing insights. The data reveals that a majority of respondents (51.7%) reported significantly higher engagement during active learning sessions. This suggests that the interactive and participatory nature of active learning strategies resonates well with students and enhances their level of involvement. Additionally, a notable portion of respondents (20.7%) reported slightly higher engagement during active learning sessions, while an equal percentage found similar levels of engagement in both approaches.

Upon closer examination of the students' performance, an interesting observation emerges. It is worth noting that among the respondents who reported slightly higher engagement during traditional lecture-based approaches, there is a consistent trend of lower marks in their assessments. This finding suggests that these students, who may be categorized as weaker learners, tend to gravitate towards traditional lecture-based approaches as a way to strengthen their foundational understanding of the subject matter.

The comparison between overall engagement during active learning sessions and traditional lecture-based approaches is illustrated in Fig. 9. A substantial majority of respondents (51.7%) reported experiencing significantly higher engagement during active learning sessions. This finding strongly suggests that the interactive and participatory nature of active learning strategies resonates well with students, effectively boosting their level of involvement. Moreover, a notable proportion of respondents (20.7%)

indicated slightly higher engagement during active learning sessions, while an equal percentage found similar levels of engagement in both approaches. Conversely, only a small percentage (6.9%) reported slightly higher engagement during traditional lecture-based approaches, and none reported much higher engagement. These results clearly demonstrate the potential of active learning approaches to substantially increase student engagement compared to traditional lecture-based approaches.

Figure 10 presents intriguing findings when comparing overall engagement in active learning sessions and traditional lecture-based approaches. The majority of respondents (51.7%) expressed a significantly higher level of engagement during active learning sessions, indicating that the interactive and participatory nature of these strategies strongly resonates with students and effectively enhances their involvement. Furthermore, a notable portion of respondents (20.7%) reported slightly higher engagement during active learning sessions, while an equal percentage found similar levels of engagement in both approaches. In contrast, only a small percentage (6.9%) reported slightly higher engagement during traditional lecture-based approaches, with none indicating much higher engagement. These findings underscore the substantial capacity of active learning approaches to enhance student engagement significantly compared to traditional lecture-based approaches.

Based on the findings presented in Fig. 11, valuable insights emerge regarding the preferences for fostering a deeper understanding of the subject matter. A majority of respondents (55.2%) expressed a preference for the active learning approach, indicating that students perceive it as more effective in facilitating a comprehensive understanding. In contrast, a smaller percentage (17.2%) favored the traditional lecture-based approach, while a significant portion (27.6%) believed that both approaches contribute equally to achieving a deep understanding. These findings underscore the importance of both active learning and traditional lecture-based approaches in facilitating a comprehensive comprehension of the subject matter.

Examining the distribution of responses, as depicted in Fig. 12, provides insights into the impact of active learning strategies on overall motivation to learn. A significant majority of respondents (48.3%) believed that active learning strategies have a significant positive impact on their motivation. Additionally, a substantial percentage (51.7%) acknowledged that active learning strategies contribute positively to their motivation to some extent. Interestingly, none of the respondents reported that active learning strategies have a negligible or no impact on their motivation to learn. These findings not only highlight the motivational benefits associated with active learning approaches but also emphasize their potential to greatly enhance students' overall motivation to learn.

6 Conclusion

In conclusion, the findings from this study provide valuable insights and shed light on several important points:

- The majority of respondents exhibited a reasonable understanding of active learning approaches, suggesting their potential for effective integration in educational settings.
- Active learning is implemented to a significant extent in the educational environment, with a substantial number of respondents regularly exposed to these methods.

- While there is generally a lack of strong motivation, none of the respondents reported a complete absence of motivation, indicating a baseline level maintained by the lecture-based approach.
- Active learning strategies are associated with higher levels of motivation, as a notable proportion of respondents expressed feeling highly motivated during active learning sessions.
- Increased engagement with the material emerged as a key contributor to motivation during active learning sessions, highlighting the importance of creating an engaging learning environment.
- Traditional lecture-based approaches can benefit from incorporating elements of active learning to enhance motivation and engagement.
- The majority of respondents experienced significantly higher engagement during active learning sessions, emphasizing the potential of these approaches to increase student engagement compared to traditional lectures.
- Additional support and resources should be provided for weaker students who rely on traditional lecture-based approaches to solidify their foundational knowledge.
- Both active learning and traditional lecture-based approaches contribute to a deeper understanding of the subject matter, with a majority of respondents favoring active learning.
- Active learning strategies have a significant positive impact on students' motivation, with none reporting a negligible or no impact on their motivation to learn.

Drawing from these findings, we can propose several recommendations to advance instructional approaches and foster student engagement and motivation:

- Integrate active learning strategies into teaching practices by incorporating interactive and cooperative learning experiences, practical applications, timely feedback, and cultivating a supportive learning environment.
- Offer supplementary support and resources for students who may struggle with traditional lecture-based approaches, helping them solidify their foundational knowledge.
- Infuse elements of active learning into traditional lectures to sustain student motivation, including active engagement, hands-on activities, collaboration, real-world connections, and timely feedback.
- Deliver well-structured and understandable lectures to sustain student motivation during traditional lecture-based approaches.
- Combine active learning and traditional lectures to promote a comprehensive understanding of the subject matter.
- Monitor student performance and provide targeted assistance for weaker students transitioning from traditional lecture-based approaches to active learning strategies.
- Conduct further research with larger and diverse samples to validate and expand upon the study's findings, contributing to the existing knowledge on active learning.

By implementing these recommendations, educators and institutions can create a dynamic and engaging learning environment that fosters student motivation, enhances learning outcomes, and prepares students for success in their academic and professional pursuits.

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Factors Influencing Information Literacy, Perceived Validity, and Perceived Trust in the Acceptance of Using Social Media in Implementing Blended Learning

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Abstract. Blended learning is being implemented in Indonesia, with the diversity of universities implementing blended learning giving many problems. With the number of universities in Indonesia being 3,107, the number of lecturers being 269,325, and the number of students being 7,875,281 (Indonesia Central Bureau of Statistics 2022), readiness is needed in the learning plans at each university to implement blended learning. Social media is an easy and cheap learning tool in blended learning, With the number of social media users in Indonesia amounting to 191 million (BPS 2022), it is necessary to analyze the role and influence of social media in blended learning. Information literacy, perceived validity, and perceived trust can influence the readiness and acceptance of technology in using social media in blended learning in higher education. By comparing lecturers and students, we can see the differences in the influence of these three variables. This research aims to see or predict whether information literacy, perceived validity, and perceived trust can influence the acceptance of social media in blended learning. Researchers used a model that had been built previously consisting of 12 variables and 57 indicators.

Keywords: Information Literacy · TAM · social media · Blended Learning

1 Introduction

ICT provides opportunities for every student to be more active and better and provides greater motivation. The teaching process can be more interesting, clear, and of higher quality for any subject. ICT provides great advantages in the preparation, organization of learning classes, and teaching students using modern technology in the classroom so that it can relatively provide performance, visual observation, better perception, and faster learning [1].

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In Indonesia, ICT is used massively in learning and learning management. This is in accordance with and in line with the policy of the Minister of Research, Technology and Higher Education (Ristekdikti), Muhammad Nasir in his statement in 2018 [2] encouraging universities to start implementing online distance lectures by implementing blended learning method, namely an instructional approach that combines online learning and face-to-face learning [3].

Research has been conducted by the Chinese Ministry of Education in research [4] making a call to stop classes and replace them by making good use of online classes using blended learning methods, where the Covid-19 pandemic has changed their way of life and has also triggered a revolution in teaching and learning process in higher education. The implementation of blended learning by adopting the model [5] can be seen in Fig. 1, the model describes mixed learning where pre-class, after-class, and tools are online learning and in-class are face-to-face learning (F2F).

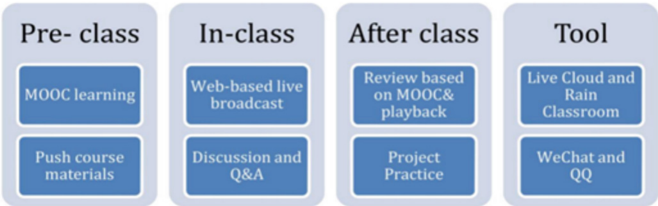

Fig. 1. Blended Learning Processing [5]

The direct application of blended learning also provides opportunities for lecturers and students to be able to expand their learning interactions anywhere without being limited by space and time, as long as they are still connected to information technology (ICT) and communication applications and the internet. However, in blended learning, it will be a challenge for lecturers to innovate and have the skills to use ICT and the Internet properly and correctly. Students are required to be more independent in learning and find learning resources well. In Indonesia, according to the Central Statistics Agency (BPS, 2022), there are 3,115 universities spread throughout Indonesia in 2021. The number of universities is dominated by private universities (PTS). Of the 3,115 existing universities, 2,990 of them have private tertiary status. Meanwhile, the other 125 are state universities. With the distribution of provinces in West Java (PTN: 12; PTS: 380; Total: 392); East Java (PTN: 17; PTS: 321; Total: 338); DKI Jakarta (PTN: 4; PTS: 275; Total: 279). So that many universities, especially private universities (PTS), need to be challenged to open up opportunities that can influence increasing the competitiveness and also the "business" of these universities so that they are sustainable and always adopt technological developments that support their sustainability [6, 7, 8].

Social media has a big influence on (academic) learning purposes, especially as a learning tool, but in some universities, its use is still minimal [9]. Because social media is an open source where information can be obtained from many information sources, it is considered important for users to increase their information literacy [10] or in research [11] when planning or giving courses in the blended learning model, so lecturers need to first understand the level of students' digital literacy for learning.

This research aims to see the influence of the variables information literacy, perceived validity, and perceived trust on the acceptance of social media in blended learning. And is there a difference in this verifiable influence between acceptance by lectures and acceptance by students?

2 Literature Review

The model used in the research has been proposed based on findings and suggestions from previous research [12] (Table 1) where previous researchers [13, 14, 15, 16] tended to develop practical information systems research models using previous models rather than based on empirical studies. This model was developed by adopting concepts, theories, and models from this research [17] and then combined and adapted in the context of testing information literacy factors in the acceptance of the use of social media towards the implementation of blended learning at private universities in West Java in Indonesia.

Table 1. List of concepts, theories, and models of the framework used

Model Concept/Theory	References
Theory of information processes	[15, 18]
Technology readiness model	[17, 19]
Technological acceptance model	[20, 21]
Theory of perception of trust and belief	[22, 23]
Process and causal models on development models	[14, 15, 22, 24–26]

Based on information processing theory [14, 17], the model developed uses the IPO logic computer logic model as the basis for its modeling design, which is still used by many researchers in their research in the field of Information and Communication Technology (ICT) to measure the quality of a system. This IPO model is used to describe a systematic concept of a system that it is hoped that stakeholders who do not understand the technicalities of the work will find it easier to understand. The IPO model can describe the phenomenon of integration readiness modeling through three dimensions, namely input, process, and output dimensions (Fig. 2).

In general, the model design was developed by adopting, combining, and adapting the technology readiness model [16], the technology acceptance model [19, 20], information literacy variables [9], truth perception variables, and trust perceptions [21, 22].

Researchers compared the IPO model [17] with the technology acceptance model [19, 20], and found that the process model and clauses in the technology acceptance model could not meet the completeness of the IPO model. The technology acceptance model only fulfills the process and output dimensions, therefore it is necessary to combine theory and models to fulfill the input dimensions.

To fulfill the input dimension, researchers adopted a technology readiness model and added an information literacy variable to measure the ability to search for, understand,

Table 2. List of incicators [12]

Code	Indicators	Code	Indicators
INL1	Information seeking	OPT1	Easiness
INL2	Information verification	OPT2	Connectivity
INL3	Information Sharing	OPT3	Efficiency
INL4	Digital literacy	OPT4	Effectiveness
INL5	Media literacy	OPT5	Productivity
DCF1	Complexity	ISC1	Failure
DCF2	Difficulty	ISC2	Threat
DCF3	Dependence	ISC3	Reducing Interaction
DCF4	Lack of support	ISC4	Distraction
DCF5	Inappropriateness	ISC5	Incredulity
PCT1	Clarity	PCU1	Work more quickly
PCT2	Integrity	PCU2	Improve job performance
PCT3	Systematization	PCU3	Increase productivity
PCT4	Openness	PCU4	Effectiveness
PCT5	Coherence	PCU5	Make job easier
PCT6	Data Sufficient	PCU6	Useful
ITU1	Intend to use it in the future	UBV1	Bad/good idea
ITU2	Use regularly	UBV2	Foolish/wise idea
ITU3	Recommend others to use	UBV3	Dislike/like
INV1	Problem-solving	UBV4	Unpleasant/pleasant
INV2	Independence	PCV1	Accuracy
INV3	Challenge	PCV2	Consistency
INV4	Stimulation	PCV3	Easy to describe
INV5	Competitiveness	PCV4	Psychometric
PEU1	Easy to learn	PCV5	Retrievable
PEU2	Controllable	ACU1	Frequency of usage
PEU3	Clear and understandable	ACU2	Duration of use
PEU4	Flexible		
PEU5	Easy to become skillful		
PEU6	Easy to use		

and disseminate information. However, this ability can influence a person's perception of the truth and trustworthiness of information. So, researchers need to add variables of perception of truth and trust which are included in the process dimension. Adopting

Fig. 2. IPO Logic [18]

4 (four) dimensions of technology readiness structure and TRI 1.0 [16] as external variables: optimism, innovation, discomfort, and insecurity (Figs. 3 and 4).

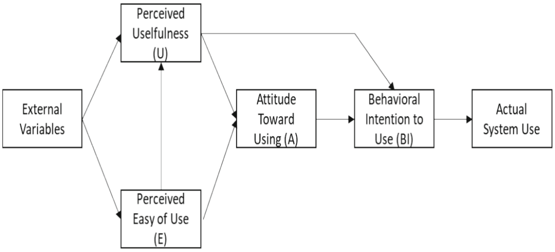

Fig. 3. TAM Model [21]

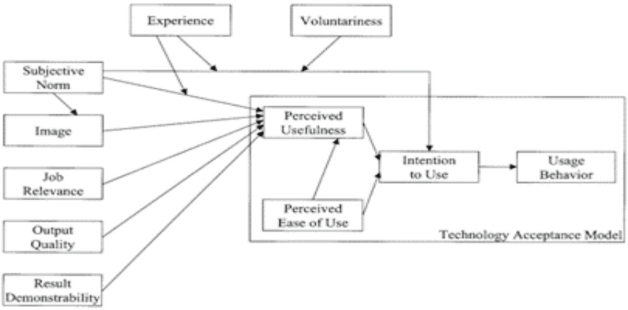

Fig. 4. TAM 2 Model [20]

The modeling integration process can also be influenced by environmental entities [26, 27] where the naming is adjusted to the research discussion in this case, namely the acceptance of the use of social media in the application of blended learning. Then other supporting variables were added by adopting the information literacy variable [9] which influences the habits of lecturers and students in sharing information on social media in implementing blended learning and supports the level of truth and trust in the information received in blended learning activities.. Therefore, it is necessary to have variables of perceived validity and perceived trustworthiness [21, 22] (Fig. 5).

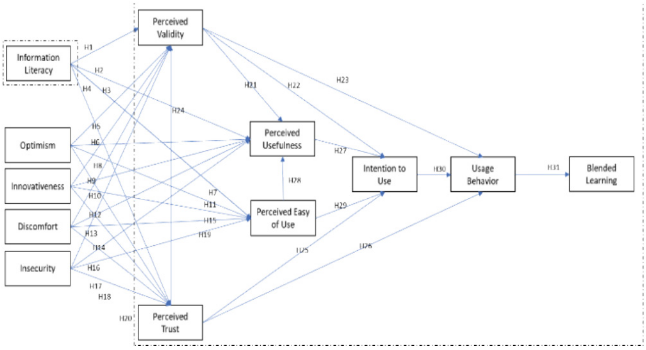

Fig. 5. Acceptance of Social Media Use to the Application of Blended Learning Model

3 Research Methode

Figure 6 shows the research procedure, where points 1 and 2 show the preliminary study stages, and points 3 to 8 show the pilot study stages. This pilot study was carried out to validate the developed model quantitatively.

At the introduction stage, the population of this research pilot test was leaders, staff, and lecturers of private universities in West Java, Indonesia who were directly involved in implementing blended learning using social media, involving 31 respondents where the results of this pilot test were useful for minimizing errors in when the main evaluation is carried out [12].

The next stage, namely the quantitative step sample used, was 120 students and 80 lecturers from the population of lecturers and students in West Java at private universities. For data collection techniques, researchers use a research instrument in the form of a questionnaire using 5 (five) Linkert scales, with a scale of 1 “Strongly Disagree” to a scale of 5 “Strongly Agree” which consists of two parts, namely an introduction and research questions. The research instrument was adapted from the research model used. As for the data collection process, this research distributed questionnaires by distributing the Google Form questionnaire link via e-mail and WhatsApp.

Inferential statistical analysis was carried out using the variance-based multivariate statistical method (PLS-SEM) using SmartPLS version 3.0 software. [27]. Referring to several previous researchers, PLS-SEM has two evaluation models, namely the measurement model, or outer model, and the structural model, or inner model. Evaluation of the measurement model is carried out to test the reliability and validity of the outer model through the stages of testing individual item reliability, internal consistency reliability, convergent validity, and discriminant validity [12]. In this research, the R square test and F test were used to see the influence between variables and compare the acceptance of social media in blended learning between lecturers and students.

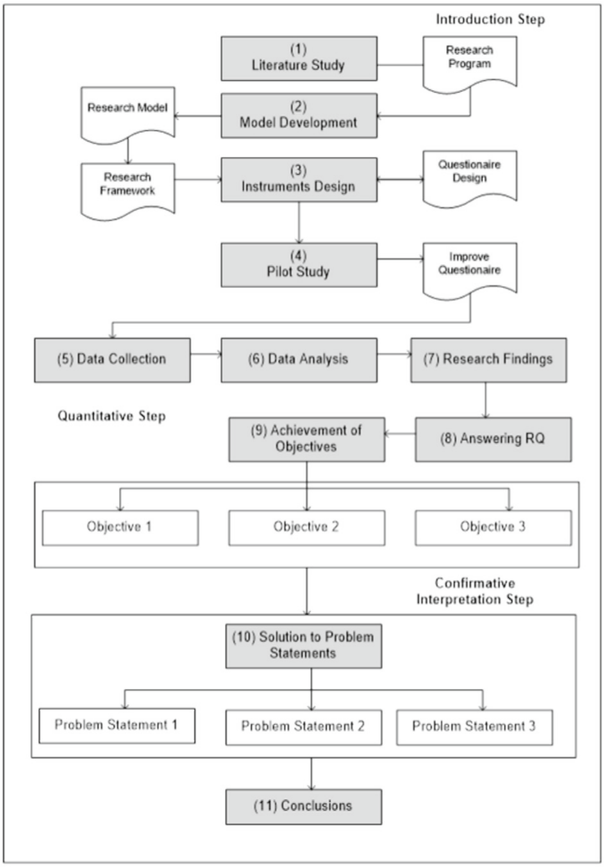

Fig. 6. Research Procedure

4 Result and Discussion

A. Analysis Results for Lecturer Respondent Data.

1) R Square Analysis Results.

R square is a value that shows how much the independent (exogenous) variable influences the dependent (endogenous) variable. R squared is a number that ranges from 0 to 1 and the R-squared value (R2) is used to assess how much influence a particular independent latent variable has on the dependent latent variable. There are three grouping categories in the R square value, namely the strong category, moderate category, and weak category [28]. Hair et al. stated that an R square value of 0.75 is in the strong category, an R square value of 0.50 is in the moderate category and an R square value of 0.25 is in the weak category [28, 29]. The R square results can be seen in the table below:

Table 3. R square analysis from lecturers respondent

Variables	R Square	R Square Adjusted
ACU	0,248	0,238
ITU	0,636	0,616
PCT	0,467	0,431
PCU	0,630	0,594
PCV	0,724	0,702
PEU	0,591	0,564
UBV	0,660	0,637

From Table 3 above it can be concluded that the highest percentage value of influence is the PCV variable at 72.4%

1) *F Test Analysis Results.*

The F test aims to find out whether the independent variables together (simultaneously) influence the dependent variable. The F test is carried out to see the influence of all independent variables together on the dependent variable. The level used is 0.5 or 5%, if the significant value F <0.05 then it can be interpreted that the independent variable simultaneously influences the dependent variable or vice versa [30].

Table 4. F test result from lecturer respondents

	ACU	DCF	INL	INV	ISC	ITU	OPT	PCT	PCU	PCV	PEU	UBV
ACU												
DCF								0,000	0,020	0,038	0,001	
INL								0,002	0,031	0,000	0,308	
INV								0,005	0,028	0,066	0,122	
ISC								0,012	0,001	0,001	0,009	
ITU												0,106
OPT								0,225	0,015	0,000	0,003	
PCT						0,000				0,733		0,021
PCU						0,118						0,024
PCV						0,048			0,078			0,024
PEU						0,132			0,115			0,214
UBV	0,329											

It can be seen in Table 4 that based on the hypothesis created that H1, H2, H4-H7, H10-H20, H22, H23, H25, and H26 there are significant differences between the related variables according to Table 4 above. Meanwhile, H3, H8, H9, H21, H24, H27-H31, the results of the f test have a significant value above, then >0.05, meaning that Ho is accepted, meaning there is no significant difference between the related variables.

B. Analysis Results for Students Respondent Data.

1) R Suare Analysis Result.

The results of the R Square analysis of student respondents can be seen in Table 5 below:

From Table 5 above it can be concluded that the highest percentage value of influence is the PCU variable at 74.7%.

1) F Test Anlalysis Result.

Table 5. R square analysis result from students respondent

	R Square	R Square Adjusted
ACU	0,296	0,290
ITU	0,670	0,659
PCT	0,575	0,557
PCU	0,747	0,731
PCV	0,702	0,686
PEU	0,604	0,586
UBV	0,691	0,677

The results of the F test analysis on student respondents can be seen in Table 6 below:

Table 6. F test result from students respondents

	ACU	DCF	INL	INV	ISC	ITU	OPT	PCT	PCU	PCV	PEU	UBV
ACU												
DCF								0,014	0,005	0,021	0,000	
INL								0,009	0,001	0,008	0,057	
INV								0,130	0,023	0,083	0,146	
ISC								0,053	0,046	0,000	0,000	
ITU												0,151
OPT								0,075	0,018	0,005	0,048	
PCT						0,025				0,616		0,000
PCU						0,116						0,001
PCV						0,004			0,088			0,025
PEU						0,126			0,330			0,093
UBV	0,421											

It can be seen in Table 6 that based on the hypothesis created that H1, H2, H4, H7, H8, H9-H13, H18, H20, H21, H23-H25, H27-H31 there are significant differences between the related variables according to Table 3 on. Meanwhile, H3, H5, H6, H14-H17, H19, H22, the results of the f test have a significant value above, then >0.05, meaning that Ho is accepted, meaning there is no significant difference between the related variables.

10) Results of Comparative Analysis between Lecturers and Students.

The analysis method used to determine the magnitude of the influence of the INL (information literacy) variable on the variables according to the research indicators was carried out using R square analysis or Determination Coefficient using the help of smart PLS. The analysis technique used is by comparing the percentage of influence of INL on the research variables with the results in the following Table 7:

From Table 7, the comparison above shows that the INL variable on the research variables has an average value of 0.565 for lecturer respondents and 0.612 for student respondents, so it can be concluded that both groups of respondents have the same influence interpretation value, namely medium. If analyzed in more detail, student respondents have a better influence than the lecturer respondent group, this can be seen in the influence of INL on the PCU variable which shows a difference between lecturers of 0.630 (63%) in the medium category but for student respondents it is 0.747. (74.7%) in the High category.

Table 7. R Square Comparison

Variables	Lecturers		Students	
	R Square	*Influence status*	*R Square*	*Influence status*
ACU	0,248	Low	0,296	Low
ITU	0,636	Moderat	0,670	Moderat
PCT	0,467	Moderat	0,575	Moderat
PCU	0,630	Moderat	0,747	High
PCV	0,724	High	0,702	High
PEU	0,591	Moderat	0,604	Moderat
UBV	0,660	Moderat	0,691	Moderat
Mean	0,565	Moderat	0,612	Moderat

Table 8. F test result comparison

variables	Respondent	variables							
		ACU	**ITU**	**OPT**	**PCT**	**PCU**	**PCV**	**PEU**	**UBV**
INL	Lecturers				0,002	0,031	0,000	0,308	
	Students				0,009	0,001	0,008	0,057	
PCV	Lecturers		0,048			0,078			0,024
	Students		0,004			0,088			0,025
PCT	Lecturers		0,000				0,733		0,021
	Students		0,025				0,616		0,000
PCU	Lecturers		0,118						0,024
	Students		0,116						0,001
PEU	Lecturers		0,132			0,115			0,214
	Students		0,126			0,330			0,093
UBV	Lecturers	0,329							
	Students	0,421							

After the percentage analysis process of the influence of R square or Determination Coefficient, it is then continued by comparing F square or testing the difference between the INL variable and the variables from the research indicators. The comparison test process using the F test is by comparing the calculated significance value with an alpha value of 0.05 (error level) with the following conditions [29, 31]:

- If the sig alpha value <0.05 then HO is rejected, meaning there is a significant influence between the independent variable and the dependent variables.
- If the sig alpha value is >0.05 then HO is accepted, meaning there is no significant influence between the independent variable and the dependent variables

For the INL variable, the influence of the PCT, PCU, and PCV variables on lecturer and student respondents obtained a value of <0.05, meaning it had a significant influence. However, the PEU variable for both lecturer and student respondents obtained a value of >0.05, meaning that the INL variable does not have a significant influence on the PEU variable. For the PCV variable, the influence of the ITU and UBV variables on lecturer and student respondents obtained a value of <0.05, meaning it had a significant influence. However, for the PCU variable, both lecturer and student respondents obtained a value of >0.05, meaning that the PCV variable does not have a significant influence on the PCU variable. For the PCT variable, the influence of the ITU and UBV variables on lecturer and student respondents obtained a value of <0.05, meaning it had a significant influence. However, for the PCV variable, both lecturer and student respondents obtained a value of >0.05, meaning that the PCT variable did not have a significant influence on the PCV variable. The PCU variable has a large influence on the UBV variable for lecturer and student respondents who get a value of <0.05, meaning it has a significant influence. However, for the ITU variable, both lecturer and student respondents obtained a value of >0.05, meaning that the PCU variable does not have a significant influence on the ITU variable. For the PEU variable, the influence of the ITU, PCU, and UBV variables on lecturer and student respondents obtained a value of >0.05, meaning it did not have a significant influence. The UBV variable has a large influence on the ACU variable for lecturer and student respondents who get a value of >0.05, meaning it does not have a significant influence.

5 Conclusion

The Information Literacy (INL) variable among lecturer and student respondents has a great influence on perceived trust (PCT), perceived usefulness (PCU), and perceived validity (PCV). The variable Information literacy (INL) Collaboration with perceived validity (PCV) has a very significant influence on intention to use (ITU) and usage behavior (UBV). The variable Information Literacy (INL) Collaboration with Perceived Trust (PCT) has a very significant influence on intention to use (ITU), and usage behavior (UBV). This indicates that the ITU and UBV variables can be followed up by correlating their effects on other variables.

Information literacy (INL) variable Collaboration with perceived usefulness (PCU) has a very significant influence on usage behavior (UBV). The variable Information Literacy (INL) Collaboration with Perceived ease to use (PEU) does not have a significant effect on the intention to use (ITU), perceived usefulness (PCU), and usage behavior (UBV). The variable Information literacy (INL) Collaboration with usage behavior (UBV) does not have a significant effect on actual use (ACU). This indicates that this variable cannot be followed up.

In future research, this model will be tested on a wider sample so that it is possible that different results will be obtained on the variables tested and the influence of technology readiness in the use of social media in blended learning will also be analyzed.

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Integrated Field Camp: Project Based Learning for Geology and Geophysics Courses

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Abstract. Integrated field camps (IFCs) are a type of field camp that combines aspects of geology and geophysics in a hands-on, field-based learning environment. They are typically designed for students, researchers, or professionals in the fields of geology and geophysics and aim to provide them with practical experience, skills, and knowledge in both disciplines. This paper presents the results of a project-based learning (PBL) activity that was implemented in an IFC at Langkawi Island, Kedah, Malaysia. The PBL activity involved observing and acquiring both geological and geophysical data at the study area. The primary objectives of the PBL activity were to acquire basic field techniques, create a geological map, produce a cross-section, develop students' teamwork skills, design good geophysical surveys, and evaluate the limitations of each instrument. The PBL activity was divided into three main phases: pre-field camp, field camp, and post-field camp. The pre-field camp phase involved providing students with a guidebook that covered the geology of the study area and geophysical procedures. The field camp phase involved visiting various geological sites throughout Langkawi Island and conducting geophysical surveys. The post-field camp phase involved analyzing the acquired data and preparing presentations and reports. The results of the PBL activity showed that it was effective in helping students improve their understanding of the subjects, increase their geological and geophysical skills, and improve their motivation. The PBL activity also helped students develop their teamwork skills and learn how to design and conduct effective geophysical surveys.

Keywords: Integrated Field Camp · Geology Field camp · Geophysics Field camp · Project Based-Learning

1 Introduction

The utilization of project-based instruction and learning represents an enticing approach with the potential for significant enhancements in science and engineering education [1]. One way to enhance the student's effectiveness and competency skills is to let them

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in inquiry-based experiences [2]. Generally, project-based learning (PBL) embodies a dynamic methodology where students actively engage with real-world problems and challenges. Through this interactive and participatory educational style, students are not only motivated but also inspired to delve deeper into their academic subjects. Project-based learning (PBL) is a constructivist educational approach centered around projects designed to foster problem-solving, critical thinking, and learner independence by tackling real-world problems [3]. According to [4] the term PBL has been broadly used to encompass various pedagogical applications. John and Thomas [5] delineated five key criteria for PBL: projects hold a central role in the curriculum, focusing on questions and challenges that compel students to engage with the core concepts and principles of their field; projects involve constructive investigation; students drive projects, not teachers; and projects are grounded in realism.

The integrated field camps (IFC) in geology is an educational and research program that combines aspects of geology and geophysics in a hands-on, field-based learning environment. This type of field camp is typically designed for students, researchers, or professionals in the fields of geology and geophysics and aims to provide them with practical experience, skills, and knowledge in both disciplines. Some key components and features of PBL in IFC includes field-based learning: geological fieldwork: geophysical surveys: interdisciplinary approach: integrated problem solving.

A. Field-Based Learning.

The primary focus of the field camp is hands-on learning in real-world geological and geophysical settings. Participants spend time in the field, exploring geological formations, collecting rock samples, and conducting geophysical surveys.

B. Geological Fieldwork.

Participants learn about geological processes, rock identification, and the interpretation of geological features in the field. This may include mapping geological structures, understanding stratigraphy, and studying the history of the Earth's crust.

C. Geophysical Surveys.

The field camp also emphasizes geophysical techniques and equipment. Participants are trained in using geophysical instruments like seismometers, magnetometers, gravity meter and others to collect subsurface data.

D. Interdisciplinary Approach.

The camp encourages an interdisciplinary approach, where geologists and geophysicists work together to solve complex problems. This integration helps participants develop a holistic understanding of subsurface features. Integrated problem solving.

E. Integrated Problem Solving.

Field camps often include projects or research tasks that require participants to apply their knowledge and skills to address real-world geological and geophysical challenges. Participants create geological maps, cross-sections, and interpretations that combine geological and geophysical data to understand subsurface structures and potential resources.

The IFC is valuable for students in the earth sciences because they provide practical skills and experience that can be applied in careers related to resource exploration, environmental assessment, hazard mitigation, and more. Additionally, they promote collaboration between geologists and geophysicists, which is essential for solving complex geological problems.

Starting 2022, The new program structure has been designed for all petroleum geoscience students at UTP to have a combined fieldwork that addresses more than one course in a single field trip for every year of study. This is to establish a comprehensive fieldwork that integrates more courses for multiple purposes. Integrated field camps (IFCs) are mandatory assessments to conclude the second year of study. The IFCs address two courses that are offered in the same semester: QCB2083 Fieldwork Management and Geo-field camp (GFC), and QCB2093 Non-Seismic Methods (NSM). Prior to the restructuring, these courses were not offered in the same semester, and two separate field camps at different locations were conducted: the geo-field camp and the geophysics field camp.

2 Methodology

The IFC is a PBL activity that encompasses observing and acquiring both geological and geophysical data at Langkawi Island, Kedah, Malaysia. Langkawi was chosen as the study area because of its unique geological features, including the oldest rock formations in Malaysia and a variety of outstanding geological landscapes on a single island. Additionally, there are many unanswered questions about the geology of Langkawi that require subsurface study, such as the extent of the Kisap thrust fault. The IFC lasts for seven days and includes three days of geological fieldwork and two days of geophysical tasks. With the theme of the IFC is “Unveiling the Earth’s Wonders of Langkawi Island” the primary objectives of the IFC are to acquire basic field techniques, create a geological map, produce a cross-section, develop students’ teamwork skills, design good geophysical surveys, and evaluate the limitations of each instrument.

A. Problem Based-Learning Activities.

The PBL implementation was divided into three main phases: pre-field camp, field camp and post-field camp as shown in Fig. 1. Pre-field camp phase was started from week 7 to week 8 where the students were provided with a guidebook that covered the geology of the study area and geophysical procedures. The flipped classroom approach was used for the proposal assignment, where students were first presented with an example of a previous real proposal. As for geophysics surveys, each group was then assigned a study area of the same size, and they were tasked with designing, planning, and discussing their field surveys during class hours. The instructor also introduced students to the equipment and provided training on the machine operations so that they would be well-prepared for their fieldwork.

The field camp was conducted in week 9, with two days for travel, three days for geology fieldwork, and two days for geophysical acquisition. The geology fieldwork involved visiting various geological sites throughout Langkawi Island (Fig. 2), while the geophysical survey had a more specific objective at a specific site: to find the Kisap Thrust Fault, a major fault in Langkawi (Fig. 3). As the daytimes were the execution, the night times required students to analyses the acquired data and submit the daily report [2] (Fig. 4). Upon returning to campus, the students continued their analyses and prepared their presentations and reports within two weeks. After submitting reports, peer evaluations were conducted within each group and feedback about overall activities from students were collected.

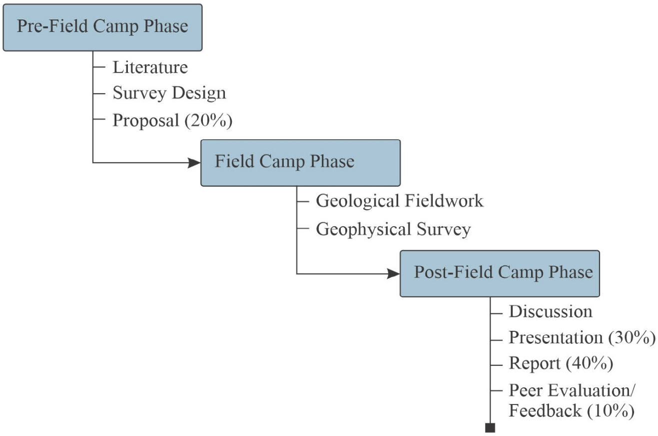

Fig. 1. The flow of PBL activities.

Fig. 2. Map of Langkawi Island, the red dots indicates the locations of geological outcrops.

B. Problem Based-Learning Assessment.

The assessment for this PBL can be divided into two types: formative and summative. Formative assessment is ongoing feedback from the instructor based on the students' progress, as well as peer evaluation among group members. Summative assessment is the written report and presentation, which are evaluated based on a rubric. The PBL assessment is different between these two courses because the coursework carries different marks: 100% for Geofieldcamp and fieldwork management (QCB2083), and 60% for non-seismic methods (QCB2093). Therefore, QCB2083 has a higher weighting

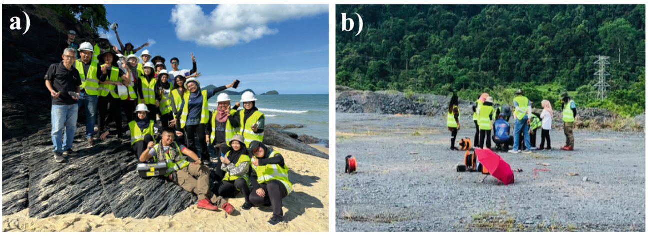

Fig. 3. a) Geofieldcamp at Tanjung Mali b) Geophysics Survey at abondance Lafarge quarry.

Fig. 4. a) night sharing activities b) visiting Langkawi Research Centre.

than QCB2093. However, the total marks of the PBL is divided into four assessments: proposal, report, presentation, and peer evaluation as shown in Fig. 5.

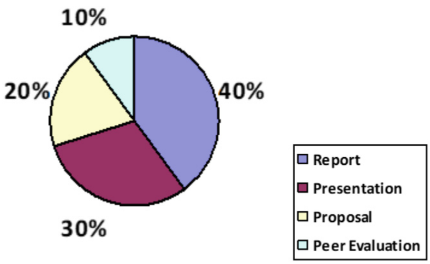

Fig. 5. PBL Coursework Breakdown.

3 Result and Discussion

At the end of the semester, students were required to complete a feedback questionnaire to assess the following: 1) The effectiveness of the PBL implementation in the assessment. 2) The efficiency of conducting the IFC for the GFC and NSM courses. In addition, selected students were also interviewed to gather more in-depth feedback.

K. Feedback on PBL implementation in the assessment.

Figure 6 shows the survey results on the effectiveness of the PBL implementation. The implementation of PBL was met with positive feedback from students. Most students

(83%) agreed that PBL helped them improve their understanding of the subjects, increase their geological and geophysical skills, and improve their motivation while 17% who had a neutral view expressed concerns about the tight schedule and the large number of tasks and assignments involved in PBL, which they felt made it difficult to complete all the assessments.

The implementation of PBL was met with positive feedback from students. Most students (95%) agreed that it improved their motivation, as they were highly motivated to participate in fieldwork after the COVID-19 pandemic had prevented such activities for the past year. This was evident in the high level of engagement and enthusiasm that students showed during the fieldwork. The feedback on the improvement of geological and geophysical skills was also positive. Students felt that they had a better understanding of the concepts and theories they had learned in the classroom after applying them in the field. However, some students felt that they could have gained the same experience by conducting the fieldwork in a nearby or campus site, especially for geophysical surveys. This is because the geophysical equipment is often expensive and difficult to transport, and it can be difficult to find suitable locations for geophysical surveys on campus or in nearby areas. The understanding skill score of 75% is also a positive result. This indicates that most students were able to understand the concepts and theories they were learning and apply them to real-world problems. However, some students still felt that they needed more practice with the equipment and techniques. Overall, the feedback from students on the implementation of PBL was positive. Most students felt that it was an effective way to learn and that it improved their motivation, skills, and understanding of the subject matter.

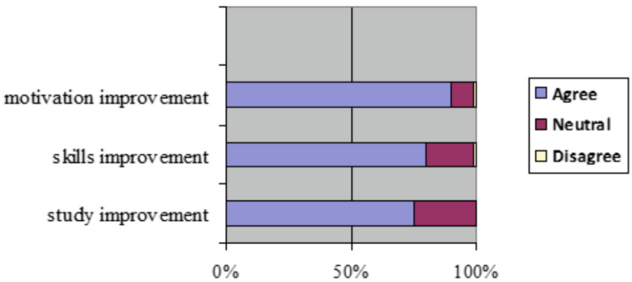

Fig. 6. Majority of the students believe that PBL increase their cognitive, psychomotor, and effective skills.

A. Feedback on IFC for the GFC and NSM courses.

Figure 7 shows the survey results on the efficiency of conducting IFC for the GFC and NSM courses. 85% of students agreed to conduct IFC for fieldwork organization efficiency, budget optimization and time management. The IFC would optimize the students' fieldwork costs and budget by conducting the field camps back-to-back, which would reduce the expenses for transportation and accommodation. In addition, the students expressed their liking to work in the same group for two courses, as this would help them to organize their semester study group and assignments by sharing knowledge and skills and helping each other to stay on track with their work.

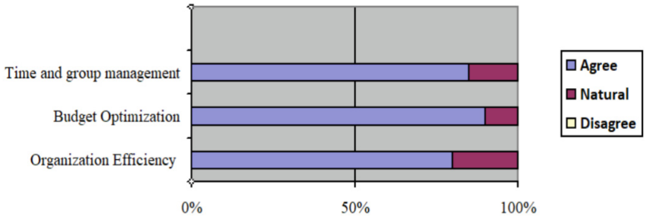

Fig. 7. Majority of the students agreed that IFC is good organization in term of budget and time optimization.

The neutral feedback we received is still considered positive feedback, as 25% of the students want to have separate field camps. They want to visit more than one location, which would increase their knowledge and widen their geological scopes. In addition, students suggested finding a mechanism to combine the reports for the GFC and NSM courses, as they believe this would be a better solution to reduce the time and cost of writing two separate reports. Regarding budget optimization, most of the respondents wanted the organizers to also consider the meal budget, as they would be spending 7 days outside the campus.

B. IFC instructors Feeback.

In addition to the students' feedback, we also collected feedback from the instructors, including four lecturers, four graduate assistants, and three technologists. All instructors agreed that the IFC would optimize the budget and help them with time management. Previously, they had to spend money and time on two separate field camps, which disrupted their office responsibilities and caused delays. In terms of budget, this IFC has reduced up to 25% spending compared to two separates fieldworks previously, especially on the transportation and accommodation costs.

The majority of instructors (90%) agreed that the IFC added value to the PBL implementation process, while only 10% felt that the process needed improvement. For instance, some instructors felt that the field guidebook was unnecessary, as they believed that it was a form of spoon-feeding. They argued that students should be allowed to find their own resources of information, rather than being given confined instruction that would make them passive learners.

4 Conclusion

The implementation of PBL and IFC was met with positive feedback from students and instructors. Most students and instructors agreed that the IFC was an effective way to integrate two courses and optimize the budget. However, some students and instructors felt that the field guidebook was unnecessary and that the reports for the two courses should be combined. The PBL implementation was effective in improving students' understanding of the subjects, increasing their geological and geophysical skills, and improving their motivation. The IFC was effective in optimizing the students' fieldwork costs and budget, and in helping them to organize their semester study group and assignments. The instructors were generally satisfied with the IFC and felt that it added value to the PBL implementation process.

Overall, the implementation of PBL and IFC was a success. The feedback from students and instructors was positive, and the programs were effective in achieving their goals. However, there are some minor changes that could be made to improve the programs.

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Investigating the Academic Stress and Mental Well-Being Among Undergraduate Students After COVID-19 Pandemic Era

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Abstract. Stress has been identified to be detrimental to students' well-being especially during the COVID-19 pandemic. A descriptive cross-sectional online survey was conducted among undergraduate bachelor's degree students at Universiti Tenaga Nasional (UNITEN) between December 16, 2022, and January 6, 2023. This study is aimed to investigate the level of perceived stress due to academic related activities after the pandemic. Descriptive statistical analysis was used to assess the levels of perceived stress among genders and different levels of study. A total of 338 students (55.03% male, 44.97% female) participated. Most students perceived themselves to be stressed (34.62% high stress, 50.62% medium stress) with academic related work. More female students (39,47%, n = 152) perceived themselves to experience high stress level compared to male students (30.65%, n = 182). The main factors causing stress are due to assessment (54.44%), subject difficulty (50.3%) and class schedule (30.77%). Perceived stress can have a major negative impact on a student's mental wellbeing. It is important to identify students who experience a high amount of stress and take immediate suitable action to reduce the perceived stress.

Keywords: academic stress · mental wellbeing · undergraduate students

1 Introduction

Stress in an individual is typically linked to the pressure faced by a person due to environmental factors, family, peers, and friends, or due to a certain expectation or situation [1]. Stress is an unavoidable element in daily life, in which at a certain level it can be helpful in achieving certain targets or goals, however it is often associated with undesired consequences such as causing health problems and disorders [2]. Perceived stress is said to have a negative link to mental wellbeing [3]. COVID-19 pandemic has caused worldwide disruption including in the field of education. It was reported that the pandemic caused the increase in perceived stress among university students [4].

For students, there are many factors causing stress that can affect not only academic performance but more importantly can negatively affect the mental state leading to physical health problem [5]. One of the major sources of this is categorized under

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academic stress. The rise of academic stress may be due to assessment, peer pressure, high family expectations and issues related to time management [6]. COVID-19 pandemic may have further worsened the situation due to drastic changes in teaching and learning approaches, such as online learning, virtual examination, and self-learning from home [8].

A study was carried out among undergraduate students at Universiti Tenaga Nasional (UNITEN), to investigate the perceived stress level that they feel, and the factors that causes this stress. Even though many similar studies were carried out in other higher learning institutions, it is often acknowledged that each institution experience a different and unique situation.

It is expected that the findings from this survey will provide more insight and in-depth information for us to understand better on the academic stress among undergraduate students, especially at UNITEN, and providing path to come up with meaningful solutions.

2 Background

2.1 Academic Stress

Academic stress is a mental state that all students face throughout their study period impacting their mental health due to academic reasons [6, 9, 12]. During study periods, the student may face many different types of stresses, most of them were stressed due to academic related factors [15].

Academic stress can be considered as a double-edge sword, in which it can be beneficial as a certain amount can motivate, providing healthy competition within peer group thus promoting learning to excel in academics [6]. On the other hand, higher perceived academic stress is associated with poorer academic performance [5, 11]. A study conducted by a group of researchers to examine the association of chronic mental stress with academic performance in Korean adolescents found that those with high chronic mental stress were less likely to achieve average academic performance or higher [14].

The COVID-19 pandemic has brought up the issue of mental health and well-being among students into the spotlight. Various studies and surveys investigating stress, anxiety, and depression among students, particularly at undergraduate level, found that a significant number of them experienced moderate to severe stress level [4, 8, 10, 11]. During the pandemic and lock down period, all teaching and learning activities including assessment have been shifted into online or virtual mode. The sudden change in the learning environment coupled with the worrisome of relatively unknown COVID-19 virus during that time, has created uncertainty and fear.

Different gender students may have different levels of perceived stress. A study conducted at 6 different universities in Sudan among medical students, reported that male students were far less stressed than females [7]. Other similar studies [2, 4, 8] also reported that female students are more likely feeling stressed and vulnerable to mental health issues.

Students at different levels of studies may also experience different levels of perceived stress. Typically, students at towards the final year of study were academically more stressed compared to the first or second year [7, 13].

2.2 Research Questions

1. What is the stress level perceived by undergraduate students at UNITEN, and is there any difference between gender and year of study?
2. What are the causes of stress perceived by these students?

3 Method

This study is carried out as descriptive cross-sectional online survey conducted at the end of Semester 1 2022/23. UNITEN's students from all bachelor level academic programs are invited via email to participate in this survey.

The survey questions were designed by the Teaching and Learning Centre (TLC) of UNITEN, focusing on the perceived level of stress that they are facing during the semester due to academic matters. Three questions, that are designed to be simple and straightforward, were asked in the survey, as described in Table 1.

Table 1. Survey questions

No.	Question	Selection of answer
1	Throughout the semester, on average, how do you rate your stress level due to teaching and learning process	No stress; Low stress, Medium stress, High stress
2	I am able to cope well with teaching and learning in this semester	5-point Likert scale style – Strongly Disagree (SD), Disagree (D), Neither Agree nor Disagree (N), Agree (A), Strongly Agree (SA)
3	Please choose the reason(s) that makes you stressful (you may choose more than one)	(1) The subjects I took are difficult; (2) Assessment is too much or could not cope with given assessments; (3) Difficulty in communicating/discussing with the lecturer (4) The class schedule is too packed or not convenient (5) Others

At this stage of the study, a descriptive statistics approach was used to analyze the survey data. The focus is on the prevalence frequency and the mean or average score of the different groups based on gender and year of study.

For Question 1, the answers are converted into numerical values for the analysis (No stress = 0; low stress = 1; medium stress = 2; high stress = 3). Meanwhile for Question 2, the answers are converted into the scale of 1 (strongly disagree) to 5 (strongly agree).

4 Results and Discussion

4.1 Respondent Background

The total number of respondents of the survey is 338 students from undergraduate bachelor program. Table 2 shows the demographic characteristics of the correspondent. Most respondents were male (55.03%, n = 186). The students from all academic programs and years were represented in this survey, with majority are from 1st and 2nd year.

4.2 Descriptive Statistics Analysis

The initial analysis carried out was on the descriptive statistics and frequency analysis on the responses for each question. Table 3 shows the breakdown of the result for Question 1 on the perceived stress level for all students as well as male and female students.

Table 3 shows the mean score for perceived stress for all respondents was 2.16 (Standard deviation (SD) 0.77) on the scale from 0 to 3. A total of 34.6% indicated experiencing high amount of stress, 50.3% medium or moderate stress and 11.2% a low amount of stress. A total of 84.9% of the respondents were either in 'high stress' or 'medium stress' group which can be considered as alarming. Female students had higher mean score of 2.23 (SD 0.72) comparing to male students (mean 2.08; SD 0.79). Higher number of female students also experiencing high amount of stress (39.5%) compared to male students (30.7%).

Table 2. Demographic characteristics of the respondents

Aspect	Characteristics	n (%)
Gender	Male	186 (55.03%)
	Female	152 (44.97%)
Year of study	1^{st} year	104 (30.77%)
	2^{nd} year	91 (26.92%)
	3^{rd} year	81 (23.96%)
	4^{th} year	62 (18.34%)

Table 4 shows the analysis of the respondent group by the year of study, as well as the breakdown based on gender for each year group. At UNITEN, all engineering undergraduate bachelor programs are conducted in four years, while programs in other fields are three years.

The result shows that the highest mean score of perceived stress for all respondents is among 3rd year students (Mean 2.34; SD 0.67), while the lowest is among 1st year

Table 3. Descriptive statistics and frequency analysis

Respondent	Mean	Std. Dev	% of respondents			
			No stress	*Low stress*	*Medium stress*	*High stress*
All	2.156	0.767	3.85	11.24	50.30	34.62
Male	2.080	0.797	5.38	11.83	52.15	30.65
Female	2.250	0.721	1.97	10.53	48.03	39.47

students (Mean 1.97; SD 0.79). More 3rd year students also experienced high amounts of stress (44.4%), followed by 4th year students (37.1%), 2nd year students (36.3%) and 1st year students (24.0%). It is concerning that about 91% of 3rd year students have either medium or high amount of perceived stress.

Among the different genders and year of study, the group with the highest mean score of perceived stress is the 3rd year female students (Mean 2.43; SD 0.60), followed by the 2nd year female students (Mean 2.37; SD 0.70). It is very concerning than nearly half of the female students in 3rd year (48.6%) and in the 2nd year (47.8%) indicated that they were experiencing high amount of stress. Among the 4th year students, there are fewer female students (25.0%) indicated in experiencing high stress compared to male students (41.3%).

Table 4. Descriptive statistics analysis based on year of study

Respondent	Mean	Std. Dev	% of respondents			
			No stress	*Low stress*	*Medium stress*	*High stress*
1st year						
All	1.971	0.790	5.77	15.38	54.81	24.04
Male	1.837	0.791	8.16	16.33	59.18	16.33
Female	2.091	0.769	3.64	14.55	50.91	30.91
2nd year						
All	2.230	0.697	2.20	8.79	52.75	36.26
Male	2.089	0.661	2.22	11.11	62.22	24.44
Female	2.369	0.703	2.17	6.52	43.48	47.83
3rd year						
All	2.346	0.669	1.23	7.41	46.91	44.44
Male	2.283	0.712	2.17	8.70	47.83	41.30
Female	2.429	0.599	0.00	5.71	45.71	48.57
4th year						
All	2.112	0.863	6.45	12.90	43.55	37.10

(*continued*)

Table 4. (*continued*)

Respondent	Mean	Std. Dev	% of respondents			
			No stress	*Low stress*	*Medium stress*	*High stress*
Male	2.130	0.923	8.70	10.87	39.13	41.30
Female	2.062	0.658	0.00	18.75	56.25	25.00

The second question of the survey is asking whether the student can cope with the teaching and learning in the semester. Table 5 shows the frequency analysis of the result, showing the overall respondents as well as the breakdown based on the year of study and gender.

Table 5. Frequency analysis on the coping ability

Respondent (n)	% of respondents				
	SD	*D*	*N*	*A*	*SA*
All (338)	3.25	9.47	30.18	48.82	8.28
1st year (104)	0.00	7.69	33.65	52.88	5.77
Male (49)	0.00	6.12	30.61	57.14	6.12
Female (55)	0.00	9.09	36.36	49.09	5.45
2nd year (91)	2.20	12.09	30.77	45.05	9.89
Male (45)	2.22	8.89	31.11	42.22	15.56
Female (46)	2.17	15.22	30.43	47.83	4.35
3rd year (81)	4.94	11.11	29.63	43.21	11.11
Male (46)	4.35	13.04	26.09	45.65	10.87
Female (35)	5.71	8.57	34.29	40.00	11.43
4th year (62)	8.06	6.45	24.19	54.84	6.45
Male (46)	8.70	8.70	23.91	50.00	8.70
Female (16)	6.25	0.00	25.00	68.75	0.00

The result shows that, overall, most of the respondents (57.1%) can cope with the learning process (answering "agree" or "strongly agree") despite experiencing some amount of stress. Meanwhile about 13% of the respondents indicated that they were unable to cope with the semester learning (answering "disagree" or "strongly disagree").

The highest percentage among the group students based on the year of study that indicated they cannot cope is from 3rd year (16.1%), followed by 4th year (14.5%), 2nd year (14.3%) and 1st year (7.7%).

Looking at the result based on gender breakdown, for female students, the highest percentage that could not cope with the semester learning is from 2nd year group (17.39%)

followed by 3rd year group (14.29%). For male students, the highest are from the 3rd year group and the 4th year group, both at 17.39%.

4.3 Causes of Perceived Stress

The third question asked in the survey was on the causes of the perceived stress. Most of the students (54.4%) indicated the main reason is assessment, followed by subject difficulty (50.3%), the class schedule (30.8%) and communication difficulties (23.7%). Table 6 shows the details of respondents' percentage for each of the causes.

Comparing between genders, more female students (57.2%) indicated that assessments were causing stress compared to male students (52.1%). More male students (25.3%) indicated that communication difficulty was causing stress comparing to female students (21.7%). For two other causes – subject difficulty and packed class schedule, the percentage of responses from male and female students are similar.

Table 6. Causes of perceived stress

Causes	% of respondents		
	All respondent (n = 338)	*Male respondent (n = 186)*	*Female respondent (n = 152)*
The subjects I took are difficult	50.30	51.08	49.34
Could not cope with assessments	54.44	52.15	57.24
Communication difficulty	23.67	25.27	21.71
The class schedule is too packed	30.77	30.11	31.58

Further analysis was conducted for the respondents in the 'high stress' and 'medium stress' groups, as they are in a concerning situation that may require future intervention. Table 7 shows the detailed result on the causes of the perceived stress for these groups. As indicated in Table 3, 117 (34.6%) of the respondents perceived themselves experiencing high stress state, and 170 (50.3%) of the respondents perceived experiencing medium stress state.

In the 'high stress' group, almost three quarters (74.36%) indicated that they could not cope with their assessments thus causing them to experience high stress level. This is followed by the subject difficulty with 52.14%. In the 'medium stress' group, the highest factor causing stress is due to the subject difficulty (54.12%), followed by assessment (50.0%). It is interesting to observe that the main cause of stress is different between these two groups. It is also worth noting that percentage of respondents for assessment factors as the reason causing stress is significantly different between the two groups, whereas the difference for the other three factors is not as significant.

Table 7. Causes of perceived stress in high and medium stress group

Causes	% of respondents in high and medium stress group	
	High stress group (n = 117)	*Medium stress group (n = 170)*
The subjects I took are difficult	52.14	54.12
Could not cope with assessments	74.36	50.00
Communication difficulty	28.21	21.76
The class schedule is too packed	38.46	30.00

5 Conclusion

This study shows that almost all students experience certain amounts of stress due to their academic activities. A concerning percentage of students having moderate to high amount of stress during the semester. More female students and students in the 3rd and 4th year perceived themselves to experience higher stress. Most of the students indicated that the sources of stress are from the assessment and the subject that they took. Further investigation should be carried out in the future to obtain more details on why assessments are causing students to experience a high level of stress.

This study's findings highlight the need to continually monitor and engage the students about their perceived stress level and appropriate action can be taken to ensure the betterment of their mental health and wellbeing.

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Learning Sustainability Concepts-A Quantitative Assessment Beyond the Classroom Through Research Project and SciFinder^n

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Abstract. Chemistry is the science that focuses on understanding the structure, properties, behavior, and changes that matters undergoes. Designing and structuring science-driven approaches based on green chemistry principles can enhance sustainability. This paper highlights how we have practiced learning beyond the classroom for our green processes course by indirectly using information from a research project. We had synthesized thiosalicylate-functionalized ionic liquid (IL), a promising adsorbent for heavy metal. However, the greenness of IL syntheses is constantly debated. The greenness of this IL synthesis was quantitatively evaluated through skills and knowledge gained in the green chemistry course from the resource intensive indicators such as atom economy (AE), process mass intensity (PMI), reaction mass efficiency (RME), and E-factor alongside yield. It was found that the retrosynthesis pathway provided by SciFinder^n overlooked sustainability aspects. Therefore, suggestions on greener pathways which support sustainability were put forward for a 'greener' synthesis.

Keywords: resource intensive indicators · sustainability · learning beyond classroom

1 Introduction

Our planet Earth is a shared home where humans and all diverse forms of life inhibit this planet for their living. Thus, everyone including educators needs to take the responsibility to ensure the planet is sustainable. Chemistry is the scientific study of the properties and behavior of matter. It is vital that sustainability is to be incorporated into chemistry education so that students develop an appreciation of the environment and its relationship to their world [1]. Teaching and learning sustainability concepts refer to the process of educating students about principles, practices, and strategies related to sustainability. The main teaching and learning concepts in this area involve among others the development of a curricula that incorporates sustainability concepts into various subjects such as science, social studies, economics, and others. There are also practical experiences, such

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as field trips, experiments, and community engagement that can be integrated to teaching sustainability. Students should be encouraged to think critically about sustainability issues, question assumptions, and analyze solutions which are fundamental aspects of teaching sustainability. Sustainability education also should emphasize problem-solving skills, as students are required to find innovative and sustainable solutions to real-world challenges.

The issue with the teaching and learning of sustainability is that students may find it difficult to practice and apply the principles of sustainability merely through theoretical knowledge as sustainability issues often are cross-disciplinary. This can be tackled by leveraging on practical experiences, using several analytical tools and allowing students to critically evaluate the impact of an issue. The mentioned learning concepts can be carried out by incorporating learning experiences outside the classroom. Taking classroom learning beyond the textbook can help enrich a student's educational experience by showing them real-life applications of theories that they are learning in class. Learning beyond the classroom has its benefits; among others, it provides more engaging and relevant learning experience, students are allowed to think critically about sustainability issues, question assumptions, and analyze solutions is a fundamental aspect of teaching sustainability. Indirectly, students are learning problem-solving skills, as students are tasked with finding innovative and sustainable solutions to challenges.

This paper aims to highlight the importance of learning beyond classroom on sustainability concepts by quantitatively evaluating the greenness of producing a chemical comprising of thiosalicylate-functionalized ionic liquid, [MTMSPI][TS]. The ionic liquid was synthesized as a final year project by the student. The compound has the potential to be used as a green adsorbent for heavy metal removal. Sustainability concepts taught in Green Processes course were applied to the synthesis path-way. This was carried out using SciFinder^n, which incorporates AI and machine learning technologies. SciFinder^n will perform a full retrosynthetic analysis powered by the renowned CAS collection of reactions, hence reducing the synthetic planning time. Based on the retrosynthetic pathway presented, the degree of 'greenness' of the ionic liquid synthesis was evaluated through resource intensive indicators [2]. Suggestions were also given to improve the sustainability of the overall synthesis route.

2 Methodology

2.1 Synthesis Scheme from SciFinder^n

The chemical structure of the [MTMSPI][TS] to be synthesized is as shown in Fig. 1, whereas the retrosynthesis pathway of [MTMSPI][TS] was generated using retrosynthesis pathway predictor feature from CAS SciFinder^n software. The proposed pathway is shown in Fig. 2.

2.2 Experimental Procedure

Based Fig. 2, the retrosynthesis begins with the methylation of the imidazole (Step 5). It involves the following: 1:5 mol ratio of imidazole and methanol were added

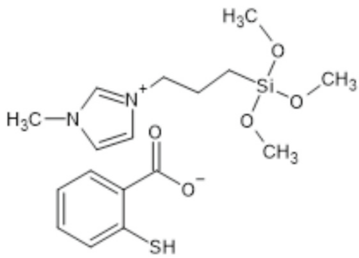

Fig. 1. Chemical structure of [MTMSPI][TS].

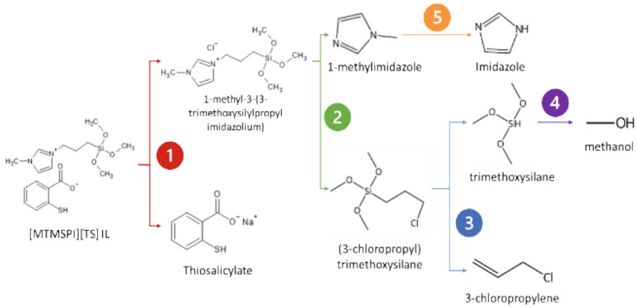

Fig. 2. [MTMSPI][TS] retrosynthesis pathway provided by ScifFinder^{n}.

into a fixed-bed quartz reactor containing 3 cm^3 of Al_2MgO_4 catalyst. The alkylation reaction took place in the gaseous phase at 350 °C for 5 h. The product, 1-methylimidazole, was collected through condensation. The yield was 98% [3]. Next, (3-chloropropyl)trimethoxysilane was synthesized following retrosynthesis Step 4 and Step 3. For retrosynthesis Step 4, the reaction between silicon (6.0 mmol) and methanol (69 mmol/hr) was carried out in the presence of copper acetate catalyst (0.31 mmol) at 200 °C and 97 kPa for 2.5 h. To increase the selectivity towards trimethoxysilane, 2 mmol of 1-chloropropane is added to the mixture. The yield was 100%, and the selectivity was 98% [4]. Tetramethoxysilane is formed as a by-product during this reaction, which can be easily separated from the product via simple distillation [5].

As for retrosynthesis Step 3, trimethoxysilane was refluxed with 63 μg of $RuCl_3 \cdot 3H_2O$ catalyst. Once the temperature reaches 80 °C, 3-chloropropylene is added dropwise at using mole ratio of 1.2. The reaction was stopped with the complete addition of 3-chloropropylene. Under these conditions, the hydrosilylation reaction yielded 97% of desired (3-chloropropyl)trimethoxysilane Retrosynthesis Step 2 involves the synthesis of 1-methyl-3-(3-trimethoxysilylpropyl) imidazolium.. Herein, imidazole was refluxed with (3-chloropropyl) trimethoxysilane (1:1 mol ratio) in 10 mL of toluene for 24 h at 70 °C in presence of 1 wt.% K_2CO_3 [6]. The predicted yield was 59% after vacuum filtration and purification using vacuum distillation. Lastly, the ionic liquid, [MTMSPI][TS] was synthesized through retrosynthesis Step 1. In this step, 1:1 mol ratio of 1-methyl-3-(3-trimethoxysilylpropyl) imidazolium chloride and sodium thiosalicylate were mixed at room temperature and stirred for 2 days. Sodium thiosalicylate was obtained via neutralization between sodium hydroxide and thiosalicylic acid at room temperature. The final product was obtained by washing using acetonitrile (3 × 50 cm^3) and filtering to remove sodium chloride by-product. The yield was 91% and the selectivity was 92% [7].

3 Results and Discussion

3.1 'Greenness' of SciFinder^n Retrosynthesis Pathway

From the concepts of sustainability taught in Green Processes and Products course, we have learned to calculate 'green' indicators that can determine whether a process is green. This was carried out through Eqs. 1–5, which were used to calculate percentage yield, atom economy (AE), process mass intensity (PMI), resource mass efficiency (RME), and E-factor.

$$percentage\ yield\ (\%) = \frac{experimental\ mass}{theoretical\ mass} \times 100\% \tag{1}$$

$$AE\ (\%) = \frac{molar\ mass\ of\ desired\ product}{total\ molar\ mass\ of\ reactants} \times 100\% \tag{2}$$

$$PMI\ (kg/kg) = \frac{mass\ of\ all\ input\ chemicals}{mass\ of\ desired\ product} \tag{3}$$

$$RME\ (\%) = \frac{mass\ of\ desired\ product}{mass\ of\ reactants} \times 100\% \tag{4}$$

$$E - factor\ (kg/kg) = \frac{mass\ of\ waste\ generated}{mass\ of\ product} \tag{5}$$

For a synthesis to be considered sustainable, the values obtained for yield, AE, and RME should be high. Meanwhile, the values obtained for PMI and E-factor should be low. The results of Resource Intensive indicators are provided in Table 1. The values that are in red in Table 1 indicate the undesirable values obtained for respective resource intensive indicators.

A predicted yield of 59% for retrosynthesis Step 2 indicated that that there is significant product loss and possibly a low conversion during the reaction. An AE of 30.96% for retrosynthesis Step 3 suggests that there are large amounts of by-products produced. On the other hand, a high PMI and E-factor, alongside very low RME for retrosynthesis Steps 3 and 4 indicated that there are many auxiliary reagents used in the reaction and large amount of waste production. Lastly, an RME of 35.35% and PMI of 6.50 for retrosynthesis Step 5 indicated that there is a large excess of reagents used. It could be deduced that the retrosynthesis route proposed by SciFinder^n is unsustainable. This is understandable as SciFinder^n is basically a predictive tool providing pathways for a successful synthesis, not taking consideration of sustainability factors.

Table 1. Summary of resource intensive indicator according to retrosynthetic step.

Step	Yield (%)	AE (%)	PMI (kg/kg)	RME (%)	E-factor (kg/kg)
1	91	87.24	1.58	79.39	0.15
2	59	87.40	2.02	51.57	0.14
3	97	30.96	4.47	22.37	2.23
4	100	43.25	16.23	6.439	1.31
5	98	82.00	6.50	35.35	0.22

3.2 Suggestions for Greener Synthesis

In this section, we are proposing alternative methods or reactants that could be used to make the experimental route more sustainable. The results which compare the values of Resource Intensive indicators between SciFinder^n method and our proposed greener suggestions for all steps are found in Table 2 and Fig. 3.

Table 2. Summary of resource intensive indicator according to retrosynthetic step. Numbers without brackets are method proposed by SciFinder^n, whereas those in brackets are greener suggestions.

Step	Yield (%)	AE (%)	PMI (kg/kg)	RME (%)	E-factor (kg/kg)
1	91 (91)	87.24 (95.69)	1.58 (1.15)	79.39 (87.08)	0.15 (0.05)
2	59 (98)	87.40 (100.0)	2.02 (1.08)	51.57 (98.00)	0.14 (0)
3	97 (99)	30.96 (100.0)	4.47 (1.38)	22.37 (72.58)	2.23 (0)
4	100 (90)	43.25 (43.25)	16.23 (4.62)	6.439 (21.63)	1.31 (1.29)
5	98 (83)	82.00 (82.00)	6.50 (1.49)	35.35 (68.06)	0.22 (0.22)

The synthesis of 1-imidazole from retrosynthesis step 5 suffers from the use of harsh reaction conditions and excess methanol. A greener alternative would be to replace Al_2MgO_4 catalyst with hydrotalcite to implement milder reaction conditions, such as 250 °C and 4 h reaction time. Most importantly, the molar ratio of methanol to imidazole can be significantly reduced from 5:1 to 1:1 in the greener alternative [8]. Additionally, purification was carried out through fractional distillation to collect the cut between 100 °C to 110 °C, thus reducing solvent usage. Values of RME in-creased by two times and in addition, the values of PMI decreased by four times its original value, whereas there was no difference observed in E-factor (Table 2).

The major issue in retrosynthesis step 4 is the substantial use of reactants in excess, leading the highest PMI and lowest RME. Hence, it is imperative to find synthesis routes that could reduce the use of excess reactants, specifically methanol (29 molar equivalents used). A solution is provided by Ritscher and Childress [9], who utilized a different copper-based catalyst at a lower amount (copper (II) hydroxide, 0.0975 g) as compared to the method proposed by SciFinder^n. As a result, they were able to reduce the amount of methanol used from 29 molar equivalents to 2 molar equivalents. Though the decrease in amount of methanol has decreased the yield by 10%, whereas atom economy maintains due to inevitable formation of by-product tetramethoxysilane (Table 2), which can be removed via simple distillation. The values of PMI and RME were greatly improved, as indicated in Table 2. In fact, PMI was reduced by four times, whereas RME in-creased by almost 3.5 times as compared to their original values. Not to mention, the E-factor value had decreased slightly by 0.02.

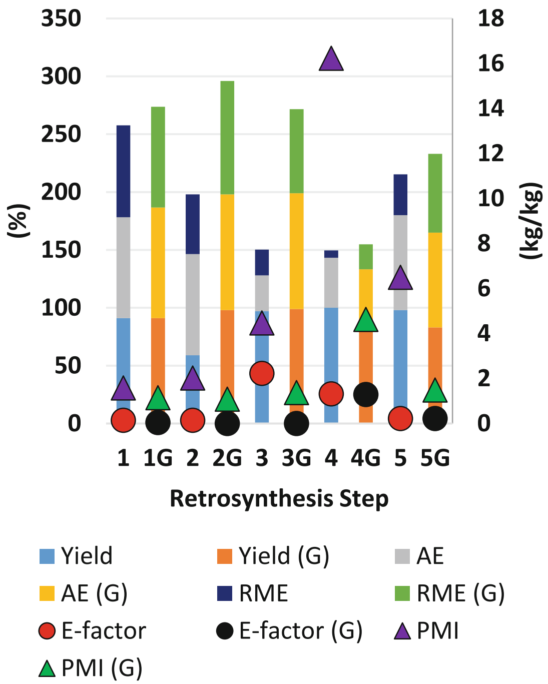

Fig. 3. Comparison of resource intensive indicator values between SciFinder^n method and greener suggestions (labeled G).

Retrosynthesis step 3 can be improved by reducing by-product formation. In the proposed SciFinder^n method, the reaction between chloropropylene and trimethoxysilane would produce a mixture of four chemicals besides the desired product. This leads to a low atom economy of 30.96% even though the yield was 97% (Table 1 and 2). A greener method, which could account for atom economy of 100% was patented by

Bowman and Schilling [10]. Their method was similar in terms of reaction temperature alongside usage of ruthenium-based catalyst and excess reactants. The product was also purified via distillation. However, Bowman and Schilling [10] used $Ru_3(CO)_{12}$ as a catalyst instead of $RuCl_3$, and at a smaller amount. $Ru_3(CO)_{12}$ is safer than $RuCl_3$ because it is less corrosive and more stable. Besides that, the excess reagent used was trimethoxysilane instead of chloropropylene. This prevents the formation of hazardous chlorine-containing by-products that complicates the purification process [10]. However, it is necessary to use 60% excess of trimethoxysilane as compared to the 20% excess of chloropropylene to produce a yield of 99% and atom economy of 100%. Even so, the method proposed guarantees zero by-product formation and thus, low waste. With that, the E-factor was lower (0) as compared to the original method (2.30), as shown in Table 2.

As for retrosynthesis Step 2, the yield was quite low, only reaching 59% (Table 1 and 2), even though the reaction was catalyzed over 24 h. This indicated that there is low reactant conversion and significant product loss. Additionally, the reaction was carried out in toluene, which is a flammable irritant that is hazardous to health. Thus, a method utilized by Mamaghani, et al. [11] may improve the greenness of this step. In their paper, there were no catalyst or solvent used; they simply mixed the reactants in a 1:1 molar ratio and heated it under reflux at 80 °C for 72 h, followed by washing with diethyl ether (3×8 cm^3). Although the reaction temperature was 10 °C higher than the procedure proposed by SciFinder^n, and the reaction time tripled, the yield produced was a promising 98%. Furthermore, there were no by-products formed in this reaction, allowing an atom economy of 100%. The amount of waste was also minimized due to high reactant utilization, which is evidenced by PMI of 1.08, RME of 98%, and E-factor of 0 (Table 2).

Lastly, the NaCl by-product formed in retrosynthesis step 1 must be removed through washing with substantial amounts of acetonitrile solvent three times due to its solubility in the reaction mixture, in turn forming large amount of waste. To avoid the formation of NaCl, an alternative route is proposed. In detail, it is suggested to stir the 1-methyl-3-(3-trimethoxysilylpropyl) imidazolium chloride with potassium hydroxide at room temperature before reacting with thiosalicylic acid [12]. By doing so, the metathesis reaction occurs between 1-methyl-3-(3-trimethoxysilylpropyl) imidazolium chloride and KOH instead of with sodium thio-salicylate. This produces KCl salt that precipitates out from reaction mixture with-out the need of washing using excess organic solvent. 1-Methyl-3-(3-trimethoxysilylpropyl) imidazolium hydroxide could be neutralized with thiosalicylic acid, producing water as the only by-product. It is the carboxylic acid functional group instead of thiol functional group in thiosalicylic acid that will react with the hydroxide ion of 1-methyl-3-(3-trimethoxysilylpropyl) imidazolium hydroxide due to lower pKa value (higher acidity) of hydrogen in the carboxylic acid functional group than hydrogen in thiol functional group. Since only water is produced as the by-product, a rotary evaporator would be sufficient for product purification. By using the alternative route, the atom economy, PMI, RME, and E-factor values can be remarkably improved (Table 2). It should be noted that these values were calculated based on the same yield assumed as metathesis method proposed by SciFinder^n.

Overall, it is near impossible to completely improve the greenness of all 5 retrosynthesis steps with respect to individual indicators (Table 2). However, from Fig. 3, it can be observed that when all indicators are considered simultaneously, the greenness of the synthesis is improved.

4 Conclusion

In conclusion, the concept of learning beyond classroom was practiced through (i) the utilization of SciFinder^n, and (ii) utilization of resource intensive indicators, e.g., AE, RME, PMI, E-factor, and percentage yield on a final year research project to better understand how sustainability could be applied for a chemical synthesis route of a chemical compound.

When the 5-step retrosynthesis route predicted using SciFinder^n was analyzed step-by-step using Resource Intensive indicators, it was found that most of the retro-synthesis steps were not green with respect to at least one indicator. Thus, greener suggestions were proposed to target the unsatisfactory indicator values. For instance, AE can be increased by utilizing reactions that produce lesser by-products, and the values of PMI and RME can be improved by avoiding excess reagents or auxiliaries. Meanwhile, E-factor can be reduced by waste prevention. Through the greener alter-natives, it was possible to improve the overall 'greenness' of the synthesis route. Nonetheless, it is obvious that a fully green synthesis process is rare as there are always trade-offs based on needs and requirements. Not to mention the need to consider factors such as cost, energy consumption, manufacturing time, and the hazards involved. Even so, it is always encouraged to obey and exercise green chemistry principles whenever possible.

The learning beyond the classroom approach allows the student to understand the concepts of sustainability better. It will also be helpful to educators who wish to integrate collaborative learning experiences or place sustainability-based education into their courses or curriculum. Lessons learned during the planning and implementation of this approach will lead to further research in developing other sustainability courses.

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Navigating Educational Video Development Course in Blended Learning Environment Through Partnership in Teaching and Learning

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Abstract. In this chapter, we explore the exciting world of multimedia education, exploring a unique course called "Audio and Video Development for Education." This course blends theory and hands-on practice to introduce students to techniques in creating audio and video content for teaching purposes. Through a mix of online learning, workshops with professionals, real-world experiences, and creative presentations, we display the solutions to the criticism of limited interactions with 51 pre-service teachers taking the course in blended learning environment. This multifaceted approach helps these future teachers delve beyond traditional learning boundaries, preparing them for modern challenges. One special aspect of the course is our collaboration with the University Teaching and Learning Center's Creative Content Creation team. Through this partnership, we guide students with hands-on training, including in acting, shooting, and editing their video project. The chapter, through vibrant images and QR codes sharing, explains how we facilitate learning and assess their progress, focusing on developing skills for making educational content in video format. The chapter also includes the students' reflections, conducted in online and hybrid platforms, offering personal insights into their learning journey, revealing how this holistic approach impacts their beginning of professional endeavor. The chapter concludes by showcasing the students' educational videos on YouTube along with their achievement for each of the assessment criteria, highlighting their newfound skills and the course's significance and implications for meaningful and flexible learning in multimedia education.

Keywords: Flexible learning · Learning partnerships · Partnership in teaching · Multimedia education · Audio and video development · Teacher Education

1 Multimedia Education

Multimedia education, with its integration of audio and video elements, has emerged as a pivotal approach in modern pedagogy. This innovative approach capitalizes on the dynamic combination of auditory and visual stimuli to enhance learning outcomes. The cognitive theory of multimedia learning suggests that humans possess separate channels for processing visual and auditory information, allowing for more effective and efficient learning when both channels are engaged simultaneously [14].

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Furthermore, incorporating audio and video development within educational materials provides a multi-dimensional experience, catering to diverse learning styles [7]. The concept of modality principle [15], emphasizes the efficacy of using relevant audio narration paired with visual graphics to enhance comprehension and knowledge retention. This multimedia constructive collaboration is particularly advantageous in complex topics where visualization and narration can simplify abstract concepts [11]. Therefore, by harnessing the potential of audio and video development, educators can create immersive learning experiences that resonate with a wide range of learners and foster deeper understanding.

This chapter's objective is to delve into the transformative potential of multimedia education, designed for future next generation teachers, specifically focusing on audio and video development for educational purpose. Through an exploration of an innovative course titled "Audio and Video Development for Education," this chapter aims to elucidate the holistic learning experience that blends theoretical knowledge with hands-on practice that is beyond the four-wall classroom.

2 Course Design: Blending Theory and Practice

This course for pre-service teachers offers a harmonious blend of theoretical knowledge and hands-on practice, aiming to introduce students to the intricacies of audio and video development tailored for educational materials. Through a balanced curriculum, students are not only familiarized with fundamental concepts but also equipped with practical skills indispensable for crafting impactful teaching materials by dedicating their learning on types of camera shots, angels, movements, and picture composition as well as audio and video editing. Central to this course's assessment are practical proficiency, digital skills, and adept communication. By course completion, students will demonstrate skills in the development of audio and video and the pivotal role in education. They will adeptly discern relevant and meaningful audio and video teaching resources, effectively articulate challenges linked to audio and video technology in educational settings and develop appropriate and interesting audio and video instructional materials. This comprehensive approach prepares pre-service educators to apply various multimedia elements effectively, enhancing their ability to engage and educate future learners.

The course includes several important assessments to evaluate students' skills in audio and video development in which students are required to create audio recordings, make screen casting videos, write scripts, plan storyboards, as well as produce and

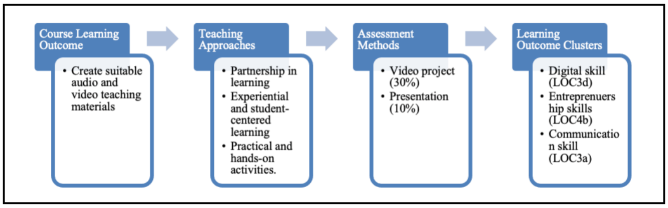

Fig. 1. The constructive alignment of the Audio and Video Development for Education course.

present the videos. In this chapter, we focus on the final video project and presentation which contribute to 40% of the course learning outcomes (CLO). Figure 1 provides the constructive alignment of the assessment.

3 Learning Beyond Boundaries: Multifaceted Approaches

3.1 Online Learning Environment

The course was recently offered in an online mode due to the Covid-19 pandemic. Through this mode, it provides students with online learning experience, blending synchronous and asynchronous components. Through the online conferencing platform, namely Webex, students engaged in synchronous (real-time) sessions, fostering interactive discussions and live demonstrations. Simultaneously, asynchronous learning transpired through the Learning Management System (LMS) and WhatsApp group, offering flexibility for accessing resources, discussions, and assignments at students' convenience.

Nevertheless, delivering a comprehensive hands-on course within an online environment is not without its challenges. Among the foremost concerns is the limitation of interaction with students, which impedes the thorough assessment of skill effectiveness through instructor feedback. Furthermore, the inadequacy of technological resources and tools among students presents a substantial challenge. Equipment like noise-reduction microphones, sturdy stabilizers, and adequate lighting props often come with a hefty price tag and are not readily accessible to all.

3.2 Workshops with Industry Professionals

Considering these challenges, we proactively engaged with the University Teaching and Learning Center (UTLC), a pivotal department entrusted with upholding the standards of teaching and learning within our institution. A distinct division within UTLC is dedicated to creating learning materials, equipped with advanced audio and video recording studios, multimedia labs, and a team of creative experts. Recognizing the potential of this collaboration to overcome limitations, we realized that partnering with UTLC could be transformative. This strategic collaboration was forged with the core intention of offering enrolled students' invaluable exposure and targeted skill refinement opportunities. Central to this partnership was the intended objective of augmenting students' ability in producing audio and video content tailored for educational contexts—an indispensable proficiency for aspiring educators.

To address these considerations, a one-day workshop was thoughtfully designed to cater to the needs of 95 Postgraduate Diploma in Education students enrolled in the course within the School of Education. The students, organized into four groups (Groups A to D) and led by four dedicated instructors, convened in the morning for an invigorating outdoor session. This session marked the convergence of all instructors and the UTLC team, presenting an ideal setting for learning. During this session, the UTLC team delivered a comprehensive briefing on the fundamentals and intricacies of a typical photoshoot. This briefing seamlessly transitioned into immersive hands-on segments, where students, under the guidance of their respective instructors and

UTLC representatives, embarked on on-site shooting endeavors. The foundation for these practical sessions was established through prior online discussions, meetings, and collaborative efforts to formulate storyboards and audio scripts.

In the afternoon session, the focus shifted to video and audio editing, conducted within one of UTLC's smart classrooms. Here, students worked together in groups, leveraging the insights shared by the UTLC team to initiate their editing pursuits. The facilitators introduced *Wondershare Filmora* as a suitable video editing tool, aligning with both its user-friendly nature and cost-effectiveness. Throughout this process, the collaborative partnership between instructors and the UTLC's creative experts remained steadfast, ensuring ongoing guidance.

Concluding the workshop, each student group embarked on a journey to explore other UTLC facilities, including the studio equipped with green and white screens, a dedicated sound recording room, and a creative space designed to ignite innovative ideas. Illustratively, Fig. 2 showcases the workshop's promotional poster, which was effectively disseminated across social media platforms to maximize awareness about this collaborative learning opportunity.

Fig. 2. The promotional poster for the school-industry partnership.

Notably, this workshop was designed to be the equivalent of six hours of in-person classroom instruction, condensing valuable experiential learning into a concentrated timeframe. Additionally, this workshop held profound significance for most students, as it marked their first in-person interaction with their instructors. Prior sessions had been conducted online via Webex and social media platforms, and this face-to-face engagement provided an opportunity for more personalized guidance, immediate feedback, and the cultivation of a vibrant and interactive learning environment. Fortunately, both for us as instructors and for the students, circumstances were favorable. During that period, the students were residing near the campus, driven by the requirement to attend other courses that were being conducted in a traditional face-to-face mode.

The experiential highlights of the workshop were thoughtfully captured and vividly portrayed in Fig. 3, offering a glimpse into the dynamic and engaging sessions that unfolded throughout the day.

Fig. 3. An immersive workshop, a team-teaching effort beyond online classrooms.

The collaborative partnership [3] between students, instructors, and industry-based entities in higher education constitutes a proactive response to the evolving demands of modern pedagogy. Such partnerships align well with high impact educational practices [2, 13]. This perspective, providing students with exposure to industry-standard facilities and technologies, effectively bridging the gap between academic knowledge and real-world skills.

This approach, as exemplified in this chapter at hand, reflects the educational shift towards integrating theoretical learning with practical application. Instructors play a pivotal role in facilitating this synergy, aligning coursework with industry needs and guiding students through experiential learning [8] and meaningful guidance [4, 16]. The captured moments from workshops, depicted visually in Fig. 3, provide tangible evidence of this enriching partnership, reflecting the dynamic interplay of students, instructors, and industry experts in fostering holistic growth and competence.

3.3 Real-World Experiences Enhancing Practical Understanding

Field work and hands-on activities, guided by instructors' expertise, serve as instrumental avenues for nurturing audio and video development skills among students, as evidenced by the study at hand. Experiential learning [10, 12, 17] fosters deeper comprehension and skill acquisition by enabling students to apply theoretical knowledge in real-world contexts. The combination of hands-on activities and instructor guidance fosters the application of theoretical principles, increase students' motivation [11], refining technical proficiency and nurturing creativity in students' audio and video creations. Importantly, as these students are pre-service teachers, experiential learning allows them to gain a deeper understanding of instructional video development. In addition, by actively engaging in hands-on experiences, they can explore the value and potential of instructional videos as effective teaching tools.

4 Learning Outcome Achievement: Creative Presentations and Showcasing Expertise

The culmination of students' endeavors in the audio and video development course is vividly demonstrated through the creation of educational videos, which are thoughtfully showcased on YouTube. These videos, developed by the students themselves, stand as a testament to their acquired proficiency and the profound influence of the course. As previous researchers [1] suggest, the act of creating and sharing multimedia content reflects a transformative learning process, whereby students transition from passive recipients of knowledge to active creators of meaningful resources. The YouTube platform, a ubiquitous tool in the digital age, offers a global stage for students to exhibit their mastery. These videos embody the fusion of theoretical concepts, technical skills, and creative aptitude refined throughout the course. This demonstration underscores the students' newfound ability to effectively communicate complex ideas through multimedia, aligning with the goals of modern education that emphasize the integration of technology and communication skills.

The partnership of learning approach that focuses on collaborative, active and reflective activities applied in this course (see also [3]), has enable students to achieve the intended course learning outcomes. Students in the group of four to five successfully produced the educational video projects by applying the knowledge and skills that they gain through participation and engagement in the online classes as well as during the collaborative workshop with the industry partner. These can be seen from the video outcomes as listed in the YouTube playlist in Fig. 4 (Note that there are only 12 videos in the playlist. One group could not be added as they set their video to primarily be viewed by children).

This project's evaluation is allocated a weighted distribution, with the video itself accounting for 30% of the total marks, while the presentation component contributes 10%. The overarching objective of this final assessment aligns with CLO 4, which centres on the creation of suitable audio and video teaching materials.

Fig. 4. Playlist of the Video Projects produced by students from groups C and D

Rubrics for the video project and the presentation were prepared and shared with the students as to provide clear expectations and guidelines for the tasks at hand. For this assignment, students were expected to achieve the intended digital and entrepreneurship skills through their engagement in audio and video production that incorporates some commercialization principles. The assessment criteria include purpose, relevance, shots, camera movements, picture composition, audio quality, video quality, background music, editing process, values and lessons learned, uniqueness, diligence, originality, commercialisation potential, and impact to society. Whereas, for the presentation students were expected to achieve communication skill, which delineates the following assessment criteria in the rubric: justification of the video production, engagement with audience during the presentation, their expressiveness when presenting, reflections of what went well and wrong during the video and audio productions, as well conclusion.

Fifty one (51) students from the Group C and D (two out of four groups taking the course) formed 13 groups to produce 13 educational video projects. Their achievement of the CLO for the final video project and presentation assignment can be seen from the analysis of their scores on each assessment criteria as shown in the spiderweb diagram (Fig. 5). For the video project, not a single group scored lower than three points (above average) on a scale of five in all assessment criteria. Specifically, three groups scored three points for originality of the video. This is acceptable as some educational videos may share similar storylines with important lessons learned. A few were having problems with their audio quality due to no access to quality microphone, as evident in a few of their videos (YouTube playlist in Fig. 4.) and their reflections below (see Fig. 9). Their enthusiastic involvement in producing the educational video paved the way for the subsequent presentation of their efforts and reflections, which flowed effortlessly in a narrative style. Each group excelled across all presentation assessment criteria, particularly when analysing areas for improvement in their video and audio production (see

Fig. 5). This demonstrated a high level of proficiency in communicating their strengths and weaknesses through the assessment of their own work and discerning opportunities for improvement.

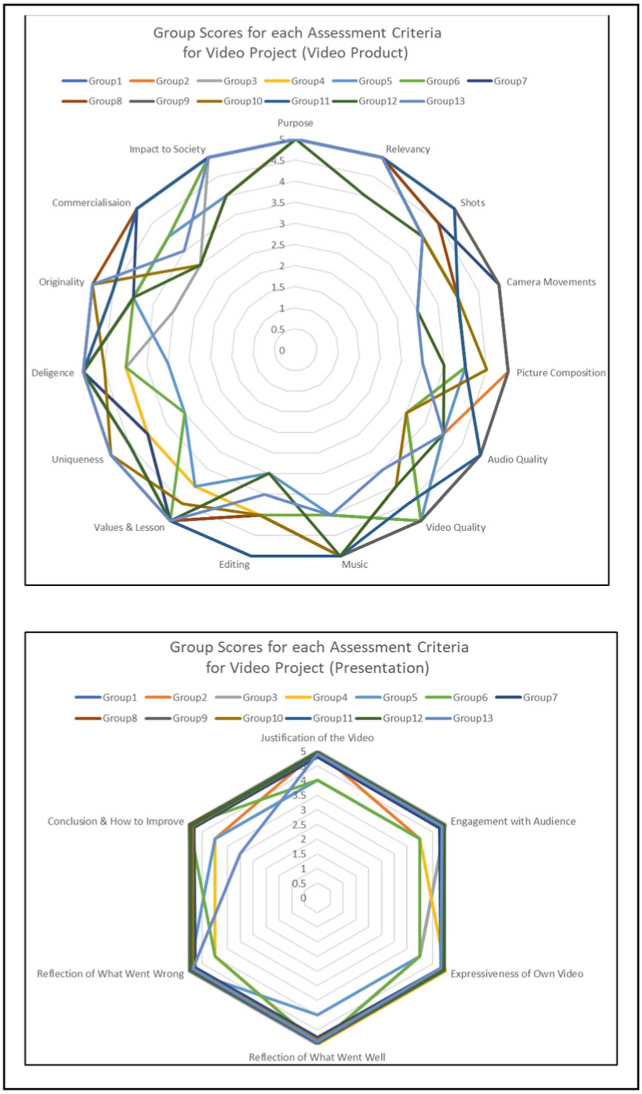

Fig. 5. Spiderweb diagrams on thirteen groups' scores for each assessment criteria for video product and presentation.

5 Course Impact and Reflections: Student Journeys

Reflection is the heart of teaching and learning, wherein we engage in a deliberate process of pondering the objectives, techniques, and approaches to teaching. We persistently seek to enhance our teaching methods and effectiveness while also exploring new approaches and methods. Following Gibbs' reflective cycles [9] as depicted in Fig. 6, we asked students to reflect on their learning experiences to gather data and information on how the partnership of learning approach give impacts on their personal growth in developing audio and video materials. Students were encouraged to engage in reflective practices to collect insights into how the collaborative learning approach impacted their personal growth in the context of audio and video materials development.

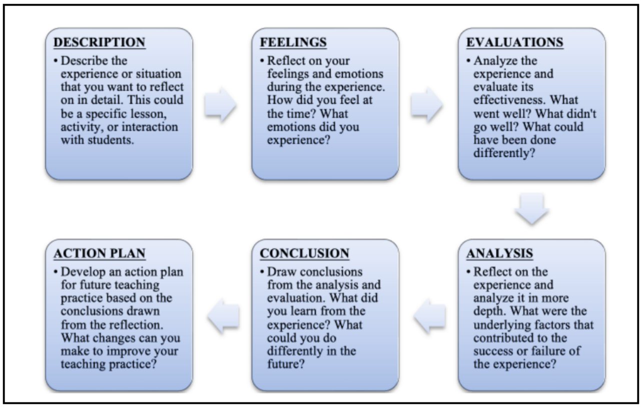

Fig. 6. Description of Gibb's Reflective Cycles [9]

5.1 Students Creative Reflections Showcasing Personal Growth

After attending the workshop, students creatively reflected on their learning experiences in an online platform namely *Canva* in which they were asked to provide three keywords to describe the workshop, three new skills that they have learned from the workshop, and a video reflection on how the skills that they have gained from the workshop can be applied in future practice. Examples of such creative reflection are illustrated in Fig. 7.

It was found that students enjoyed the activities conducted during the collaborative workshops when most of them repeatedly provided encouraging keywords such as "enjoyable", "fun", "awesome", "amazing", and "interesting". In addition, students also valued the knowledge and skills that they have gained from the workshop. The most remarkable skills that they mentioned are related to shooting and editing, which we belief are genuine as during the workshop they were given opportunity to shoot various types of shots around the beautiful surroundings of the campus and later to edit the footages during the editing session conducted indoor within the UTLC facilities. From our observations during the shooting activities based on the storyboards they prepared

Fig. 7. Students' creative reflection using Canva after the workshop.

and the sharing of the edited videos at the end of the workshop, it is evident that students were able to apply the theories that they have learned during the previous online classes on the different types of shots, picture composition, movements, and other shooting rules and principles during the workshop.

Students also provided video reflections on "How the skills that they have gained from the workshop can be applied in their future practices?", for the video project of this course as well as when they go for their teaching practicum in the following semester. Two themes emerged from the video reflections. First, students were confident that they can apply the skills in preparing teaching aids in video format to make the contents of their teaching to be more interesting. Students also perceived that by preparing video contents, they can make teaching and learning activities to be more interesting and consequently will be able to attract student's attention and engagement. One student said, *"This workshop is very useful, and I [have] learnt a lot. I think the skills in creating and editing video is very important because we can use it later to come up with interesting teaching aid. Also, we can make the teaching and learning more attractive by having multimedia contents"*.

These reflections suggest that students did not only value the learning experiences, knowledge, and skills that they have gained during the workshop, but they also foresaw the importance of those experiences for their future practice as educators.

5.2 Insights into the Holistic Educational Approach

Students also reflected on their overall experience in this course at the end of the semester. From the word cloud in Fig. 8, collected through *Mentimeter* application, it was apparent that the students "enjoyed" *(seronok)* and "excited" *(teruja)* about the experiences that they have gained from this course although some of them felt that the course was quite "challenging" *(mencabar)*. The word cloud also suggests that students have gained "new knowledge" *(ilmu baru)*, have learnt to become "creative" *(kreatif)* and develop "cooperation" *(kerjasama)* among their group members through the video project that they developed from this course.

In terms of the new skills that students gain from this course, it is consistent with their reflection after the workshop as in Section V, in which students perceived that they have gained editing and shooting skills from this course. Also, they noted on the new tools that they have learned such as *Capcut* and *Audacity* for the video and audio editing.

Interestingly, as students worked on the video project, they have also gained "acting" *(berlakon)* skills although they were feeling "coy and kittenish" *(malu-malu kucing)* during the process. Students also highlighted other skills such as "script writing" *(tulis skrip)*.

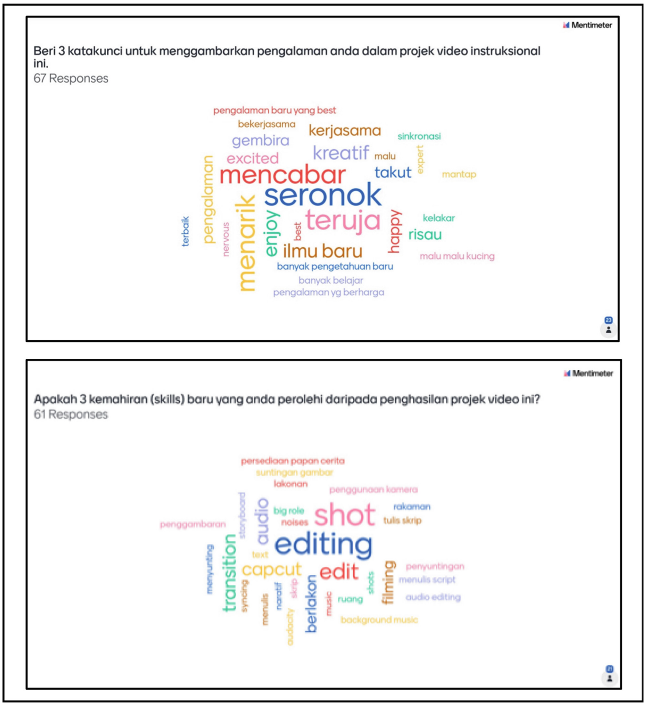

Fig. 8. Student's reflection in the forms of key words to generate word cloud analysis.

Following Gibb's reflective cycle (Gibbs, 1988), students also reflected on what they have done best in their video project, and their action plan if they were about to develop a similar project in the future. As it was a group project, students' reflection varies from one another depending on their roles in the project, such as director, actor, videographer, narrator, and video editor. From the reflection, it appears that one student may take several roles to ensure they successfully produced the video.

For example, one student wrote, "*I contributed best to acting and editing the video. I also served as a photo/videographer during the shooting*". Another student wrote "*I contributed in terms of acting and giving ideas in editing*". Importantly, students can identify areas for further improvement and suggest their action plan if they were to produce more video projects in the future. For example, one student wrote, *"I will make sure the storyboard of the video project is designed well to ensure the video outcome is aligned with what is planned"*. Another student wrote, *"in the future, I will make sure we consider distractions that may occur during the shooting beforehand"*. Other than that, students also realized that they needed to improve the shots taken and the audio quality to produce high quality audio video materials.

To triangulate the findings on student's reflection and their action plan, students also reflected on what went well and wrong throughout their video project journey during their final presentation, and suggested improvement for their future practice. The presentation was conducted in online mode for students from Group D and in a hybrid mode for Group C students. Some evidence on the presentation session and their reflections are illustrated in Fig. 9.

Overall, students' reflection during the final presentation were centered around the shooting techniques as well as the audio and video quality, in which they realized that due to limited technological devices and the use of multiple devices and applications with different quality and settings have caused the inconsistencies in terms of the quality of some parts of the videos produced. Some shots are in high quality whereas some parts of the video are not in good quality. For example, one of the groups reflected, *"Because we used different devices, the quality of the recording is not the same. Also, because we used different applications such as Capcut, Filmora and Movie Maker, when we combined them, the quality is also not the same"*.

While these reflections may underscore students' perceived weaknesses, we, as instructors, view them as compelling evidence of effective collaborative efforts. These reflections vividly depict the intricate interplay of students pooling their strengths, tactfully delegating tasks, and optimally leveraging the available resources to meticulously craft educational videos. Importantly, the group also reflected on improving the weaknesses. They said, *"It is important to use only one camera/smartphone for shooting the main shots as Dr. Always remind us during the class. Only after editing we know what Dr. Meant. Lesson learnt. We will improve this next time"*.

Significantly, these videos have undergone rigorous assessment, aligned with the rubric, and meticulously analyzed as expounded in the preceding section. Evidently, they consistently satisfy the criteria set for elevated standards. This accomplishment reinforces the value of these reflections as a robust attestation to the transformative synergy promoted through teaching and learning partnerships and astute resource utilization. This synergy has notably resulted in the creation of commendable educational content. We take immense pride in acknowledging that our students' reflections illuminate their resilience in navigating challenges and effectively accomplishing the designated tasks.

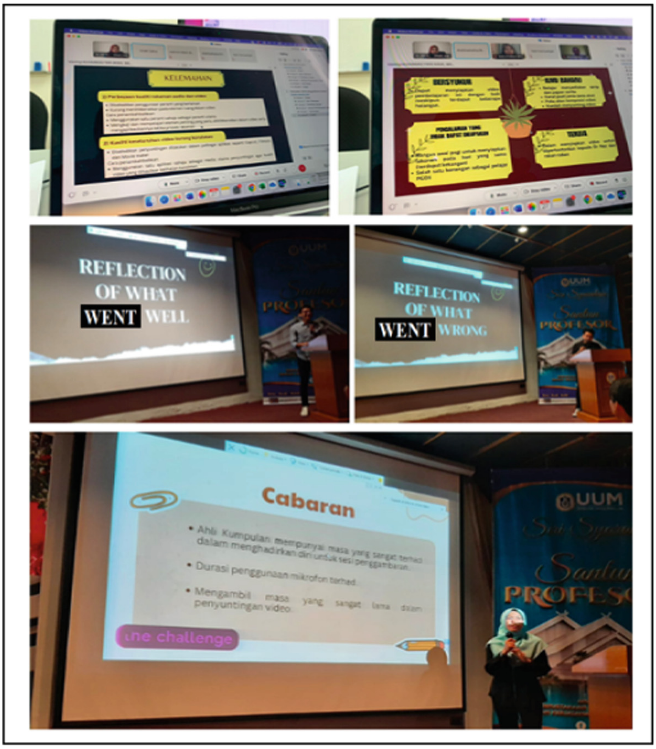

Fig. 9. Reflecting on what went well and wrong.

Furthermore, these reflections unveil that, for many students, the processes, challenges, and experiences encountered during this course have etched invaluable memories and lasting impressions, shaping both their academic journey and personal growth.

6 Discussion and Conclusion: Transformative Potential of Multimedia Education

A unique aspect of this course emerges through our symbiotic partnership with the UTLC's Creative Content Creation team. This collaborative effort propels students on a transformative journey that seamlessly merges theoretical insights with hands-on experiences [3]. Residing near the campus due to concurrent participation in other face-to-face courses, students not only absorb the nuances of video creation in online class sessions but also actively immerse themselves as actors and editors in their projects through the workshop and on-site shootings and meetings. The full-day workshop successfully integrated outdoor activities within the university's picturesque setting and the dynamic learning environment of UTLC. This groundbreaking partnership stands as evidence to the effectiveness of partnership, illustrating its capacity to foster engagement and adaptability, thereby catering to diverse learning contexts while nurturing creativity.

Amidst the digital intricacies of their journey, the significance of students' voices echoes profoundly [see also 4, 5, 16]. Reflecting through online and hybrid platforms, they offer personal insights into their learning journeys. As they grapple with novel concepts and acquire skills, their reflections encapsulate the transformative process that primes them for their forthcoming careers. Through experiential learning, pre-service teachers explore fresh ideas, techniques, and instructional video innovations, fostering professional growth and equipping them for effective real-world classroom practices.

The fusion of multimedia education with immersive hands-on training and collaborative alliances [1, 6] heralds a paradigm shift in contemporary learning [12, 17] and ushering in a novel era of learning experiences [6, 10]. By stepping into the dual roles of creators and performers within video creation, students excel theoretical boundaries and transform into adept practitioners. This transformation resonates through their reflections, where the evolution of their skills and perspectives offers intimate insights into their learning journeys. As these students proudly unveil their educational videos on global platforms, the mastery showcased stands as irrefutable evidence of their newfound capabilities. This substantiates the potency of multimedia education in preparing learners to navigate the intricate elements of modern educational landscapes.

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Redefining Learning Spaces: A Holistic Exploration of Hybrid Classroom Approaches

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Abstract. In the era of technology-enhanced learning, numerous educational institutions are investing in hybrid learning spaces to accommodate diverse learning styles and foster effective learning environments. A hybrid learning classroom represents a dynamic setting where both in-person and remote students collaborate seamlessly across a range of learning activities. This research delves into the design and configuration of Hybrid Learning spaces, leveraging technology to establish an inclusive environment that facilitates collaborative engagement for both on-site and remote learners. These innovative learning environments integrate various components, including touch-enabled interactive screens, AI-powered cameras, advanced microphones, and projectors. These elements work harmoniously to bridge the divide between physical and virtual learning realms, ensuring a cohesive and interactive educational experience. Furthermore, this paper explores the diverse teaching methodologies employed within these Hybrid Learning spaces, emphasizing their potential to enhance student engagement throughout the learning process. Additionally, this paper highlights the numerous strengths and benefits associated with the incorporation of hybrid learning modalities for both learners and educational institutions. It underscores how these approaches contribute to enriched educational experiences and improved outcomes for all stakeholders involved in the learning process.

Keywords: hybrid learning · learning spaces · education · pedagogy · synchronous classroom

1 Introduction

The outbreak of the pandemic has triggered a series of alarming challenges and societal complexities within the realm of education, necessitating an unexpected push for transformation. This has placed universities at a pivotal juncture, compelling a profound re-evaluation and reorientation of traditional classroom norms and pedagogical approaches.

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This essential shift aims to elevate experiential learning, benefiting not only students but also educators, all while aligning with overarching organizational objectives in this era of uncertainty [1]. In the midst of this disruptive upheaval in educational paradigms, universities are presented with a unique opportunity to reimagine and reshape their educational landscape. By seizing this moment, institutions can comprehensively redefine learning environments, recalibrate pedagogical strategies, and ingeniously design curriculum frameworks that resonate with the ideals of impactful and transformative education.

The core objective underlying the conceptualization and execution of both the HySpace and HyFlex models is the enhancement of teaching and learning pedagogies within the hybrid learning landscape [2]. Additionally, these models aspire to equip individuals with a profound mastery of hands-on technological skills, strengthened by robust leadership qualities and a sharp insight for critical thinking. This approach not only elevates the overall effectiveness of hybrid-mode education but also lays a sturdy foundation for fostering a workforce distinguished by its competence, productivity, and adeptness in navigating the complexities of a technologically driven world.

In the design of Hybrid Learning spaces, several design considerations such as the technology-enhanced equipment, pedagogy, learning materials, physical setup, accessibility, security, and ongoing improvement needs to be taken into consideration to build a conducive learning experience. Instructors face the imperative task of flexibly adapting their teaching methodologies to accommodate both in-person and remote students [3]. This adaptation involves seamlessly blending traditional teaching techniques with dynamic interactive online engagement strategies to ensure that the educational experience caters to the diverse needs of all students, regardless of their physical presence. Furthermore, learning resources must be readily available and easily accessible to all students. This inclusivity ensures that every learner can engage with the curriculum effectively. Moreover, it's essential to establish a robust and dependable network infrastructure that enables remote students to participate in class activities without disruptions, guaranteeing a seamless learning experience [4]. However, the key to a truly successful implementation of Hybrid Learning extends beyond technology and materials. Educators play a pivotal role in this paradigm shift. Therefore, it's imperative to provide them with continuous training and professional development opportunities [5]. These initiatives equip educators with the necessary skills and knowledge to harness the full potential of Hybrid Learning effectively. This ongoing support ensures that instructors remain agile and adaptable in the ever-evolving landscape of education.

The objective of this study is to emphasize the instructional methods and advantages of implementing hybrid learning within the university context. The inquiries addressed in this article include: What defines Hybrid Learning Spaces and its setup? What are the associated pedagogies for Hybrid Learning? What primary advantages does synchronous hybrid learning offer?

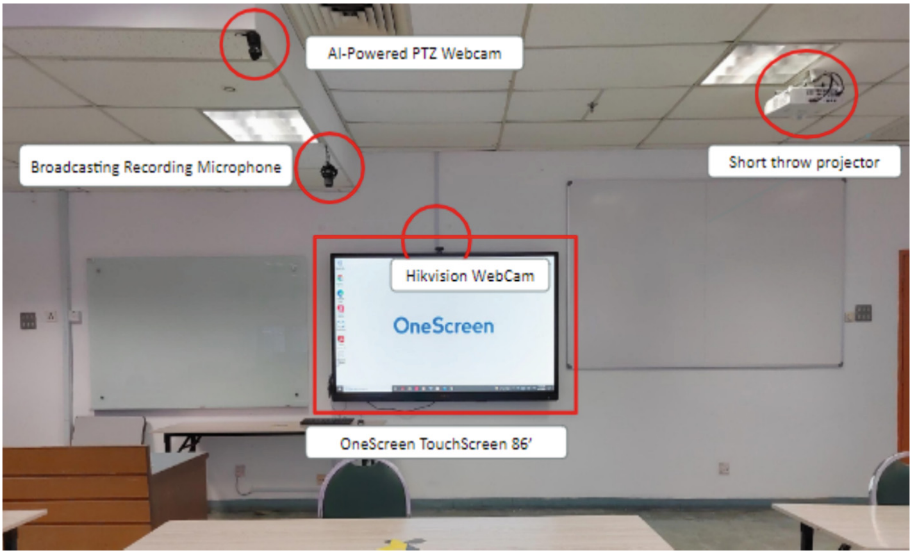

Fig. 1. Design and setup of the Hybrid Learning space

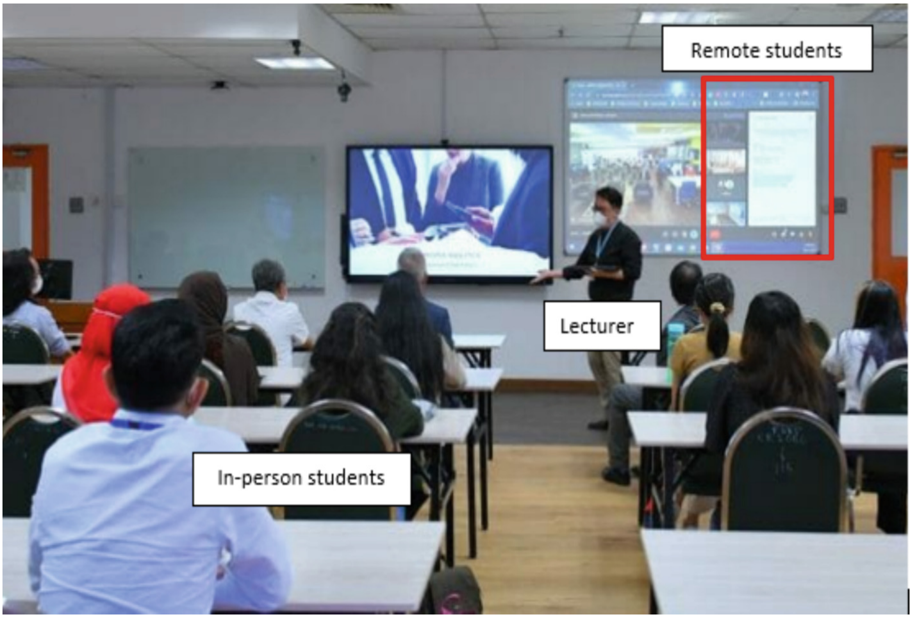

Fig. 2. A hybrid learning environment for in-person and remote students.

2 Learning Space Setup and Methodology

The design of the Hybrid Learning space involved the integration of various technological components aimed at facilitating a seamless blend of in-person and online educational experiences. The classroom configuration comprised several key elements: a touch-enabled interactive screen, an AI-powered pan-tilt-zoom (PTZ) webcam, a high-quality broadcasting recording microphone, and a short throw projector as illustrated in Fig. 1.

At the heart of the hybrid classroom setup was the touch-enabled interactive screen, strategically positioned to foster engagement among students in both physical and virtual environments. This dynamic screen served as a repository for all written materials, ensuring easy access and future reference for both on-site and remote learners. With the capability to store content digitally, it bridged the gap between in-person and online learning, enabling all students to benefit from shared resources. An intelligently placed HIKVision camera, situated atop the interactive screen, played a dual role. It captured video footage of the classroom surroundings, fostering a sense of connection and participation among students. Moreover, it facilitated interaction among classmates, effectively integrating remote learners into discussions and activities within the physical classroom.

Adding to the technological hybrid classroom, an AI-powered PTZ webcam driven by deep learning neural networks brought advanced features to the table. This camera harnessed AI tracking, auto framing, and gesture control functionalities to enhance the viewing experience for online students. Through automatic lecturer tracking, it ensured that remote participants always had a clear view of the instructor. Simultaneously, it recorded the entirety of the lecture session, paving the way for future revisions and reviews. To capture the lecturer's voice and the classroom ambiance during discussions, a professional condenser microphone was mounted on the ceiling. This audio input facilitated crisp and clear audio transmission to remote students, ensuring that the educational content was delivered with utmost clarity and coherence.

A short throw projector further augmented the learning environment. This projector served a dual purpose: projecting lecture materials for in-person students and displaying the virtual conference room for online discussions. By enabling real-time communication between the lecturer and remote learners, this projection capability effectively erased geographical boundaries and facilitated a unified educational experience. In the context of this research, the online students seamlessly connected to the lecture session via the Google Meet platform. This choice of platform ensured a reliable and accessible means for remote learners to participate actively in the learning process, fostering engagement and interaction despite physical separation.

In summary, the arrangement of these technological elements within the Hybrid Learning space represented a concerted effort to create an inclusive and immersive educational environment, where both on-site and online students could collaboratively engage, share insights, and contribute to their learning journey. This newly integrated learning space also operates as a dynamic laboratory for investigating novel approaches to teaching and learning methods tailored to the hybrid learning context. Figure 2 shows a hybrid learning environment wherein both in-person and remote students engage collaboratively within a unified interactive learning setting, facilitated by the utilization of the Google Meet platform. The lecturer employs an interactive board to display instructional content, quizzes, and polls, accessible to all students irrespective of their physical presence.

3 Discussions

In relation to our research questions, this section will be split into two sections. This division aims to provide more details about the kinds of teaching and learning methods used in the Hybrid Learning Space, and also to explain the key strengths and advantages in implementing Hybrid Learning.

3.1 Teaching and Learning Strategies in Hybrid Learning

The implementation of Hybrid Learning Spaces brings about the need to employ diverse teaching and learning strategies. This arises due to the unique challenge of engaging both students present in the physical classroom and those participating remotely at the same time [6]. In response to this, educators find themselves compelled to reassess their existing teaching approaches and acquire new skills to effectively navigate this blended mode of instruction. This shift necessitates a certain level of adaptation and innovation to ensure that the learning experience remains consistent and valuable for all students involved [7]. Balancing this transition between traditional and modern methodologies is essential to uphold the quality of education in the Hybrid Learning Space [8]. Considering this, the university implements three distinct learning approaches to involve both students attending in person and those participating remotely.

- **Team-based Learning (TBL).** TBL is a teaching approach that involves students in both individual testing and group collaboration to enhance their understanding. In this approach, students initially engage in independent problem-solving by answering questions individually. This step is designed to ensure that students come to the team discussions well-prepared to contribute to the conversation on the suggested topics. Then, they form teams and work together to solve problems, especially those they got wrong initially. This method is particularly useful when mistakes are made. TBL is well-suited for Hybrid Learning environments since it enables both in-person and online students to engage actively in individual testing and group discussions through the utilization of breakout rooms.
- **Collaborative and Active Learning.** Integrating a fusion of conventional lectures and dynamic activities that promote engagement holds particular significance within the context of hybrid learning. This method proves exceptionally valuable in ensuring a comprehensive conceptual understanding for both online and in-person students. Embedding collaborative group work into the hybrid learning framework presents a powerful tool for students to identify and address any gaps or misconceptions in their understanding. Moreover, it plays a pivotal role in refining their cognitive structures, fostering the development of effective public reasoning and teamwork abilities. Additionally, this approach liberates educators to guide students in their exploration of more advanced cognitive domains, aligning with the overarching goals of hybrid learning.

- **Case-based Learning.** In the realm of hybrid learning, both students who are present in the physical setting and those engaged remotely are immersed in real-world scenarios, strategically designed to elevate their cognitive capacities. This inclusive approach involves group collaboration, where they collectively delve into complex case studies, addressing challenges and proposing solutions. The instructor plays a guiding role in facilitating these collaborative efforts, ensuring that students, regardless of their mode of participation, benefit from this dynamic learning experience.

3.2 Key Strengths and Benefits of Hybrid Learning

The adoption of Hybrid Learning ushers in a multitude of opportunities and advantages for both the institution and its stakeholders. As we delve into the realm of Hybrid Learning, it becomes abundantly clear that this innovative approach holds the potential to significantly enhance the quality of education and the effectiveness of teaching.

Hybrid Learning presents a pivotal advantage by enhancing students' pedagogical outcomes. It empowers students to customize their learning experiences, adapting to their individual rhythms and schedules. In Hybrid Classrooms equipped with recording capabilities, students gain the valuable flexibility to access online lectures at their convenience. This feature proves invaluable when unforeseen circumstances prevent them from attending in-person classes or when they need to balance their educational pursuits with other commitments. Notably, research substantiates the practicality and long-term educational benefits of this flexibility in learning. Studies have demonstrated that accommodating students' diverse schedules and needs contributes to addressing learning deficiencies in our contemporary society [9]. This underscores the crucial role of Hybrid Learning in fostering a more adaptable and effective approach to education, ultimately shaping a brighter future for learners.

Moreover, the synergy between students attending in-person and those participating remotely fosters collaboration and interaction, creating a valuable space for them to harness technology in their educational journey. This experiential aspect is pivotal in equipping students with the skills needed to navigate our technology-driven society and encourages them to communicate effectively across diverse global contexts. Hybrid Learning not only facilitates improved collaboration and engagement among students but also extends its reach to external experts and stakeholders. This inclusive approach promotes a richer exchange of ideas, knowledge, and experiences, enhancing the overall educational landscape.

Incorporating Hybrid Learning can offer significant advantages to educational institutions. By providing both in-person and online learning options, institutions can widen their reach and attract students from various parts of the world who can participate through online classes. This expansion of the potential student base enhances enrollment numbers and contributes to the growth of the institution's global presence. Furthermore, Hybrid Learning allows universities to address challenges such as a shortage of teaching staff. It enables the consolidation of different groups of the same class into a single hybrid classroom, optimizing resource allocation. This arrangement grants students the flexibility to choose between attending classes in person or online based on their preferences and circumstances. Moreover, the availability of online facilities within the classroom simplifies the process of consulting external experts during lectures. This convenience is especially valuable in integrating industry-relevant insights into the learning environment, aligning education with the dynamic demands of today's professional landscape. As such, Hybrid Learning emerges as a versatile and strategic approach for educational institutions seeking to enhance their global reach, adapt to staffing challenges, and enrich the educational experience for students.

4 Conclusion

This article thoroughly examines the design and pedagogy of Hybrid Learning Spaces in a Malaysian university. It covers three key pedagogical approaches utilized in the Hyflex and Hyspace Learning environments: Team-based Learning, Collaborative and Active Learning, and Case-based Learning. Moreover, it highlights the significant advantages of implementing Hybrid Learning, both in terms of teaching and learning applications and institutional benefits. These advantages include increased student enrollment from diverse locations, the ability to address staffing challenges, and tailored learning experiences for students. In essence, the article provides a comprehensive look at how Hybrid Learning spaces are shaping education in Malaysia, emphasizing their potential to transform the learning landscape.

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Service Learning Implementation Initiatives in UniKL

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Abstract. Service Learning is a dynamic educational approach that transcends traditional classroom boundaries, benefiting both students and communities on a global scale. It has become a central pillar of progressive education in the United States, effectively bridging the gap between classroom learning and community engagement. European institutions actively incorporate service learning, fostering civic responsibility among students. In the ASEAN region, institutions like Singapore Management University prioritize civic engagement and cross-cultural understanding through SL initiatives. Africa explores innovative avenues by engaging in co-designing technologies with local communities. In Malaysia, the Ministry of Higher Education champions Service Learning Malaysia (SULAM), a transformative approach that integrates academic knowledge with community engagement. SULAM emphasizes reciprocity in learning, promoting mutually beneficial relationships between students, faculty, and communities, enhancing students' skills, empathy, and encouraging valuable partnerships between universities, local organizations and communities. Many Malaysian universities, including Universiti Kebangsaan Malaysia and Universiti Malaya, have embraced SULAM, positively impacting students' personal and academic development. Universiti Kuala Lumpur (UniKL), a private institution with a focus on Technical and Vocational Education and Training (TVET), aims to equip academicians with service learning principles and methodologies, enhancing teaching and learning experiences, fostering social responsibility, and promoting collaborative partnerships between the university and local communities. To conclude, UniKL's service learning initiatives aim to bridge the gap between academic knowledge and real-world application, empower students to make meaningful contributions to society and enrich the educational experience.

Keywords: Service Learning · private university · Malaysia

1 Introduction

Service Learning (SL) is an experiential learning technique that actively mixes community service with classroom learning, allowing students to gain practical knowledge through hands-on field experience. An increasing number of academicians are implementing SL into their curriculum to improve students' understanding of course content and theoretical expertise.

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SL, an innovative pedagogical approach, has emerged as a transformative educational practice in higher learning institutions worldwide. Combining academic learning with meaningful community service, SL goes beyond traditional classroom experiences to foster experiential learning, critical thinking, and social responsibility. Rooted in the principles of active learning and civic engagement, this educational model equips students with valuable skills and knowledge while addressing real-world challenges faced by communities.

The essence of SL lies in its reciprocity. It is not just about students providing service to the community; it is also about cultivating a deep understanding of the complex social issues faced by marginalized populations. Through active engagement with community partners, students gain a broader perspective, recognizing the interconnectedness of their academic studies with the broader societal context. This mutually beneficial relationship empowers students to become agents of positive change, bringing their academic expertise to bear on real-life problems.

In SL, students are not passive recipients of knowledge but active participants in their learning journey. They embark on hands-on experiences that challenge assumptions, ignite curiosity, and prompt self-reflection. These experiences encourage students to critically analyze their roles as global citizens and develop a sense of empathy and cultural sensitivity. SL nurtures a deep appreciation for diversity and encourages students to become advocates for social justice and equity.

Moreover, SL offers a unique platform for faculty to integrate theory and practice seamlessly. By incorporating service projects into the curriculum, faculty create opportunities for students to apply classroom knowledge in real-life settings, reinforcing the relevance and practicality of their learning. As facilitators of these transformative experiences, faculty members are enriched through meaningful community engagement, connecting with the realities beyond the campus.

This literature review explores the recent research and emerging trends in SL, aiming to shed light on the multifaceted impacts it has on students, faculty, and communities. By examining theoretical underpinnings, student learning outcomes, faculty perspectives, and community collaborations, we seek to illuminate the transformative potential of SL and its role in nurturing socially responsible and engaged graduates.

In conclusion, SL is a powerful educational model that transcends traditional classroom boundaries, enriching students and communities. Its emphasis on experiential learning, civic engagement, and reflective practices cultivates a generation of conscientious global citizens driven to make a meaningful difference in the world. As SL continues to evolve, it remains a cornerstone of progressive education, contributing to a more just and compassionate society.

2 Related Works

2.1 Service Learning Empowering Global Engagement

SL is a transformative educational approach that has gained popularity worldwide for its ability to bridge the gap between classroom learning and community engagement. Rooted in the principles of experiential learning and civic responsibility, SL goes beyond traditional teaching methods to provide students with practical experiences that enrich their academic journey and cultivate their sense of global citizenship.

In the United States, SL has become a cornerstone of progressive education. Numerous universities and colleges nationwide have integrated SL into their curricula, offering students opportunities to engage with diverse communities and apply their theoretical knowledge to real-world challenges. For example, Stanford University's Haas Center for Public Service supports a wide range of SL initiatives, encouraging students to collaborate with local nonprofits and governmental organizations to address social issues such as poverty, healthcare disparities, and environmental sustainability [1].

Europe, too, has embraced SL as a powerful tool for fostering civic engagement and developing socially responsible graduates. Institutions in countries such as the Netherlands, Spain, and the United Kingdom have actively incorporated SL into their educational frameworks. For instance, the University of Groningen in the Netherlands offers SL projects that focus on community development, environmental conservation, and intercultural understanding. These projects provide students with a deeper appreciation of the complex challenges faced by local communities and inspire them to become advocates for positive change [2].

Beyond the United States and Europe, SL has made significant strides in other continents as well. In the Association of Southeast Asian Nations (ASEAN) region, countries like Singapore, Thailand, and the Philippines have recognized the transformative potential of SL in nurturing socially responsible citizens. Singapore Management University (SMU) is a shining example of SL success in ASEAN. SMU's SL initiatives have positively impacted students' personal and professional development and contributed to meaningful community engagement and sustainable solutions to societal challenges [3].

In Africa, universities like the Namibia University of Science and Technology have championed SL, focusing on co-designing technologies with indigenous and marginalized communities. Professor Heike Winschiers-Theophilus, a prominent figure in the field, leads research groups that collaborate with local knowledge holders and international research partners to address socio-economic challenges and promote societal transformation [4].

As SL continues to gain traction globally, it remains a cornerstone of progressive education that transcends cultural and geographical boundaries. By engaging with diverse communities, students not only enhance their problem-solving, communication, and teamwork skills, but they also cultivate a sense of empathy and cultural sensitivity. SL empowers students to become conscientious global citizens, driven to make a meaningful difference.

In conclusion, SL serves as a catalyst for empowering global engagement among students. From the United States to Europe and across other continents, SL initiatives foster experiential learning, critical thinking, and civic responsibility. As academic institutions worldwide recognize the transformative potential of SL, they pave the way for a new generation of socially conscious leaders committed to creating positive change in their communities and beyond.

2.2 SULAM in Malaysia

Service Learning Malaysia (SULAM) is a groundbreaking educational initiative that has gained substantial traction within Malaysian higher education institutions, notably championed by the Ministry of Higher Education. Over recent years, SULAM has played a pivotal role in redefining the educational landscape by seamlessly integrating academic knowledge with real-world community engagement. This innovative pedagogy serves as a conduit for experiential learning, cultivating critical thinking abilities and nurturing a strong sense of civic responsibility among students. The centre of the SULAM's philosophy is the concept of reciprocity in learning, emphasizing a symbiotic relationship between students, faculty, and the community. It transcends the traditional educational framework by actively involving students in community issues, particularly those faced by marginalized groups, which prompts introspection and empowers them to be proactive change agents.

At its core, SULAM aligns with the principles of active learning and civic engagement. It uniquely empowers students to apply their theoretical classroom knowledge to practical, real-world scenarios, thereby reinforcing the practicality and relevance of their education. Through participation in community service projects tailored to address specific community needs, students acquire indispensable skills such as problem-solving, effective communication, and teamwork. These competencies significantly contribute to their personal and professional development.

Another paramount objective of SULAM is to foster a heightened sense of social responsibility and civic engagement among students. This is achieved through their direct involvement in communities and the intimate understanding of their needs. Consequently, students develop profound empathy and cultural sensitivity, instilling an appreciation for diversity and motivating them to champion social justice and equity causes.

SULAM's significance extends to fostering collaborative partnerships between universities and local community organizations or non-governmental entities. These symbiotic collaborations serve as crucibles for shared learning experiences and resource sharing. Universities, in turn, gain valuable insights into community dynamics, which inform the development of sustainable and impactful service projects that serve the community's best interests.

Several Malaysian universities, including prestigious institutions like Universiti Kebangsaan Malaysia (UKM) and Universiti Malaya (UM), have embraced SULAM as an integral part of their academic frameworks. This has translated into a multitude of opportunities for students to actively engage with their communities and partake in experiential learning. Empirical research demonstrates the positive effects of SULAM on students' personal and academic development. It has been found to enhance problem-solving abilities, refine communication skills, and elevate civic consciousness among students [5, 6].

The trajectory of SULAM's implementation in Malaysian higher institutions continues to evolve dynamically. Notably, efforts are underway to further enhance faculty members' comprehension of the principles and methodologies underpinning Service Learning. This pedagogical approach aims to equip educators with the tools to seamlessly integrate SL components into their courses and teaching practices.

In essence, SULAM symbolizes a paradigm shift in Malaysian higher education. It actively embraces experiential learning and civic engagement, aiming to produce socially responsible graduates. By harmonizing academic knowledge with community engagement, SULAM propels students toward transformative learning experiences that empower them to make meaningful and lasting contributions to society. As SULAM continues to gain prominence across Malaysian universities, it holds the promise of nurturing a generation of conscientious global citizens firmly committed to advancing positive social change.

2.3 Benefits of Service Learning

SL is a dynamic educational approach that extends beyond the traditional confines of the classroom, offering a multitude of benefits to both students and the broader community. Numerous studies underscore the transformative impact of SL, emphasizing its capacity to foster social responsibility, enhance critical thinking, and advance personal and professional development.

A literature review conducted by Marcilla-Toribio et al. [7] delves into the effects of SL on nursing graduates, revealing its potential to elevate social responsibility and critical thinking skills, ultimately benefiting community health. This finding underscores the far-reaching implications of SL in preparing future healthcare professionals to be socially conscious and adept at addressing community healthcare needs.

Furthermore, SL has been found to significantly impact students' overall learning outcomes [8]. Beyond acquiring theoretical knowledge, students who engage in SL often experience heightened social involvement as a common outcome [9]. This strengthened social engagement signifies the broader societal contributions of SL, as it encourages students to actively participate in addressing pressing community issues.

In the context of nursing education, a study reveals the stimulating nature of community-learning engagement. Nursing students engaged in SL benefit from a collaborative environment that allows them to apply and enhance their professional development skills. This practical experience bolsters self-confidence and stimulates critical thinking, attributes essential to becoming proficient healthcare practitioners. Importantly, SL instils a profound awareness of community needs among nursing students, fostering a sense of reciprocal knowledge exchange. This integration of theory and practice promotes responsible citizenship while advancing students' professional development [10].

Similarly, in the field of teacher education, SL plays a pivotal role in bridging the gap between theory and practice [11]. Teacher educators, in particular, benefit from SL as it enables them to distinguish between various orientations, including connecting theory and practice, fostering engagement, addressing community needs, enhancing job-related skills, and facilitating learning outside the classroom. These multiple orientations reflect the diverse ways in which SL enriches teacher education, providing educators with valuable insights into real-world situations that schools encounter. This exposure prepares pre-service teachers to effectively engage with diverse student populations and navigate the complexities of inclusive education.

Overall, SL serves as a powerful pedagogical tool with far-reaching benefits. It equips students, particularly in healthcare and education, with the skills and awareness needed to be socially responsible and effective professionals. Furthermore, it enriches the learning experiences of students by bridging the gap between theory and practice, thereby fostering a deeper understanding of real-world challenges. As SL gains recognition and integration across various disciplines, its potential to nurture socially conscious graduates and bridge the divide between academia and the community becomes increasingly evident.

3 Service Learning Implementation Initiatives in UniKL

Universiti Kuala Lumpur (UniKL) is a private higher learning institution focusing on Technical and Vocational Education and Training (TVET). TVET is an innovative education model that embodies the spirit of democratization of knowledge and champions the continuous advancement of science, technology and trades.

Currently, there are no activities or programs designed explicitly for SL or SULAM at UniKL. To embed the elements of community engagement within the students, UniKL offers two (2) community service courses, known as MPU3422 Community Service 2 for the bachelor's degree program and MPU2422 Community Service 1 for the Diploma program. Both courses are offered as optional courses in the MPU U4 categories. The courses required students to organize a high-impact community service project. Some of the projects that have been conducted are beach cleaning, re-planting trees and disaster relief. For CSR projects, students are not required to implement the knowledge gained through their study. Simply put, nursing students can organize any CSR projects and are not limited to health and wellness areas only.

In UniKL, SL is initiated by the Student Development and Campus Lifestyle Division (SDCL), which houses three (3) main departments – Centre for Student Development (CSD), Campus Lifestyle Division (CLD), and Centre for Career and Alumni Services (CACS).

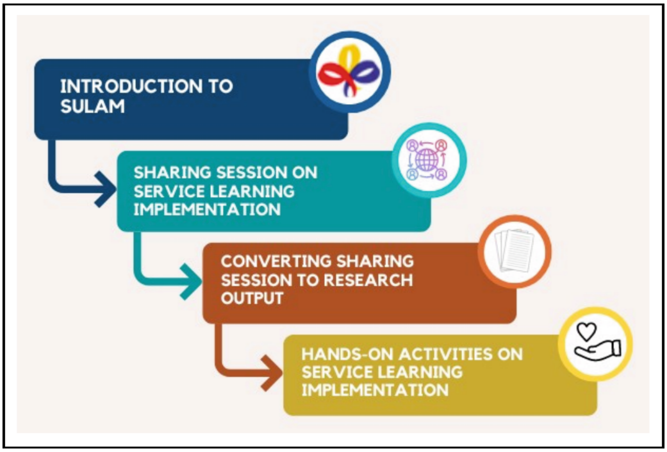

Fig. 1. The initiatives planned to introduce SL at UniKL

Figure 1 shows the stages of the implementation of SL initiatives in UniKL that has took place since June – September 2023, organized by CSD, in collaboration with the Research and Innovation Section from UniKL MIIT, one of the twelve campuses in UniKL. The main aim of SL initiatives program held at UniKL is to expose the philosophy and concept of SL to academicians.

The main participants of the activities are General Studies lecturers from all UniKL campuses, with a few technical lecturers involved as well. The general idea of the activities is to raise awareness of SL programs implemented in other universities around the globe.

The first stage of the initiatives is the introduction of SULAM from the point of view of public universities in Malaysia. The primary purpose of the first stage of the initiative is to give exposure to SULAM and how private universities can adapt and adopt the initiative to suit the environment and system of private universities. The next stage is the sharing session on the implementation of SL at the University of Hong Kong. The sharing session was fascinating, where they included senior students in developing the English language curriculum. The students are involved in designing the content of the syllabus and taking part as teaching assistants for the course. This initiative was very eye opening, as it shows that the lecturers and the students are now sharing the responsibility and authority for the course, while ensuring that the student's feedback is taken into account.

Both sessions are able to equip academicians to understand the philosophy behind SL so that they can learn and apply it in their respective courses. In addition, the program is to promote a sense of social responsibility and civic engagement among academicians. From the sharing and insights from the speakers, the program can be a platform to enhance experiential learning and connect academic knowledge with real-world applications. At the same time, the program is aimed to address community needs and contribute to sustainable solutions through meaningful service projects. Finally, the program can foster partnerships between the university and local community organizations for mutual learning and collaborative impact.

The next sharing sessions involved international speaker from Namibia University of Science and Technology and Cornell University, as summarised in Table 1. The sessions share various interesting initiatives they have conducted at their respected institutes and their outcomes. The sessions were able to share valuable inputs on the implementation and impacts of SL to students, especially at Cornell University.

At Cornell University, their service-learning programs have profoundly impacted both students and the community. One notable program is their "Engaged Learning and Research" initiative. In this program, students are actively involved in designing the curriculum and participating as teaching assistants. This approach empowers students by giving them a say in their education and ensures that their feedback is considered, creating a more student-centric learning environment. As a result, students become more engaged in their studies and feel a stronger sense of ownership over their education.

Furthermore, Cornell University's service-learning initiatives extend beyond the classroom. They actively engage with the local community to address real-world issues. For instance, they collaborate with community organizations to support underprivileged populations. This benefits the community and allows students to apply their classroom knowledge to solve complex, real-life challenges.

Table 1. Summary of SL Initiatives Programmes at UniKL

Date	*Program details*
19 June 2023	Service Learning at Higher Learning Institutions in Malaysia by Assoc. Prof. Dr. Vishalache Balakrishnan, Universiti Malaya
19 June 2023	The Impact of Student Partnership on Learning: Success and Lessons Learned in Hong Kong by Dr. Lisa Cheung, The University of Hong Kong
11 July 2023	Participatory Design in the Global South by Prof. Dr. Heike Winschiers-Theophilus, Namibia University of Science and Technology Dr. Tariq Zaman, University of Technology Sarawak
3 – 4 August 2023	Service Learning in Higher Education by Amy Somchanhmavong, Cornell University Dr. Tariq Zaman, University of Technology Sarawak

The impact of such initiatives at Cornell University is multi-fold. Firstly, students develop a deeper understanding of the subjects they study as they see the practical implications of their knowledge. This experiential learning fosters critical thinking and problem-solving skills. Secondly, students become more socially responsible and civic-minded as they actively contribute to the betterment of society. This not only enriches their personal growth but also equips them with skills that are highly valued in the job market.

From a community perspective, Cornell University's service-learning programs have a positive and lasting impact. They address community needs and provide valuable resources and support to local organizations. This collaborative approach between the university and the community leads to mutual learning and shared growth. It strengthens the bond between the university and the local residents, creating a sense of partnership and shared responsibility for community well-being.

In summary, Cornell University's service-learning programs serve as a model for integrating academic knowledge with real-world application, enhancing experiential learning, and fostering social responsibility among students. These initiatives empower students to become active agents of change and create a stronger sense of community and collaboration between the university and the local population.

The initiatives aim to enhance the teaching and learning experience by equipping academicians with the philosophy of SL, enabling them to apply it in their courses. This approach bridges the gap between academic knowledge and real-world application, promoting experiential learning and critical thinking among students. As a result, academicians gain a comprehensive understanding of SL's principles, methodologies, and benefits, enabling them to integrate SL components into their courses and teaching practices effectively. This enriches the educational experience and instils a heightened sense of social responsibility and civic engagement among academicians and students.

Furthermore, the initiatives seek to cultivate social responsibility and civic engagement among academicians. By promoting social responsibility, UniKL encourages academicians to actively engage with societal issues and contribute to sustainable solutions through meaningful service projects. These collaborative efforts directly address community needs, resulting in tangible and sustainable solutions. This approach fosters personal growth and empathy among students and faculty, nurturing a more profound sense of connection to the community.

Lastly, the initiatives strongly emphasise the importance of partnerships between the university and local community organizations. By fostering mutually beneficial relationships, UniKL creates opportunities for collaborative learning, resource sharing, and impactful community engagement. These partnerships not only enrich the SL experience but also contribute to the long-term sustainability of the initiatives. Through these collaborative efforts, the initiatives extends its reach beyond the university campus, creating a collaborative impact that positively influences the broader community.

In summary, the proposed SL initiatives at UniKL intertwine the objectives of enhancing teaching and learning, promoting social responsibility, and fostering partnerships. Through this integrated approach, UniKL aims to provide students with practical experiences, instil a sense of civic responsibility, and create collaborative networks that contribute to positive social change. By interconnecting these justifications, the SL initiatives at UniKL hold the potential to enrich the educational journey, empower students and faculty, and make a lasting and transformative impact on the community.

4 Conclusion

In conclusion, the SL Implementation Initiatives at Universiti Kuala Lumpur (UniKL) represent a significant step towards redefining the role of higher education today. These initiatives have been meticulously designed to equip academicians with the principles and methodologies of SL, ultimately enriching both teaching and learning experiences. By introducing academicians to the philosophy of SL and its practical applications, UniKL bridges the chasm between academic knowledge and real-world engagement, fostering experiential learning and critical thinking among students.

Moreover, the initiatives are committed to nurturing social responsibility and civic engagement among academicians and students. This commitment encourages active participation in addressing pressing societal issues through meaningful service projects. By directly engaging with communities and proactively addressing their needs, UniKL's initiatives empower students to become responsible and empathetic global citizens.

A fundamental aspect of these initiatives is forging partnerships between the university and local community organizations. This approach enriches the SL experience and strengthens the collaborative impact that extends far beyond the university's confines. These collaborations offer opportunities for shared learning, resource sharing, and impactful community engagement.

In essence, UniKL's SL initiatives harmoniously intertwine the objectives of enhancing education, promoting social responsibility, and fostering enduring partnerships. This integrated approach holds the potential to enrich the educational journey, empower students and faculty, and make a profound and lasting impact to the community. As UniKL continues to champion the philosophy of SL, it aligns itself with the global movement towards producing socially conscious graduates who are both academically proficient and committed to positive social change. These initiatives signify UniKL's commitment to shaping a brighter future for its students and the communities it serves.

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Student Immersive Learning Through a 3-Semester Integrated Engineering Project

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Abstract. This research promotes student immersive learning using a 3-semester integrated engineering project for the Coastal Engineering elective courses, namely Ocean and Coastal Engineering, Coastal Planning and Management, and Design of Coastal Structures, which are offered by Civil Engineering Programme of Universiti Teknologi PETRONAS between September 2021 and May 2022. The project designed for the courses was industry-inspired and problem-based and was able to address all learning outcomes of three courses. The objective of this study is to assess the effectiveness of the proposed integrated project in promoting immersive learning experiences among the participating students through monitoring of their academic performance and upgrading of various technical and soft skill sets. The project was jointly developed with Department of Irrigation and Drainage Perak, which was the key stakeholder and beneficiary. The students were required to (1) determine the environmental forces acting on the assigned Management Unit, (2) access the coastal vulnerability based on the various data sources, and (3) design a solution to combat the coastal problems in 1st, 2nd, and 3rd semesters, respectively. The participating students had substantial hands-on experience, and consequently mastered the relevant knowledge and skills adequately. A questionnaire survey was developed to gauge the students' learning experience through the 3-semester integrated project. The project had successfully enhanced students' understanding and retention of knowledge through experience of solving complex and open-ended problems. It also helped to upgrade the students' academic performance and their skill sets throughout the project implementation period.

Keywords: Problem-based Learning · Student Immersive Learning · Integrated Engineering Project

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1 Introduction

1.1 Coastal Engineering Elective Courses

Coastal engineering is one of the major areas offered to the final year Civil Engineering undergraduate students. The students who enroll Coastal Engineering as the major area are required to complete three elective courses, i.e., (1) Ocean and Coastal Engineering, (2) Coastal Planning and Management, and (3) Design of Coastal Structures, one for each semester. The course objectives and learning outcomes are respectively outlined in Table 1. Even though these courses are designed to gradually build up the coastal engineering knowledge profile among the students within 3 semesters, some students still find it difficult to relate to these elective courses. Hence, this study is set to explore a solution to this problem through an innovative teaching and learning (T&L) method.

Table 1. Courses Course objectives and learning outcomes for coastal engineering elective courses.

Course Code	Course Name	Course Objective	Course Learning Outcomes (CLO)
VEB4213	Ocean & Coastal Engineering	To develop understanding on the fundamental principles in ocean and coastal engineering.	1. Evaluate the properties of offshore and near shore waves, and establish design wave specifications 2. Assess currents and tidal processes 3. Formulate sediment budget and perform shoreline evolution analysis
VEB4233	Coastal Planning & Management	To develop understanding on sustainability of coastal zones through planning and management.	1. Assess the influencing environmental factors and related coastal processes, and analyze causes of coastal erosion/sedimentation 2. Develop skills and knowledge for the planning and management of coastal zone in respecting the principles of sustainability 3. Evaluate application of different coastal stabilization schemes and the governing factors for their selection and impacts
VEB4223	Design of Coastal Structures	To develop technical abilities in undertaking various stages of design works related to coastal protection measures.	1. Analyze site condition and identify data requirement for design works 2. Evaluate the feasibility of various coastal protection measures 3. Assess the overall design concept and needs, and develop the required design parameters 4. Undertake detailed engineering design for complex coastal structures and develop construction strategy

1.2 Problem-Based Learning

Problem-based learning (PBL) is a student-centered, inquiry-based instructional model in which learners engage with an authentic problem that requires further research [1]. PBL requires learners to identify gaps in their knowledge, conduct research, apply their learning to develop solutions and present their findings [2]. It focuses on the learner's reflection and reasoning to construct their own learning [3]. PBL helps learners to develop skills that are necessary for their future practices as it enhances critical appraisal, literature retrieval and encourages ongoing learning within a team environment [4]. The PBL involves seven processes, i.e., clarifying terms, defining problem(s), brainstorming, structuring and hypothesis, learning objectives, independent study and synthesis [5]. These processes identify what they already know, what they need to know, and how and where to access new information that may lead to the resolution of the problem. Despite PBL's potential benefits, many instructors lack the confidence and knowledge to utilize it in their courses [6].

1.3 Problematic Site

The Manjung District is a district in the southwestern part of the state of Perak, Malaysia. The district is well known for Pangkor Island, Teluk Batik, Royal Malaysian Navy, Lumut Naval Base and dockyard. Manjung District has become the fastest growing district in Perak. The major economic sectors in Manjung are agriculture, manufacturing and the services industries. Sea fishing and farming fresh-water fish and prawns at the coastal areas are the most important economic activities in Manjung. The district is also rich with coastal and marine biodiversity (turtles, fire-flies, etc.) as well as mangrove forests which need to be safeguarded for the creation of a more sustainable living environment. It is important to identify the coastal vulnerability and the associated risks of the Manjung's coast so that the relevant mitigation plans can be devised by the local authorities, to effectively address the problems. Upon securing supports from Department of Irrigation and Drainage Negeri Perak, a systematic integrated problem-based learning (PBL) project was developed and implemented in Ocean and Coastal Engineering, Coastal Planning and Management, and Design of Coastal Structures for September 2021, January 2021 and May 2022 Semesters, respectively. This 3-semester integrated engineering project is expected to be able to enhance students' understanding and retention of knowledge through experience of solving complex and open-ended problems (Fig. 1).

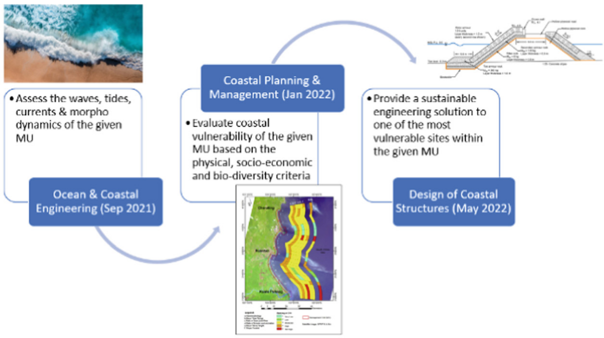
Fig. 1. Coverage of Manjung District

2 Methodology

In this study, a 3-semester integrated coastal engineering project with the aim to provide students with in-depth knowledge, management and design skill sets related to coastal engineering, has been undertaken. The chosen problem is a real-life and genuine problem given by the industry partners who have background information of a selected problematic site. Through this industry-inspired project, it is anticipated that the students will be able to deliver all the CLOs of the respective courses.

The industry inspired PBL project proposed in this study was implemented for the same batch of students for 3 consecutive semesters, i.e., Sep 2019, Jan 2022 and May 2022 Semesters. The student class size was 22. A total of 9 groups were created with each group consisting of 2 to 3 students. Manjung has approximately 50 km of shoreline, which has been subdivided into seven Management Units (MU), i.e., MU9, MU10, MU11, MU12, MU13, MU14 and MU15. Each group was designated with an MU that required a detailed study of various scopes over three consecutive semesters. For each semester, the groups were anticipated to execute a list of specific tasks that addressed all the CLOs of the course within 10 weeks (Fig. 2). The generic workflow designed for the 3-semester integrated engineering project is schematically illustrated in Fig. 2.

An intervention was undertaken for each semester through online questionnaires to gauge the students' perception towards PBL and their learning satisfaction before and after the activity. Upon completion of the semesterly integrated project, the participating students presented their findings for comments by the course instructor and industry partner. Towards the end of the engineering project, the students received certificates of completion recognizing their commitment and efforts rendered for the past 3 semesters.



Courses	Ocean & Coastal Engineering	Coastal Planning & Management	Design of Coastal Structures
Offering Semester	Sep 2021	Jan 2022	May 2022
Specific task	Assess the waves, tides, currents & morpho dynamics of the given MU	Evaluate coastal vulnerability of the given MU based on the physical, socio-economic and bio-diversity criteria	Provide a sustainable engineering solution to one of the most vulnerable sites within the given MU
Industry Partner	JPS Perak	JPS Perak	JPS Perak
Project Duration	10 weeks	10 weeks	10 weeks
Data Source	The relevant coastal data of the respective MUs are provided by JPS	The sea level rise, shoreline changes and land use data of the respective MUs are provided by JPS	The students will need to develop the design parameters based on the outputs from earlier semesters and data collection at the site
Activities	• Virtual site visit • Briefing/Engagement with JPS • Adjunct lecture • Group discussion (with the course instructor) • Joint evaluation with JPS	• Virtual/physical site visit • Briefing/Engagement with JPS • Adjunct lecture • Group discussion (with the course instructor) • Joint evaluation with JPS	• Physical site visit • Adjunct lecture • Group discussion (with the course instructor)
Deliverables	1. Evaluate the wave climate of the designated MU. [CO1] 2. Assess currents and tidal processes of the respective littoral cells [CO2] 3. Evaluate the sediment transport activities within the MU. [CO3]	1. Evaluate the health of the coasts within the designated MU. [CLO1] 2. Identify the coastal stabilization structures/schemes adopted along the coast within the designated MU. [CLO2] 3. Develop the integrated Coastal Vulnerability Index (CVI) covering physical, socio-economics and biodiversity aspects for the designated MU. [CLO3]	1. Develop a detailed data acquisition plan to assess the coastal site condition (CLO3). 2. Select a hard engineering structure to combat the coastal problems reported in the designated MU. Justify your selection (CLO2). 3. Evaluate coastal engineering design processes, project considerations and material selections (CLO1). 4. Develop the detailed design of the selected coastal structure (CLO4). 5. Evaluate the impact of the proposed solution on environmental, socio-economic and biodiversity within the MU (CLO4).

Fig. 2. Integrated PBL project: Specific task for each course.

3 Result and Disussion

The industry inspired PBL project proposed in this study was implemented for the same batch of students between September 2021 and May 2022 Semesters. Table 2 presents the median grades of course learning outcomes (CLO) for the three Coastal Engineering elective courses. The CLO median grades of Ocean and Coastal Engineering (September 2021 Semester) were satisfactory considering the students were exposed to coastal engineering fundamentals for the very first time. As the students advanced to the subsequent semester (January 2022 Semester) taking Coastal Planning and Management, their overall academic performance dropped marginally. The grade deterioration was partly due to the inability of the students to attain CLO1 and CLO3 in their integrated engineering projects. Nevertheless, the students' performance improved significantly in the last part of the integrated project, which involves designs of coastal structures, when the they enrolled for the last coastal engineering elective course in May 2023 Semester. The median grades for CLO1, CLO2, CLO3 and CLO4 were A-, A, A and B +, respectively. Based on the feedback from the participating students, the knowledge profiles and the skill sets developed through the integrated project in the last two semesters helped them to master coastal engineering fundamentals and to apply the relevant knowledge or skills in the design of coastal structures. Overall, the improvement of the median grades in Design of Coastal Structures confirms the effectiveness of the 3-semester integrated project in enhancing the learning experience and outcomes of the participating students.

Table 2. Median grades of course learning outcomes (CLOs) for Coastal Engineering elective courses.

Course Learning Outcomes	Ocean & Coastal Engrg (Sep 2021 Semester)	Coastal Planning & Management (Jan 2022 Semester)	Design of Coastal Structures (May 2022 Semester)
CLO1	B+	B	A-
CLO2	A-	B	A
CLO3	B	B	A
CLO4			B+

A comparison of the CLO median grades of Design of Coastal Structures for the September 2018, January 2019, January 2020, May 2020 and May 2022 semesters is presented in Table 3. Note that problem-based projects were introduced to the course for all offering semesters except September 2018 Semester. This is another yardstick to measure the effectiveness of the 3-semester integrated project in upgrading the academic performance of the participating students. From Table 3, the CLO median grades for the semesters with the PBL implementation show some improvements, i.e., one or two grade difference, relative to the those of September 2018 with-out the PBL implementation. The grade improvement is particularly obvious in May 2022 Semester. This is principally due to the execution and impacts of the 3-semester integrated coastal engineering project.

Once again, the above observations confirm the suitability and effectiveness of the 3-semester coastal engineering integrated project in teaching and learning.

Table 3. CLO median grades of design of coastal structures for the past semesters.

CLO	Sep 2018	Jan 2019	Jan 2020	May 2020	May 2022
Num. of students	17	18	7	27	22
PBL Implementation	No	Yes	Yes	Yes	Yes
CLO1	B	B+	B+	B+	A-
CLO2	C+	B	B	B+	A
CLO3	B	B+	B+	B+	A
CLO4	B+	A	B	A-	B+

Towards the end of the integrated coastal engineering project, a final survey was undertaken to gauge the student attainments in cognitive, psychomotor and affective domains. The results show that 76% of the participating students had an exceptional experience with the 3-semester coastal engineering integrated project, whereas 24% of them had a good experience. All participating students agreed that the given project was able to connect them to real-life problems and provided them with an opportunity to work in a genuine business setting (with stakeholder's involvement). The project did help them to manage and relate the knowledge accumulated from the previous semesters, as well as to acquire new information. Figure 3 presents the student perceptions on their attainment of various skill sets throughout the project period. Their involvement in the project helped to develop communication, critical thinking, computer usage, information literacy skills and understanding of professional behavior. One of the aims of the 3-semestert integrated project is to develop a self-directed, learning skill which requires the students to demonstrate the attributes as shown in Fig. 4. It is evident that the majority of the students had developed those self-directed qualities when delivering the project outcomes over three semesters. Some of the key qualities developed by the students are ability to brainstorm and to identify the knowledge gaps, independent study, learning within a team and problem solving.

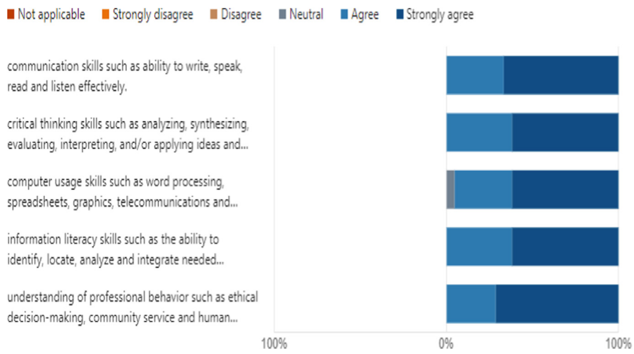


Fig. 3. Students' perception on skill attainment

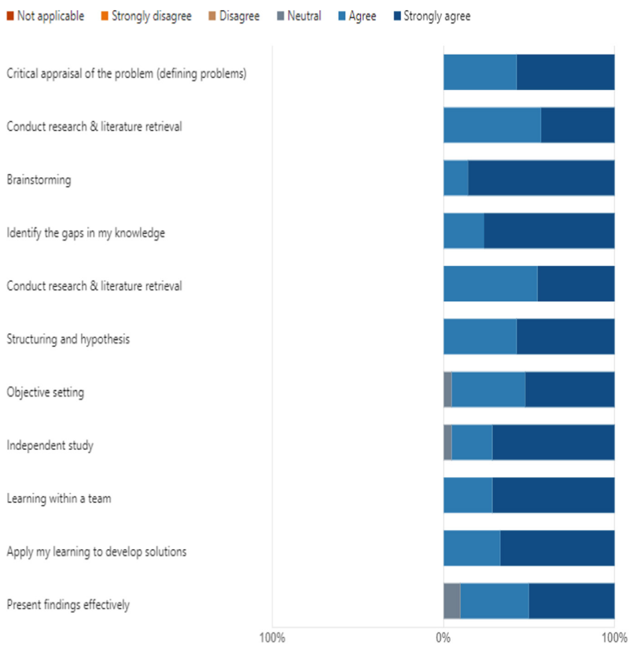


Fig. 4. Demonstration of self-directed learning qualities by the students

4 Conclusion

A 3-Semester integrated coastal engineering project was introduced to the same batch of students between September 2021 and May 2022 semesters, with the support from Department of Irrigation and Drainage Perak. The given problem was industry inspired and real. The participating students had substantial hands-on experience with the real-life problems, and consequently mastered the relevant knowledge and skills adequately. The engineering integrated project is a proven tool to effectively enhance the students' academic performance for the courses, and to nurture various skill sets including self-directed learning skills that leads to life-long learning. In short, the teaching innovation executed in this study has provided an immersive learning experience to the participating students of the coastal engineering knowledge throughout the 3-semester project implementation period.

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Students' Learning Experience Through Physics Simulation Project via Microsoft Excel Spreadsheet

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Abstract. This research paper aims to demonstrate the students' learning experience through a Physics simulation project utilizing a Microsoft Excel spreadsheet. As educators continue to explore effective instructional methods, the significance of problem-based learning and technology integration becomes evident in fostering students' academic growth and preparing them for the challenges of the modern world. In this study, a total of 50 Foundation students engaged in a 10-week simulation project as part of their project assignment. Students' reflection through an online survey was conducted and analyzed. The result analysis revealed that the majority of the students agreed that the simulation project improved their understanding of Kinematic and Dynamic concepts and enhanced their Microsoft Excel skills. Furthermore, the project fostered their creativity, kindled their interest in science and engineering, and encouraged positive teamwork, collectively contributing to an enriching learning experience. Despite the challenges such as limited knowledge of using Excel, difficulty in designing an appropriate physics case study, and lack of cooperation from some team members, most students demonstrated resilience by overcoming them through determination, collaborative effort, and seeking guidance from instructors.

Keywords: Physics · Simulation · Case study · Microsoft Excel spreadsheet · Kinematic · Dynamic

1 Introduction

The COVID-19 pandemic facilitated a swift shift to online learning, leading to the emergence of diverse learning environments that surpass traditional classroom teaching. This transformation in the education system has been facilitated by the adoption of impactful teaching strategies such as hybrid learning, online and remote learning, blended learning, digital skills, and literacy, as well as project-based learning. The focus of the educational system now extends beyond the acquisition and understanding of scientific concepts to incorporate the development of students' problem-solving and critical-thinking abilities. These skills are vital for students to thrive in global competitions. One teaching model

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that not only emphasizes science as a product but also the process specifically in enhancing problem-solving and critical thinking skills, is Problem-Based Learning (PBL). The implementation of PBL has been recommended in the Curriculum 2013 [1, 2].

PBL is a teaching method based on constructivism that lets students build knowledge by actively solving real problems. This process helps develop their advanced thinking skills and boosts their self-confidence [3]. PBL is a student-centered pedagogical approach that flips traditional teaching by presenting a real-world problem to students before teaching them relevant material. In PBL, instead of presenting content, instructors present students with a problem, thereby making learning an active process. This method, whether applied to short assignments or extended semester-long projects, encourages collaborative group work and requires dedicated classroom time for group preparation and project engagement.

PBL guides students through a structured process: they first examine and define the problem, explore existing knowledge related to it, identify their learning needs, seek out relevant information and tools, evaluate potential solutions, and ultimately, work together to solve the problem [4]. This approach not only fosters critical thinking but also emphasizes the importance of students taking an active role in their learning, culminating in the presentation of their findings, and promoting a deeper understanding of the subject matter. Through collaborative teamwork, students solve real-world problems which could directly improve their critical thinking skills and help them find rational and authentic solutions by conducting thorough research. PBL is an effective method for actively involving students in the learning process, particularly when it comes to comprehending real-life applications of physics concepts and principles.

PBL has expanded considerably in recent decades, thanks to a substantial body of research covering various aspects of PBL. This research paper concentrates on the subject of Physics, primarily because many students encounter difficulties in grasping its concepts, often leading to a decrease in their enthusiasm for the subject. A study conducted by Aji *et al.* demonstrated that implementing a PBL approach in a physics module focusing on "Balance and Rotation Dynamics" led to improvements in high school students' problem-solving skills in physics [5]. Gorghiu *et al.* expressed that PBL proved to be an effective method for comprehending scientific concepts, resulting in enhanced cognitive and social factors [6]. Sustra *et al.* discovered that senior high school students learning Physics using problem-based learning (PBL) combined with authentic assessment exhibited greater proficiency in physics problem-solving and higher levels of critical thinking compared to those who learned through PBL with conventional assessment methods [1]. These findings indicate that the utilization of a PBL-based module positively contributes to the development of students' problem-solving and critical-thinking abilities.

In this study, PBL was implemented within a physics course, focusing on the design and simulation of a physics case study by leveraging a Microsoft Excel spreadsheet. The integration of technology in implementing the case study plays a vital role in driving notable enhancements that not only lead to increased student engagement but also improved learning experiences. Therefore, the main aim of this research paper is to examine the students' learning experiences while they engage in the process of designing a physics case study and simulating it using a Microsoft Excel spreadsheet.

2 Methodology

The research sample for this study comprised 50 Foundation students in Engineering and Science who were enrolled in Physics I. These students were divided into 10 groups, each consisting of five members. Figure 1 shows the overview process flow of the project assignment. The project assigned to them involved designing a case study centered around a real-world physical situation that could be simulated by applying the principles covered in Physics I, specifically focusing on the chapters on Kinematics and Dynamics. Within this context, students had the opportunity to apply various concepts and topics from both Kinematics and Dynamics to develop their case studies.

All calculations and measurements required to solve the case study were performed using Microsoft Excel spreadsheets. The students were required to insert related Physics formulas in the Excel sheet to get the output variables. The simulation of the case study involved the inclusion of a realistic range of input and output parameters to ensure accuracy and practicality. In addition, the teams have to provide an appropriate diagram that visually represents the entirety of their project to enhance comprehension not only the team members themselves but also their peers and instructors in grasping the project's scope.

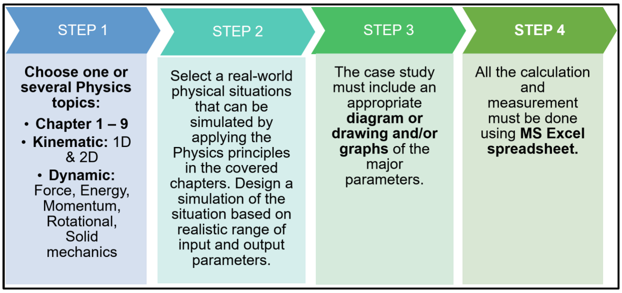
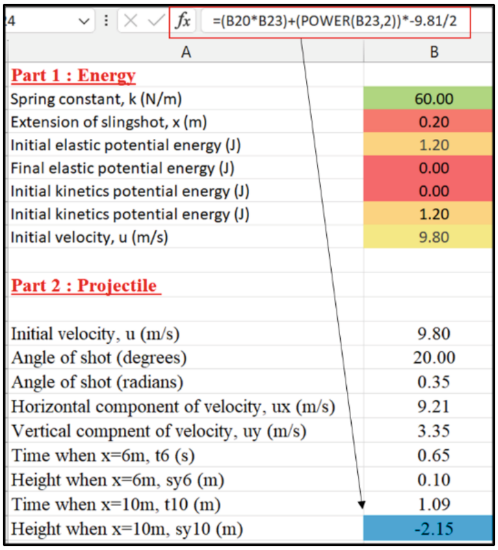


Fig. 1. The process flow of the project.

The project spanned a duration of 10 weeks. After the 10th week, an online survey was conducted to gather feedback from the students regarding their experience undertaking this project. The students were asked to indicate their level of agreement and disagreement with several statements using a five-point Likert scale ranging from "1 = strongly disagree" to "5 = strongly agree". The questionnaire encompassed eight questions aimed at capturing their perspectives on various aspects, including their overall experience, creativity, interest, collaboration, and challenges faced during conducting the project.

3 Result and Discussion

Figure 2 serves as a prime example of the students' Excel work that is based on the case study they have meticulously designed. To create a well-structured case study, students must demonstrate a deep understanding of the subject matter and the intricate relationships between various variables. In this step, students identify physics terms, apply their physics knowledge, and extract the necessary information to address their case study effectively. The crucial part here is their skill in accurately putting the right formulas that match the input data to get the result they want. This complex process shows how well they can turn what they learn in theory into practical solutions, resulting in important and insightful answers. These efforts not only demonstrate their analytical abilities but also emphasize how their knowledge in physics and math is valuable for solving real-world problems and making informed decisions.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A	B
Part 1 : Energy	
Spring constant, k (N/m)	60.00
Extension of slingshot, x (m)	0.20
Initial elastic potential energy (J)	1.20
Final elastic potential energy (J)	0.00
Initial kinetics potential energy (J)	0.00
Initial kinetics potential energy (J)	1.20
Initial velocity, u (m/s)	9.80
Part 2 : Projectile	
Initial velocity, u (m/s)	9.80
Angle of shot (degrees)	20.00
Angle of shot (radians)	0.35
Horizontal component of velocity, ux (m/s)	9.21
Vertical compnent of velocity, uy (m/s)	3.35
Time when x=6m, t6 (s)	0.65
Height when x=6m, sy6 (m)	0.10
Time when x=10m, t10 (m)	1.09
Height when x=10m, sy10 (m)	-2.15

Fig. 2. Example of Microsoft Excel Spreadsheet of the students' project.

The questionnaire comprises eight questions that assess various aspects of the students' experience. These questions focus on the overall improvement in understanding Physics concepts and Microsoft Excel skills, the impact on students' creativity and interest in science and engineering, the enhancement of learning experiences through collaboration with peers, as well as the identification of challenges in completing the project.

Based on the feedback received from the students in Fig. 3, it is evident that the physics project had a positive impact on their understanding of physics concepts. Out of the 50 students surveyed, a significant majority of 33 students or 66% agreed that the project significantly improved their understanding. This indicates that the project successfully facilitated their grasp of complex physics principles in everyday life situations. In other words, using PBL in this Physics project yielded positive results in terms of the students' learning experience. A similar perception was obtained towards simulating the physics case study by using Microsoft Excel. The project enhanced the students' proficiency in utilizing Excel for data analysis, calculations, and graphical representation. Specifically, the students learned how to set up Excel spreadsheets effectively, input

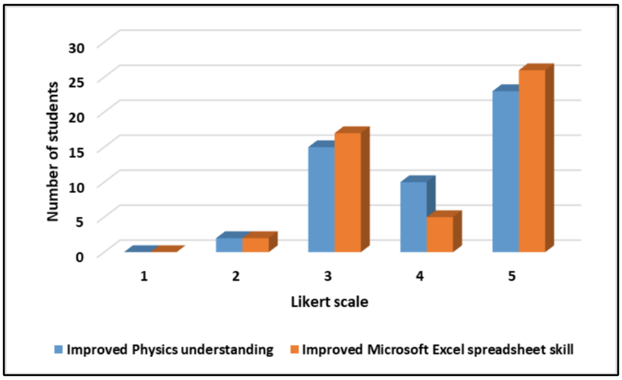

Fig. 3. Number of students who experienced improvement of Physics concepts and skill in using Microsoft Excel spreadsheet.

and manage data, create visually informative graphs and charts, and perform complex calculations. These skills extend beyond the realm of physics and are highly transferable to various academic and professional contexts. Proficiency in spreadsheet software like Excel is a fundamental skill sought after in fields such as business, engineering, science, and data analysis. Hence, this practical aspect of the project further underscores its relevance and the holistic benefits it offers to students in preparation for their academic and future career endeavours.

On the other hand, a small minority of 2 students disagreed with both statements, indicating that the project did not contribute significantly to their understanding of physics concepts as well as their Excel skill development. It is important to note that different factors, such as individual learning styles or preferences, could have influenced their perception. Overall, the majority of students reported an improvement in understanding physics concepts and gained valuable experience in using the software for scientific calculations, data analysis, and visualization as a result of conducting the Physics simulation project.

Referring to Fig. 4, the graph shows that out of a total number of respondents, 66% or 33 students agreed that the project assigned provided opportunities for creativity and innovation. As the students were given the opportunity to choose the desired topics for the assignment, they used their creativity in choosing or combining Physics 1 topics. Their creativity in adopting the physics formula into the spreadsheet can further expand their knowledge to use the spreadsheet more and be innovative in combining the related formula to add to the complexity of their project. Only 5 students answered that the project did not contribute significantly relevant to their creativity and innovation which contributed to a low percentage in the result.

As for the interest in science and engineering, 64% of total respondents agreed that the project given sparked their interest to learn more. Since the project was given to the students to analyze and relate with everyday situations, while completing the project, the students get to realize how physics is applied and with relevant assumptions and calculations, proper analysis can be made to help them to understand better about how

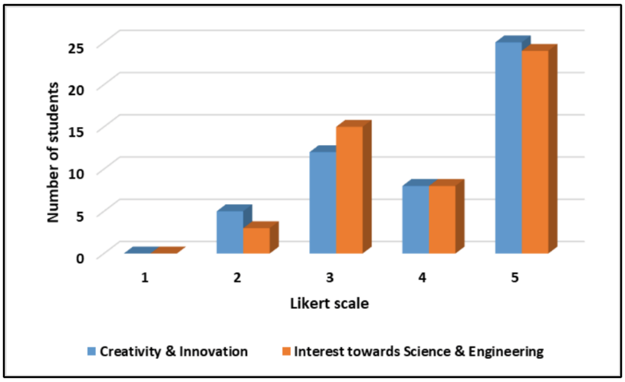

Fig. 4. Number of students who agreed on the intention of doing the project leads to initiating their creativity and innovation skills and interest in science and engineering.

things work. This indirectly taught the students to think critically about problem-solving, which later is a good skill as a scientist or engineer.

Moreover, permitting students to select their project topics not only grants them a sense of ownership and autonomy but also serves as a powerful catalyst for igniting their interest in science and engineering subjects. When students have the freedom to choose topics that genuinely intrigue them, it kindles their passion for the subject matter, and their creativity naturally thrives. This intrinsic motivation fuels their enthusiasm and commitment to the project, as they embark on a journey driven by personal curiosity and genuine interest.

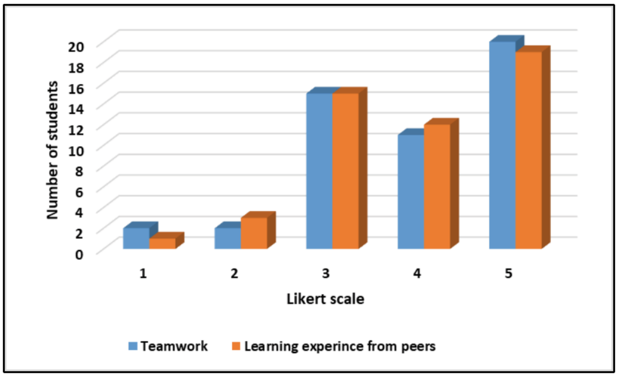

Fig. 5. Number of students agreed about the project to help them strengthen the teamwork and learning experience.

Figure 5 shows the results of the student's teamwork and learning experience. The project was done in groups to encourage the students to work in a team. 31 students or 62% of the total respondents agreed that upon completing the project, they managed to work well together with the team members. This supports one of the programme's educational objectives which need the students to be able to communicate effectively while changing ideas to complete the tasks. 4 students recorded their answers stating that they did not agree with this. Although this is a relatively low number, it is good to know that some of the team members might not contribute enough to complete the task together. This is a good example to the students of the importance of having good team members to collaborate with, which also contributes to their overall learning experience. 31 students agreed that the project enhanced their learning experience. As the students come with different learning styles, working together in a group gave them good insights into the differences between them. This also enables them to mingle and exchange good knowledge in order to complete the task while at the same time giving them good first-year experience in the learning environment in the higher institutions. 4 students disagreed that the project enhanced their learning experience. This might correlate with the result recorded about the teamwork.

The simulation project presents several challenges that students encountered during the process. One significant issue that the students ran across during the simulation assignment was their lack of experience with Microsoft Excel. Many students struggled with Excel's features, finding it difficult to maneuver and use the program properly for the simulation. The students had to become skilled in Excel's features, including data entry, formula generation, and graphical representation, all of which were essential for the project's success. This required focused learning and the development of technical skills.

Making a suitable physics case study was another significant challenge. It took a combination of creativity and critical thinking to create a scenario that not only adhered to the Physics principles being studied but also gave significant and pertinent context. Students were given the challenging task of choosing appropriate variables and scenarios that faithfully reflected actual physics circumstances; this process needed a thorough comprehension of physics topics and the ability to successfully bridge theoretical and practical applications. The dynamics of group activity is another challenge. Although collaborative teamwork is an essential component of project-based learning, students occasionally ran into problems because certain team members were unwilling to cooperate. Students had to develop crucial interpersonal skills, including clear communication, conflict resolution, and consensus building, despite the fact that this problem is frequent in collaborative settings. These problems need to be resolved in order to keep the team functioning productively and harmoniously, which in turn affects the project's overall success and quality.

4 Conclusion

This paper focuses on the experience of UTP foundation students in conducting the Physics simulation project which comprises designing a case study related to Kinematic and Dynamics topics and simulating it using a Microsoft Excel spreadsheet. In conclusion, the Physics simulation project has proven to be a valuable and effective learning experience for the students. The project's implementation allowed students to actively engage with real-world physical situations, applying the principles they learned in Physics I. By simulating the case study using Microsoft Excel, students not only enhanced their understanding of complex Physics concepts but also developed essential skills in using the software for data analysis and calculations. The project also provided students with opportunities to collaborate in teams and being creative in designing case studies which induced their interest in science and engineering.

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The Affective Factors and English Language Performance Amongst Foundation Students in a Government Linked University

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Abstract. This study aims to explore affective factors of motivation and anxiety towards English language performance amongst Foundation students at a selected government linked university (GLU) in Perak, Malaysia. English language is the lingua franca for the working world. As the Malaysian Education Blueprint aims to produce graduates that are able to work in the international arena, therefore it is important to put focus on factors that makes language acquisition a success. Anxiety and motivation have been researched separately in the past. In this paper, these two variables are combined and investigated. There are two Research Objectives in this paper which are expanded into seven items. The sample consists of 130 respondents amongst the foundation students in a GLU. Quantitative data was collected to investigate the correlations between independent variable of affective factors and dependent variable of English language performance. The study showed that students with low anxiety and high motivation achieved better in their language performance. Thus, this paper recommends for exploration of pedagogy and infrastructure in improving the success of students' performance by considering the affective factors.

Keywords: Affective factors · English language performance · Anxiety · foundation students · Motivation · Government linked university

1 Introduction

In Malaysia, most institutions of higher education generally use English as the instrument of communication in the deliverance of their teaching and learning. According to English Proficiency Index (2021), Malaysia is ranked at 28th position in the world for its English proficiency. Therefore, it is disheartening to note that the performance of tertiary students at foundation level is on a decline. Due to this, there is an extensive debate on its possible causes. In research done by Bao and Liu (2021), the authors postulated that numerous factors influenced second language learners such as age, society, environment among which, affective factors are of significance. Affective factors play a vital role in language learning beyond classroom. One of the more highly discussed possible causes is affective factors. Students' affective factors can be seen as one of the major contributors which influence the decline.

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The objectives of this study are:

1) To describe the level of affective factors in English Language Performance amongst ESL foundation students in a government linked university.
2) To investigate the relationships of affective factors towards the English Language Performance amongst ESL foundation students in a government linked university.

This research stemmed from the existing concern of English language performance which "has been a perennial problem and been going on for too long" (New Straits Times, 2019). At the tertiary level, the alarming decline of English language performance amongst university students will be a drawback in attaining the aspirations set by the government in the Malaysian Education Blueprint (2013–2025). Moreover, there is a scarcity in the current literature with regards to the relationship between affective factors of motivation and anxiety towards English language performance particularly on students at foundation level in Malaysian government linked universities. In the previous studies, the affective factors were either researched separately as individual variables or generally as a whole without linking them to foundation students at tertiary level. Thirdly, there is a need to determine the correlation between affective factors of motivation and anxiety towards English language performance for foundation students which will assist the lecturers to adapt and adopt activities for students to be done beyond classroom.

2 Literature Review

The theory developed by Krashen (1985) demonstrated affective factors as major factors which influence second language acquisition. He argued that these affective factors can impede language input and is "a kind of psychological obstacle that prevents language learners from absorbing available comprehensible input completely". Gardner (1985) echoed the same tune which put affective variables as an important factor to predict language achievement. Therefore, in order for second language learners to increase their language input, the affective factors have to play a weaker role.

In language learning, anxiety is deemed as a critical affective obstacle as it is closely related to negative experience. Anxiety as defined by Horwitz et al. (1986) is "an amalgamation of various incapacitating psychological as well as behavioral factors that go with language learning situations influenced by the unique process which is inherent in language learning". As further explained by de De Blakeley et al. (2017), anxiety can be considered to be specific anxiety arising from the process of learning and communication in a second or foreign language. Bao and Liu (2021) pointed that in language learning, anxiety mainly referred to "learners' fearfulness and uneasiness when they are supposed to express in a foreign language". Hence, anxiety can be both a push and pull factor in language learning.

Motivation is one of the most powerful affective variables in accounting to the success or failure in completing a task and in this case, related to language learning. In language learning, motivation is the learners' desire and impulse to learn language, providing power and impetus to the learners. The definition of motivation in this study is narrowed to three elements that are effort (the effort to learn the language), desire (wanting to achieve a goal) and positive affect (enjoy the task of learning the language) (Gardner, 1985a). According to Ryan and Deci (2000), motivation has been a central and perennial issue in the field of psychology. In their Self-determination theory, both Ryan and Deci suggested that learners should be able to take responsibility and be active for their own learning in foreign language classrooms. Intrinsic motivation which is related to people. Pintrich and Schunk (2002) described motivations as "the process whereby goal-directed activity is instigated and sustained". According to Maslow (1943), intrinsic motivation is more important than extrinsic motivation. Past literature demonstrated that motivations play a major role in producing better outcomes for learners in second language acquisition (Ushioda & Dörnyei, 2011, Anjomshoa & Sadighi, 2015).

3 Research Methodology

This quantitative study was designed to correlate the independent variables of affective factors with the dependent variable of English language performance amongst the foundation students in a government linked university. A questionnaire was prepared for the data collection and obtained responses from 130 respondents were randomly selected. The number of responses was in line with Krecje and Morgan (1970) for a sample size of 127. Research instrument was self-constructed and validated by the department. The Likert scale employed was 6 (1 = least and 6 = most). This research was adapted from Attitude/Motivation Test Battery by Gardner and Lambert (1972) as well as Foreign Language Classroom Anxiety Scale by Horwitz et al. (1986). The items were distributed as online questionnaires.

4 Findings

The students' demographics profile inclusive of students' semester, gender and English language course results were analyzed. All foundation students who participated in the study were from the May 2022 batch. 61 participants were female and 69 were male. 69% of respondents received excellent results (Grade A and A-), while the rest received Grade B (22%). Only 1 respondent received a C grade and 10 respondents have failed or have not completed the course. The study found that the average rating for anxiety in English language performance is 2.77 with two-thirds of respondents saying there is a relationship between anxiety and English language performance. 47.6% noted that the lower the anxiety level, the better they perform and 0.3% believes that the higher their anxiety level, the lower their language performance. On the other hand, the average rating for motivation in English language performance is 4.00 and 86% of respondents say there is a relationship between motivation and English language performance with 85% stating that the higher their motivation level, the higher their English language performance.

5 Discussion

From the findings above, most of the respondents are high achievers with low anxiety and high motivation. The low rating for anxiety in English language performance suggests that respondents feel that anxiety has little effect on their performance although they do not completely out rule its relevance as they do find that low level of anxiety generally results in better performance. However, it does suggest that anxiety is not a major issue for this set of respondents although this may be because most respondents are high achievers in the language to begin with. It is interesting to note that only a fraction of respondents believed that having high level of anxiety affected the success of their language performance. This can be concluded that these students believed that there are other variables apart from anxiety that can affect their language performance. On the contrary, for motivation, most students believed that they could perform better when they are highly motivated. This indicates that motivation is an important affective factor that help students to the success of English language acquisition. Based on this, it can be said that both anxiety and motivation as independent variable of affective factors played crucial roles is determining the success of language performance for foundation students. The findings also demonstrated that there are significant correlations between both anxiety and motivations towards English language performance.

6 Conclusion

This study confirms the levels of affective factors of anxiety and motivation towards English language performance amongst foundation students in a GLU. It was found that while anxiety levels are low in English Language performance, motivation is on the higher end. This suggests that students will perform better with higher motivation and low anxiety hence students need to have a surrounding in and beyond classroom that encourages the increase of their motivation level to ensure better performance. With this finding, it can be said that there is a need to discover the pedagogy and facilities in the university which could further improve students' performance. Furthermore, the relationships between these affective filters and the English language performance are found to be highly significant amongst foundation students in a government linked university.

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The Conventional and Emerging Technology of Xposim in Blended Learning to Enhance and Improve Student Understanding and Concepts

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Abstract. This study investigates the effectiveness of a blended teaching and learning approach in geosciences and petroleum engineering education. The research utilizes the XpoSim software as a virtual learning tool to enhance student understanding and performance in Exploration and Drilling courses. Undergraduate students from Universiti Teknologi PETRONAS participated in the study through purposeful sampling. The blended learning approach combines face-to-face instruction with virtual learning using XpoSim for five weeks. Student performance was evaluated through assignments and tasks. The results demonstrate that the blended approach improved student performance compared to traditional teaching methods. Furthermore, the blended approach significantly enhanced students' understanding of the subject matter. These findings highlight the potential of incorporating virtual learning technologies like XpoSim to provide students with unique learning experiences and enhance comprehension and problem-solving skills.

Keywords: Blended Learning · Xposim · Teaching Methodology

1 Introduction

The integration of oil and gas field-based learning has long been recognized as a powerful tool for enhancing understanding in Geosciences and Petroleum Engineering [1–3]. Petroleum geoscientists and engineers highly value the practical experience gained through such field-based learning. However, in recent years, the rapid development of Information and Communication Technology (ICT) has given rise to a new approach known as blended learning, which has gained significant recognition in higher education settings [4, 5]. Blended learning combines the advantages of face-to-face interaction and online methods to create a comprehensive learning environment [6, 7]. By leveraging the benefits of both approaches, blended learning offers improved understanding and

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facilitates lifelong learning. As per the American Petroleum Institute (API), traditional oil and gas field training programs typically require around 150 h of learning, making them logistically challenging in the current educational landscape. In this context, virtual field-based learning, facilitated by the revolutionary XpoSim software, offers a unique spatial context and real-time learning experience in the oil and gas exploration process.

Universities face the challenge of delivering high-quality theoretical and applied drilling and exploration education to an increasing number of students, often without additional faculty, labs, or funds [8–10]. To address this practical knowledge gap, the industry has introduced short-duration intern/extern programs, which are often expensive for undergraduate students. However, these programs may not provide the comprehensive learning experience required for beginners [11–15]. This project aims to introduce blended learning in geoscience and petroleum courses, employing XpoSim, an innovative upstream virtual learning software. This platform enables teaching, learning, project design, and real-time assessments, fostering practical learning and critical thinking for problem-solving in the context of real field work.

By incorporating blended learning with XpoSim, this project endeavours to enhance practical learning and improve understanding in geoscience and petroleum education. It offers students the opportunity to engage in simulated field experiences, empowering them to develop skills and knowledge vital for the industry. This innovative approach bridges the gap between theoretical concepts and real-world applications, fostering a new generation of well-rounded professionals in the field of oil and gas exploration. This study will meet following objectives:

i) To apply blended learning with XposSim tool for the virtual teaching and learning in Geoscience and Petroleum Courses
ii) Evaluate the student performance output for positive perceptions amongst participants using virtual Xposim tool in teaching and learning that can be implemented in course syllabus.

2 Method and Workflow

The primary aim of this study is to implement a blended learning approach in geoscience and petroleum courses by incorporating the virtual XpoSim Oil and Gas industry tool. The blended learning model comprises two essential components: online teaching and hands-on lab sessions. The online teaching component focuses on individual learning, allowing students to access and engage with course materials remotely. On the other hand, the hands-on lab sessions serve as extensions of the online activities, providing students with opportunities to apply their theoretical knowledge in real-time virtual practical exercises.

The online teaching segment emphasizes self-paced learning, enabling students to progress through the course materials at their own speed. The lab sessions, however, shift the focus towards collaborative group activities, fostering teamwork and shared problem-solving during virtual lab sessions. To assess individual understanding, virtual assessments are conducted, allowing students to demonstrate their knowledge and skills acquired throughout the course. At the conclusion of each week, students have the opportunity to submit their assessments, receiving valuable feedback to support their learning and growth. This feedback mechanism promotes continuous improvement and provides students with a clear understanding of their strengths and areas for development.

To provide a visual representation of the blended learning environment, Fig. 1 illustrates the various components and interactions within the approach. This diagram offers a comprehensive overview of how the online teaching, lab sessions, and assessments are interconnected to create an effective and engaging learning experience for students. By implementing this blended learning approach with the integration of the XpoSim Oil and Gas industry tool, students in geoscience and petroleum courses can benefit from a dynamic and interactive educational experience that combines theoretical knowledge with practical application.

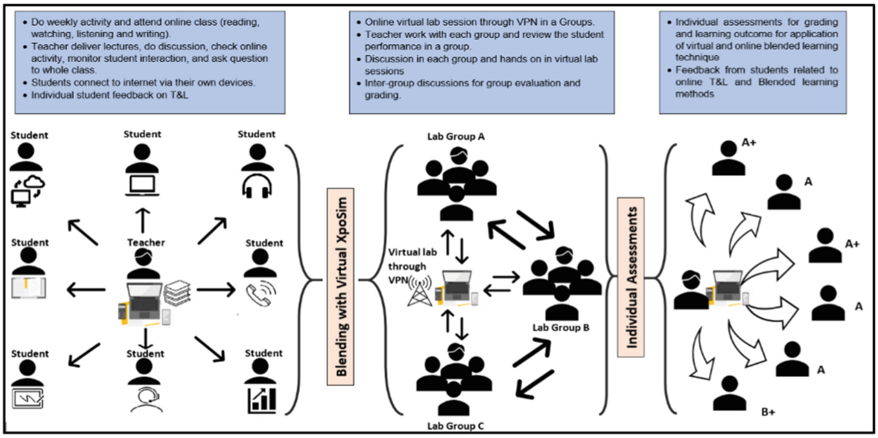

Fig. 1. The approach of blended learning in online teaching and learning with virtual lab sessions and assessments with individual student and in group.

2.1 Participants

The participants section of the paper describes the individuals involved in the blended teaching and learning study. In this particular study, the participants were students who were currently enrolled in geosciences or petroleum engineering programs, specifically taking Exploration and Drilling courses, at Universiti Teknologi PETRONAS. The selection of participants was done using purposeful sampling, which involves deliberately selecting individuals who meet specific criteria to ensure they are representative of the target population.

The criteria used for selecting student participants included three main factors. Firstly, students had to be enrolled in the Exploration and Drilling course being studied. Secondly, they needed to possess basic computer and internet skills, as the blended learning approach heavily relies on the use of technology tools and online resources. Lastly, regular attendance in the course was required to ensure active participation and consistent engagement with the blended learning activities. The study included a minimum of 20 students who were divided into five groups. The grouping was likely done to facilitate effective implementation of the blended learning approach and to allow for collaborative learning experiences within smaller, manageable groups. This approach encourages peer interaction, knowledge sharing, and teamwork among participants.

2.2 Implementation

The implementation of this study has been conducted in three distinct stages, as depicted in Fig. 2. Firstly, after careful course planning, students were introduced to the blended learning approach, which incorporated virtual lab sessions and facilitated group discussion forums as part of stage 1. Subsequently, in stage 2, individual assessments were conducted to evaluate their progress and understanding within the blended learning framework. The feedback provided by students during this stage was considered invaluable for refining and enhancing the learning process. Finally, in the last stage, student performance was graded and the results were analyzed to assess the effectiveness and impact of the blended learning approach. These analyses involved modeling the collected data to gain insights into the efficacy of blended learning and its contribution to student learning outcomes.

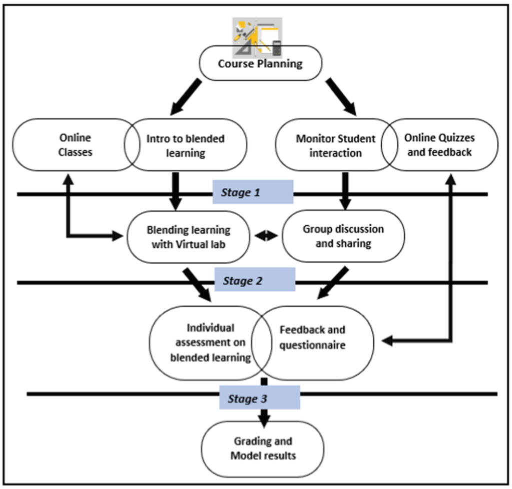

Fig. 2. Flowchart of implementation of blending learning in three stages.

3 Pilot Results

The study evaluated the effectiveness of the blended teaching and learning approach by analyzing the quantitative results obtained from this hybrid method. The evaluation was conducted based on the performance of the students in class. The study involved a sequential approach, where students initially covered most of their studies through the existing conventional teaching method, followed by incorporating virtual learning using the XpoSim software for a period of up to week 5. During this time, students were given assignments and other related tasks to assess their performance and understanding. The results, as depicted in Fig. 3, demonstrate that the blended approach had a positive impact on the students' performance compared to when they solely relied on traditional teaching techniques. The implementation of the blended learning approach resulted in improved student performance, indicating that the combination of face-to-face instruction and virtual learning experiences through XpoSim contributed to enhanced academic outcomes.

Moreover, the blended learning approach appeared to have a greater impact on the students' understanding of the subject matter. This suggests that the incorporation of virtual learning technologies provided students with a new perspective and deeper insights, enabling them to grasp the concepts more effectively. It is important to acknowledge that online teaching can pose significant challenges. However, the findings of this study highlight the benefits of using the blended learning strategy. It not only offers students a novel and comprehensive learning experience but also supports instructors/lecturers in successfully delivering the course content.

The improved performance and understanding observed among the students indicate the potential of blended learning as an effective instructional approach. By combining the strengths of traditional teaching methods and virtual learning technologies, educators can create an engaging and dynamic learning environment that fosters student success. The incorporation of interactive tools like XpoSim can enhance students' comprehension and provide them with valuable hands-on experiences, ultimately leading to a more enriching educational journey.

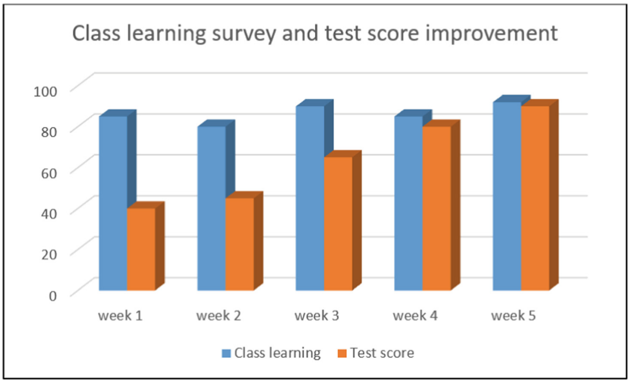

Fig. 3. Class learning improvement via surveys and corresponding test scores from week 1–week 5.

4 Future Prospects

Moving forward, there are several promising directions for future research and development based on the findings of this study. Firstly, a longitudinal study can be conducted to assess the long-term effects and sustainability of the blended learning approach. This would involve evaluating students' knowledge retention, their ability to apply learned concepts over time, and the overall impact on their academic performance. Additionally, a comparative analysis can be conducted to compare the effectiveness of the blended learning approach with other instructional methods, such as fully online learning or traditional face-to-face teaching. This comparative analysis would provide a comprehensive understanding of the advantages and limitations of blended learning in the context of geosciences and petroleum engineering education.

Developing appropriate assessment and evaluation methods specifically tailored for the blended learning environment is also important. Designing innovative assessment tools that assess both theoretical knowledge and practical application of concepts, leveraging the unique features of virtual learning platforms like XpoSim, can provide a comprehensive evaluation of students' learning outcomes. Furthermore, exploring strategies for scaling up the implementation of blended learning approaches across larger student cohorts or different educational institutions is essential. Identifying challenges, developing support structures, and providing training for instructors and students will be crucial in effectively implementing blended learning on a broader scale.

Finally, assessing the impact of blended learning on students' readiness for the industry is an important consideration. Collaboration with industry partners can provide valuable feedback on the preparedness of students who have undergone blended learning, ensuring that the approach enhances their practical skills, adaptability, and employability. By pursuing these future directions, researchers can continue to refine and optimize the implementation of blended learning in geosciences and petroleum engineering education. This will lead to improved teaching practices, better prepare students for real-world challenges, and foster innovation in the field.

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The Dynamics of Educational Pursuits: Unraveling the Impact of Instant Gratification on Macro and Micro Education

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Abstract. This paper explores the relationship between instant gratification, educational choices, and the optimization of online education benefits. The lack of understanding regarding the effects of instant gratification on learners' educational decisions hinders the development of effective strategies for lifelong learning. The study aims to identify the factors driving learners to choose short-term online education versus formal education and examine the interplay between intrinsic motivation and instant gratification in obtaining recognition and credentials. Interviews were conducted with fifteen participants, including university students, working adults, and non-working individuals. The results highlight the diverse motivations of learners to enroll and to complete the education for the recognized credentials. The study emphasizes the importance of intrinsic motivation and instant gratification in educational pursuits. It concludes that pursuing education can lead to personal fulfillment, academic and professional goals, and staying updated in one's field. Balancing intrinsic motivation and external recognition is crucial for maximizing the benefits of online education and promoting lifelong learning.

Keywords: Learners · Education · Online · Micro-credential · Motivation · Gratification · Recognition · Digital Badge

Micro-credentials have emerged as short, focused learning programs that provide individuals with the opportunity to acquire specific knowledge, skills, or competencies in a particular subject area. These programs are designed to be flexible and accessible, often delivered online, enabling learners to enhance their expertise or gain new skills in a shorter time frame compared to traditional degree programs. Universities, educational institutions, and industry organizations frequently offer micro-credentials to meet the

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growing demand for practical and relevant learning options in today's rapidly changing job market.

The popularity of micro-credentials stems from their practicality and alignment with the evolving nature of work. They offer individuals the chance to quickly upskill or reskill, enabling them to adapt to new technologies, industries, or job requirements. By focusing on specific topics or areas of expertise, micro-credentials allow learners to tailor their learning to meet their career goals or personal interests.

The concept of micro-credentials aligns with the increasing demand for lifelong learning and continuous professional development. As work dynamics change, individuals must acquire new skills or update existing ones to remain competitive. Micro-credentials provide a more flexible and accessible alternative to traditional degree programs, allowing individuals to learn at their own pace and concentrate on the specific skills they need. Learners who pursue micro-credentials benefit from the flexibility and convenience of online learning, enabling them to study at their own pace and accommodate other commitments. The focused nature of micro-credentials allows individuals to acquire targeted skills quickly, making them appealing to professionals seeking to upskill or reskill in a specific area without investing significant time and resources required for a full degree program.

Truskowska emphasis that micro-credential is also identified as digital badge [1]. Digital badges have gained widespread recognition as alternative forms of credentialing and recognition across various fields, including higher education. Digital badges serve as virtual representations of skills or knowledge and are awarded as evidence of mastery of a specific competency, acquired through formal or informal learning experiences [2]. These credentials are typically issued in a digital format [1], containing embedded data such as participant information, course details, and issuer information, making them comprehensive records of achievement [3].

The significance of digital badges in the context of micro-credentials is particularly notable in computing courses. Digital badges provide a means to acknowledge and communicate learning achievements not only within specific communities but also across different platforms. They can be shared and showcased on various online platforms, offering a more detailed and accessible way to demonstrate one's skills and knowledge [4, 5]. In addition to their value as credentials, digital badges have been recognized as motivational tool in fostering engagement and self-directed learning behaviors [6].

While digital badges are an effective tool for recognition, they also contribute to the practice of instant gratification in education context. Instant gratification refers to the desire for immediate rewards or satisfaction and can be seen as the need for immediate feedback, recognition, or validation of one's efforts and achievements [7]. Instant Gratification is particularly relevant in online learning (MOOC and ODL), as well as for micro-credentials programs. Through these learnings, the individuals can attain immediate rewards and recognition for their learning accomplishments.

To cater to this need, online learning platforms often incorporate features that provide instant feedback and rewards to learners, such as badges or points for completing tasks or modules [8]. These rewards serve as motivators and encourage learners to continue their engagement with the learning materials. In the context of micro-credentials, digital badges can provide immediate recognition and validation of the skills and knowledge acquired by individuals, offering a powerful motivator for individuals to acquire new skills and update their competencies [1].

Formal education can also offer instant gratification by providing timely feedback from teachers or peers, recognition of achievements, or immediate access to resources and information [7]. These forms of instant gratification can enhance the learning experience and promote engagement and motivation among students. Similarly, in the context of micro-credentials, digital badges serve as a form of instant gratification by providing immediate recognition and validation of the skills acquired by individuals.

The lack of understanding regarding the effects of instant gratification on learners' educational choices and their emphasis on immediate recognition and rewards in the pursuit of short-term online education and formal education hinders the development of effective strategies to promote lifelong learning and optimize the benefits of online education across diverse learner demographics.

Hence, the objectives of this paper are, (1) To recognize the factors that drive learners to pursue short-term online education versus formal education, (2) To explore the interplay between intrinsic motivation and instant gratification in obtaining of recognitions and credentials upon completion of the educational pursuits.

1 Literature Review

Instant gratification in education refers to the desire for immediate rewards or outcomes in the learning process. It is driven by the expectation of quick access to information, immediate feedback, and instant results [9]. With the increasing use of social media and digital technology in education, students have come to expect instant gratification in their learning experiences. They want quick answers, immediate feedback on their work, and instant access to resources [10].

The effects of instant gratification in education can be both positive and negative. On the positive side, instant gratification can enhance motivation and engagement in learning, as it reinforces learning and provides a sense of accomplishment, which further motivates students to continue learning [11]. Instant feedback can also help students identify and correct their mistakes in real-time, leading to faster learning and improvement [9].

However, instant gratification can also have negative effects on education. It can lead to a preference for shallow learning and a lack of perseverance. When students prioritize completing tasks quickly rather than deeply understanding the content, it can result in surface-level learning and a lack of critical thinking skills [12]. Moreover, instant gratification can make it difficult for students to develop patience and the ability to delay rewards for long-term goals [13].

Instant gratification can also impact students' time management skills, leading to procrastination and a lack of focus on long-term projects or assignments. Students may prioritize short-term tasks that provide instant gratification, such as checking social media or engaging in other non-academic activities, over important academic tasks [14]. This can result in poor time management and a decrease in overall academic performance.

To mitigate the negative effects of instant gratification in education, it is important to strike a balance between providing immediate feedback and rewards while also fostering delayed gratification and long-term goal setting. Educators can design learning experiences that incorporate elements of instant gratification, such as gamification or immediate feedback, while also emphasizing the importance of perseverance, critical thinking, and deep learning [11]. Teaching students' self-regulation skills, time management strategies, and the value of delayed gratification can also help them develop the necessary skills to navigate the challenges of instant gratification in education [15].

On the other hand, delayed gratification in the education context refers to the ability to postpone immediate rewards or outcomes in favor of long-term goals or benefits. It involves self-control, patience, and the willingness to invest time and effort in the learning process, even if the rewards are not immediately apparent [16]. Delayed gratification has been linked to various positive outcomes in education, such as higher academic achievement, improved self-regulation, and better long-term success [16].

The main difference between instant and delayed gratification in the education context lies in the time frame and mindset. Instant gratification focuses on immediate rewards and outcomes, often seeking quick fixes and shortcuts in the learning process. It prioritizes immediate satisfaction over long-term goals and may lead to shallow learning and a lack of perseverance [9]. On the other hand, delayed gratification emphasizes long-term goals and benefits, requiring patience, persistence, and the ability to withstand short-term temptations for the sake of greater achievements in the future [16].

Research has shown that the ability to delay gratification in childhood is associated with various positive outcomes in adolescence and adulthood, such as higher academic achievement, better socioemotional behaviors, and improved financial status [16]. For example, a study by Watts et al. found that the ability to delay gratification at age 4 predicted a gain in achievement at age 15 [16]. However, it is important to note that the size of the correlation between delay of gratification and later outcomes may vary and can be influenced by factors such as family background, early cognitive ability, and the home environment [16].

In the education context, the prevalence of instant gratification can pose challenges for both students and educators. Students may struggle with maintaining focus and motivation for long-term goals, as they are accustomed to immediate rewards and quick results [9]. This can lead to a lack of perseverance, shallow learning, and a preference for surface-level engagement with educational materials. Educators, on the other hand, may need to find ways to engage students and provide meaningful learning experiences that balance the desire for instant gratification with the importance of delayed gratification and long-term goals.

2 Methodology

For the interview sessions, the researcher was able to gather fifteen representatives with diverse backgrounds. These representatives included university students, working adults, and non-working adults. Through these varied perspectives, we were able to obtain a more comprehensive understanding and analysis. To schedule the sessions, we used Google Meet to accommodate the representatives' availability preferences. This allowed for a more convenient and efficient process, providing us with more time to delve deeper into our discussions.

Verbatim transcription of interview data is widely considered integral to the analysis and interpretation of verbal data. Verbatim transcription refers to the word-for-word reproduction of verbal data, where the written words are an exact replication of the audio recorded words [17] and concurrent notetaking [18]. Thus, verbatim quotations from interviewees or research participants have become standard practice in social research that includes direct quotations in the reporting [19]. The verbatim quotations can be used as a matter of inquiry, as evidence, as explanation, as illustration, to deepen understanding, to give participants a voice, and to enhance readability [20].

Positivist research uses predominantly quantitative data but can also use qualitative data [21]. Survey research is categorized into two forms: a written survey called a "questionnaire" and an oral survey known as an interview [21]. Survey research is a research method involving the use of standardized questionnaires or interviews to collect data about people and their preferences, thoughts, and behaviors in a systematic manner.

The verbatim quotations offer researchers and readers a greater depth of understanding of the interviewee's views or feelings on the subject matters or themes [20]. In this study, the themes and list of questions to ask during the interview session are adopted from the survey questionnaire itself. Hence, this interview survey provides the means to identify the learners' thoughts on short online courses versus formal education (such as diploma, degree etc.).

Therefore, the objectives of the interviews were to identify: (1) the participants' current educational status and level of engagement by determining if they are currently studying or pursuing a formal education like a diploma, degree, or professional certificate; (2) the expected duration for completing a diploma, degree program, or professional course to gain insights into the participants' long-term commitment and time frame for achieving their educational goals; (3) the participants' emotional response towards waiting for a few years to receive their diploma, degree, or professional certificate, providing insights into their attitudes and patience levels when it comes to delayed gratification; and (4) the factors that motivate learners to pursue short online courses and the importance they place on immediate recognition or reward for completing such courses, shedding light on their preferences for instant gratification and the value they associate with timely certification.

3 Result and Discussion

One of the first and most important questions that must be asked concerns the individual's current educational status. This question is essential in order to provide appropriate guidance and support to help the learner reach their educational goals. With regards to educational status, we are interested in a number of factors, such as the level of education completed, the type of degree or certificate held, the field of study, and any relevant work experience. Understanding the learner's educational background and experience will help us better tailor our services and resources to support their continued growth and development.

For the first category (category 1) of university students, participants 1, 2, 4, and 5 indicated that they are currently studying at university, pursuing degrees in various fields. Participant 3, however, mentioned that they graduated last year. For the next category

(category 2) of working adults, participants 1 and 3 mentioned that they are not currently studying, as they have completed their formal education. Participants 2 and 5, on the other hand, are currently pursuing part-time education while working, highlighting the importance of continuous learning and professional development. Participant 4 stated that they are focused on their professional career at the moment and not engaged in formal education. Lastly for the category of non-working individuals (category 3), participants 2 and 5 expressed their involvement in self-study or online courses out of personal interest. Participants 1, 3, and 4, however, stated that they have completed their studies, are retired, and are not actively pursuing formal education at present.

These responses provide an overview of the participants' current educational status and highlight the diverse range of perspectives among university students (category 1), working adults (category 2), and non-working individuals (category 3), as presented in Fig. 1.

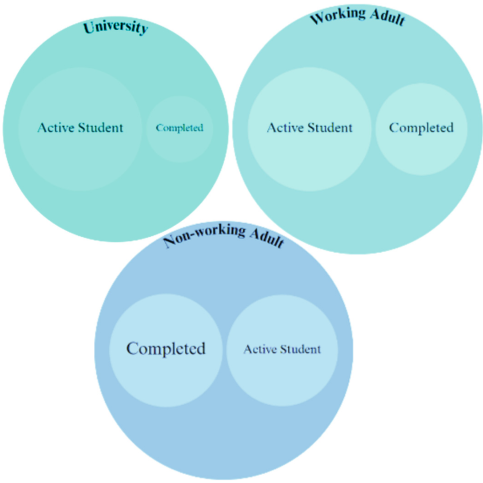

Fig. 1. Educational Status

The second question pertains to whether the participant is engaged in any formal education, such as pursuing a diploma, degree, or professional course. So, the university students (category 1), participants 1, 2, 4, and 5 reported that they are actively involved in formal education, pursuing diplomas or degrees in various fields. This highlights their commitment to obtaining recognized qualifications and enhancing their knowledge and skills. Participant 3, on the other hand, mentioned that they have already completed their formal education.

Regarding working adults (category 2), participants 2 and 5 shared that they are currently pursuing part-time diploma or online degree programs while balancing their professional commitments. Participants 1 and 3 mentioned that they have completed their formal education and are now focused on their careers. Participant 4 is currently enrolled in an evening course to enhance their skills, demonstrating their dedication to continuous learning.

Among non-working individuals (category 3), participants 2 and 5 expressed their engagement in short courses or online learning opportunities as a means of personal enrichment. Participants 1, 3, and 4 mentioned that they have completed their formal education and are retired, indicating that they are not actively pursuing further qualifications.

These responses shed light on the diverse educational pursuits among university students, working adults, and non-working individuals, with a mix of participants actively pursuing formal education, already having completed it, or focusing on alternative learning avenues, as summarized in Fig. 2.

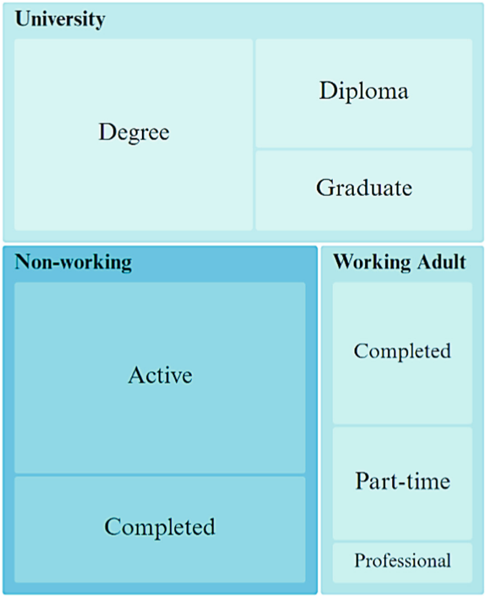

Fig. 2. Engagement on Formal Education

The third question asks about the expected duration for completing a diploma, degree, or professional course. For university students (category 1), program lengths can vary. Participant 1 expects to complete their program in four years, while participant 2's diploma program typically lasts for three years. Participant 4's degree program is three and a half years, and participant 5's program will take around five years to finish. These varying timelines reflect the different academic requirements and program structures across disciplines.

On the other hand, working adults (category 2) who are pursuing part-time education have different timelines for completing their programs. Participant 2 expects to finish their part-time diploma program in four years, while participant 4 anticipates completing their online degree program in five to six years, depending on their pace of study. Participant 5 will complete their professional course within 8 to 12 weeks. These timelines demonstrate the flexibility and adaptability of part-time education options for working adults.

Non-working individuals (category 3) who are engaged in self-study or short courses do not have specific timelines for completion since they are studying at their own pace without strict program structures or time constraints. Their motivation is driven by personal interest rather than the need to adhere to a specific duration.

These responses highlight the varied timeframes for completing diploma or degree programs, influenced by the nature of the program (full-time or part-time), individual circumstances, and personal motivation, as presented in Fig. 3.

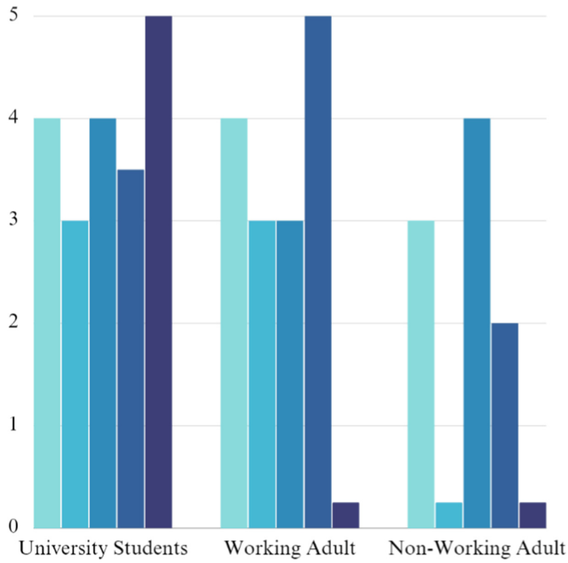

Fig. 3. Duration of Completion of Formal Education

Question 4 studies about how learners feel about waiting for several years to receive their diploma, degree, or professional certificate. During the interview session with university student participants (category 1), the researcher discovered that they had mixed feelings towards the waiting period. While some students expressed anticipation and excitement, viewing the waiting period as a culmination of their hard work and dedication, others felt demotivated due to the long duration required for the completion of program requirements. They acknowledged the importance of patience and understanding, recognizing that the time required is necessary to ensure the quality of their education.

During the interview session with working adults (category 2), it was clear that Participants 2 and 5 are enrolled in part-time education. They were accepting of the longer program duration and waiting period and seemed comfortable with it. They recognized the importance of balancing their professional commitments with their studies and the value of delayed gratification. They believed that the end result would be worth the effort and wait. Participant 4 expressed happiness about being able to finish a professional course within 8 to 12 weeks with flexible study time and receiving a professional certificate after completion. This led the participants to enroll in more courses, as they could complete the professional certificate within a shorter time frame. Overall, it seems that Participants 1, 2, and 4 have a mature perspective towards their education and career goals and are willing to invest the necessary time and effort to achieve them.

Although non-working adults (category 3), participants 2 and 5 were not required to obtain a diploma or degree certificate, they were still able to engage in self-study or online short courses. Their experience in learning new skills and knowledge was a valuable accomplishment in and of itself. Perhaps they gained a deeper understanding of a subject they were passionate about or developed new skills that allowed them to pursue a new career path. Regardless, the sense of anticipation and excitement that comes with completing a challenging course is a universal feeling and one that is well-deserved for those who put in the effort to better themselves through education, even if they are currently not employed.

Overall, the responses suggest that learners are motivated by various factors, including personal interest, career goals, and the desire to enhance their knowledge and skills. Pursuing education, whether through formal or alternative avenues, provides a sense of accomplishment and fulfillment that is well-deserved for those who put in the effort to better themselves, as illustrated in Fig. 4.

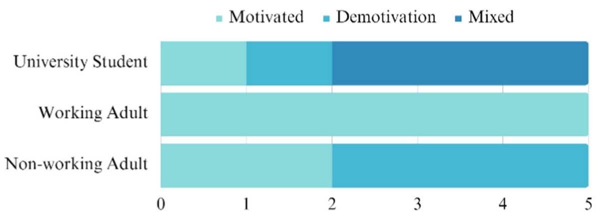

Fig. 4. Level of Motivation to Attain Qualification

Question 5 is about the learner's motivation throughout the study period, till the completion of the diploma or degree or professional course. The university students (category 1) have expressed a range of factors that keep them motivated throughout their studies. For many, passion for their field of study is a driving factor, as they are genuinely interested in learning and contributing to their chosen area of expertise. They also mentioned their aspirations for future career opportunities and personal growth as motivating factors. Support from family and peers, academic excellence, and a sense of achievement and accomplishment are also important motivators for many students.

For the working adults (category 2), few participants are pursuing their studies part-time who balance work and education, motivation can come from a desire to advance their careers, acquire new skills and knowledge, and apply what they learn in real-world scenarios. Another participant is doing the professional certificate. Participant 4 expressed happiness about being able to finish a professional course within 8 to 12 weeks with flexible study time and receiving a professional certificate after completion. This led the participants to enroll in more courses, as they could complete the professional certificate within a shorter time frame. This highlights the motivation factor of completing a professional course quickly and efficiently. The sense of accomplishment and recognition that comes with obtaining a professional certificate provides learners with the drive to continue pursuing further education and professional development opportunities.

Non-working individuals (category 3) who engage in self-study or online short courses are often intrinsically motivated, driven by their genuine interest in the subject matter, curiosity, and the joy of learning something new. They also mentioned the desire to stay intellectually engaged and updated as a motivating factor. Furthermore, these individuals often have a strong desire to expand their knowledge base, deepen their understanding of their chosen field, and gain new insights that can help them in their personal and professional lives. They are eager to explore new ideas, challenge their existing beliefs, and discover innovative ways of thinking. Finally, individuals who engage in self-study or short courses often find that the process of learning itself is rewarding and fulfilling, regardless of whether or not it leads to a tangible outcome or certification. They derive satisfaction from the act of learning and enjoy the challenge of mastering new skills and knowledge.

The results show that learners are motivated by personal interest, career goals, and the desire to enhance their knowledge and skills. Passion for the field of study, aspirations for future career opportunities, and personal growth are important motivators for many students. Working adults are motivated to advance their careers, acquire new skills and knowledge, and apply what they learn in real-world scenarios. Non-working individuals engaging in self-study or short courses are often intrinsically motivated, driven by their genuine interest in the subject matter and the joy of learning something new. They have a strong desire to expand their knowledge, deepen their understanding, and gain new insights. The summary of the findings is presented in Fig. 5.

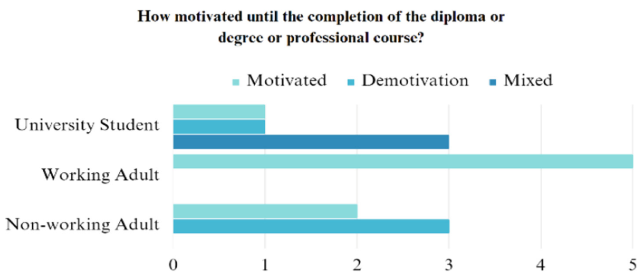

Fig. 5. Level of Motivation for Completion

During the interview, Question 6 explored the emotional impact of receiving a certificate upon completion of a diploma, degree, or professional course. University students (category 1), including participants 1, 2, 4, and 5, expressed a sense of pride, fulfillment, and accomplishment upon receiving their diploma or degree certificate. They emphasized that the certificate validates their hard work, signifies a milestone in their educational journey, and opens doors to new opportunities.

Similarly, working adults (category 2), participants 1 and 2, who were pursuing part-time education, also reported experiencing feelings of pride and accomplishment upon receiving their certificates. They viewed the certificate as tangible proof of their dedication and commitment to continuous learning and professional development. Participant

4, who completed a professional course within 8 to 12 weeks with flexible study time, expressed happiness upon receiving a professional certificate after completion. This led the participants to enroll in more courses, as they could complete the professional certificate within a shorter time frame. The participant's positive response reflects the appeal of short, focused courses that provide immediate recognition and rewards, catering to the human desire for instant gratification.

On the other hand, non-working adults (category 3) who pursued self-study or short courses did not have the experience of receiving a diploma or degree certificate. Nevertheless, this does not imply that they did not gain valuable knowledge and skills through their studies. In fact, these individuals may have had a more hands-on and practical experience, which is not always part of traditional educational programs. Furthermore, the satisfaction and fulfillment that one can feel upon completing a course and receiving a certificate of completion is not just limited to those who receive a formal degree. It can be a great source of motivation and pride for anyone who has put in the effort to learn and develop.

Therefore, even if they did not receive a formal diploma or degree certificate, the non-working adults who pursued self-study or short courses should be proud of their achievements and the skills and knowledge they have gained. Ultimately, the emotional impact of receiving a certificate upon completion of an educational program is a highly personal experience that can vary widely depending on individual circumstances and goals.

For Question 7, participants were asked about their participation in short courses lasting from 2 days to 2 weeks. It was discovered that university students (category 1) did not take such courses. Although most working adults (category 2) had not taken online short courses within this time frame, one participant mentioned that they had taken relevant online short courses in the past to enhance their professional skills. This suggests that short courses can be beneficial for working adults looking to improve their expertise in specific areas. Interestingly, non-working individuals (category 3) showed a higher tendency to take online short courses. Participants 2 and 5 reported taking online short courses ranging from 2 days to 2 weeks for personal interests. This demonstrates that short courses can be a great way for non-working individuals to acquire new knowledge, skills, and pursue their passions. Therefore, it is important to consider the diverse needs and motivations of learners when designing short courses, as summarized in Fig. 6.

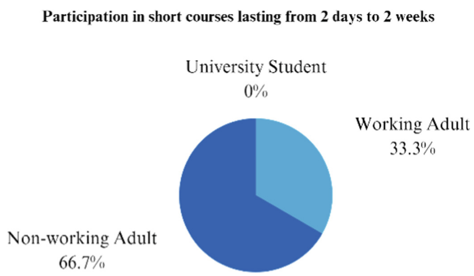

Fig. 6. Course Duration

Whilst, for Question 8, it is noted that university student participants (category 1) did not have any specific motivations for taking online short courses, unless the formal education is costly, and unaffordable by them. However, working adults (category 2), participant 4 expressed a desire to remain up to date with industry trends and acquire new skills that would ultimately benefit their professional growth. Non-working adults (category 3), participants 2 and 5 had a more diverse range of motivations for taking online short courses, including a personal interest in the subject matter, a desire to explore new areas of knowledge, as well as the flexibility and convenience of such short-term learning opportunities. It is interesting to note that non-working participants 2 and 5 also mentioned that taking short courses (online and physical) is a main avenue for them to socialize and network with like-minded individuals who share similar interests.

In question 9, participants were asked about their thoughts on receiving a certificate immediately after completing a short course. Although university students (category 1) did not have direct experience with this, but working adults (category 2), participant 4 expressed positive sentiments about receiving immediate certificates. The participants mentioned that it provides a sense of achievement and validates their efforts in acquiring new skills. Non-working individuals (category 3), participants 2 and 5 also shared positive experiences with immediate certificate recognition. They expressed a feeling of satisfaction and a sense of accomplishment upon receiving certificates for completing the short courses, and appreciated the tangible evidence of their learning that came with it. Overall, it appears that immediate certificate recognition has a positive impact on participants' sense of achievement and validation of their efforts.

Question 10 reflects the significance of receiving immediate recognition or reward for completing short courses. The university students have no experience of it but expressed high interest in obtaining fast-track recognitions and rewards. During the interview, working adults (category 2), participant 4 emphasized the importance of timely recognition or reward for their acquired skills. They viewed it as validation of their capabilities, which can boost their confidence and motivation to further excel in their career. Additionally, they noted that such recognition can have a positive impact on their career advancement opportunities, as it demonstrates their value to their organization and potential employers. Therefore, it is important for organizations to provide timely and meaningful recognition to their employees to foster a positive work environment and promote employee satisfaction and retention.

On the other hand, non-working adults (category 3), participants 2 and 5 placed greater emphasis on the intrinsic motivation derived from the learning experience itself. They expressed varying degrees of importance placed on immediate recognition or reward, while also appreciating the recognition. Participant 2, for instance, highlighted how gaining immediate recognition or reward can be a source of motivation for them to continue learning, especially when they feel demotivated.

In brief, most participants valued immediate recognition or reward for completing short courses, others placed emphasis on intrinsic motivation and long-term benefits of learning. Nonetheless, recognition and reward can play a significant role in motivating individuals to continue learning and developing their skills.

Question 11 of the interview aims to understand the preferences of participants regarding the structure of their degree courses, as illustrated in Fig. 7. For category 1, participants 1 and 2 from the university expressed a strong preference for pursuing a formal degree program that takes 3 to 4 years. They highlighted the comprehensive and structured nature of such a program, which they believe facilitates in-depth learning, specialization, and a well-rounded educational experience. For them, a formal degree program provides a solid foundation of knowledge and skills that can be applied in their future careers. On the other hand, participants 3, 4, and 5 mentioned that they prefer to take small, short courses in their professional field. This option allows them to work full-time and complete the degree at their convenience, offering more flexibility and self-paced learning. They believe that short courses provide them with practical skills that are directly applicable to their current jobs. Additionally, they can take multiple courses in different areas of interest to broaden their knowledge and skills. Overall, while the duration and structure of degree courses play a crucial role in shaping the learning experience, it is important to consider the individual needs and preferences of the learners.

For working adults (category 2), it is preferable to have degree courses that come in small, short sessions or as a formal degree that takes 3 to 4 years, which can easily fit into their busy schedules and help them meet their career goals. These options allow them to continue working as full-time employees while still pursuing their education. By utilizing these opportunities, working adults can broaden their knowledge and skills in their field of interest. They can also explore new areas of interest, gain a deeper understanding of their industry, and stay up to date with the latest trends and innovations. This helps them become more valuable employees and advance their careers. Pursuing further education can also be a source of personal fulfillment and satisfaction. It allows working adults to challenge themselves and achieve their academic and professional goals. They can also connect with other like-minded individuals and build a supportive network of colleagues and mentors. By providing flexible and accessible education options, these courses empower individuals to pursue their passions and achieve their full potential.

Non-working participants (category 2) are found to be more inclined towards self-study and short courses based on their personal interests, rather than pursuing formal degree programs. This is likely because these individuals have already acquired a solid foundation of knowledge through their own endeavors and experiences and are now seeking to expand their horizons in targeted areas of interest. As such, they tend to gravitate towards educational opportunities that allow them to delve deeper into specific topics, without the time and financial commitments of a formal degree program. This preference for more flexible and personalized learning experiences is reflective of a growing trend in the modern workforce, where individuals are constantly seeking to enhance their skills and knowledge in order to stay competitive in today's rapidly evolving job market.

The final question inquiries about the preference of participants for instant or delayed recognition/reward. It is observed and noted that university students (category 1) generally favor instant recognition/reward due to the fast-paced nature of their academic environment. However, there are also those who prefer delayed recognition/reward as they believe it ultimately leads to greater satisfaction and a sense of accomplishment. Additionally, some participants may be more inclined towards delayed recognition/reward if they have a long-term perspective in mind, such as building a strong foundation for their future career. Ultimately, the choice between instant and delayed recognition/reward

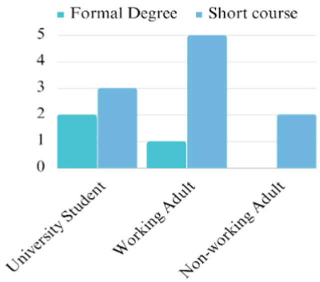

Fig. 7. Couse Structure

depends on an individual's values and goals, and both options have their respective advantages and disadvantages, as summarized in Fig. 8.

During interviews, working adults (category 2) expressed the importance of receiving instant recognition or reward for their efforts. They believe that immediate validation of their work is crucial, as recognition can boost morale, motivate them to continue performing well, and provide a sense of satisfaction and accomplishment. Employers should therefore prioritize providing timely feedback and acknowledging their employees' contributions, whether through a simple thank-you note or a more elaborate rewards program. This fosters a positive work environment that encourages productivity and job satisfaction. In contrast, non-working participants (category 3) did not express a clear preference between instant and delayed recognition, but it is observed more inclined towards instant gratification, as their motivations for learning is driven by personal interest, joy of learning, and also in upscaling their quality of life.

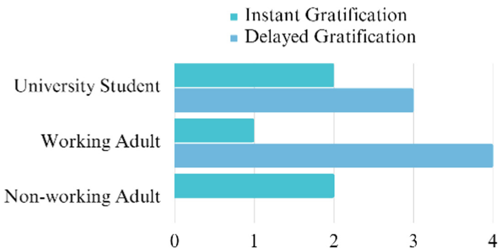

Fig. 8. Instant Gratification vs. Delayed Gratification

4 Conclusion

This study highlights the motivating factors that drive learners to pursue short-term online courses as well as formal education, while seeking to obtain certificates of completion, credentials, and digital badges. Learners are propelled by diverse factors, including personal interests, career goals, and an insatiable thirst for knowledge. The study underscores the critical importance of recognizing and harnessing both extrinsic rewards and intrinsic motivation in educational endeavors. Furthermore, there is a pressing need for further research to comprehensively understand the role of instant gratification in facilitating and enhancing the motivating factors that drive individuals to enroll in online short courses and actively attain digital certificates and badges. Gaining deeper insights into this aspect will enable the development of targeted strategies and interventions that effectively promote lifelong learning, while maximizing the wide-ranging benefits of online education across diverse learner demographics. Ultimately, this research contributes to the ongoing advancement of educational practices, fostering a culture of continuous learning and enabling learners to seize new opportunities in the ever-evolving landscape of online education.

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The Effectiveness of Flipped Classroom to Develop Data Scientist Skills for Final year Project: A Case Study of Customer Facial Recognition Using CNN

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Abstract. The objective of this project is to introduce the effectiveness of flipped classroom to improve computing skills through a case study of a facial recognition system that can identify regular customers and improve customer service at Café, UTP. The flipped classroom has been implemented in Artificial Intelligence (AI) course to help students to improve computing skills focusing on AI domain. This method has also been applied to other AI related courses such as Machine Learning (ML) and Data Science (DS) to leverage the fundamentals of AI and its applications. This method was conducted on lab sessions and Final Year Project (FYP). About 7 to 8 lab sessions have been conducted and FYP on predictive analytics has been implemented using this method. The current challenges in identifying regular customers and understanding their behavior using membership cards are inconvenience and security risks due to the possibility of losing, expiring or becoming outdated. The project aims to overcome these issues by proposing a facial recognition technology using a convolutional neural network (CNN) algorithm. The model will be trained to classify and identify customers based on their facial features and labeled images of their faces will be stored in a database to verify their status as regular customers. The goal of this project is to create a dependable system that can accurately identify the regular customers of Café, UTP. The findings of this study suggest that the flipped classroom method can be an effective way to develop computing skills.

Keywords: flipped classroom · face recognition · convolutional neural networks · customer service · deep learning

1 Introduction

One of the potential learner-oriented teaching methods worthwhile to be internalized by teachers is flipped classroom. Through the flipped classroom approach, learners can actively become knowledge seekers and lifelong academicians. The flipped is a

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recent trend in education that focuses on how to help learners achieve a higher level in the taxonomy domain. The nature of flipped classroom model itself refers to out-of-classroom learning where learners are required to prepare and get themselves ready with the assigned learning materials before the leaching-learning class session start to enhance their understanding level of the targeted subject-specific topics to be discussed in the classrooms [1]. Furthermore, the flipped learning classroom activity is focused on application and higher-level learning rather than listening to lectures and other lower-level thinking activities. Implementing flipped learning, allows students to spend more time supporting higher-level learning activities such as group discussions, while lower-level tasks such as knowledge and understanding are done independently outside of class.

Loyalty programs are established with the aim of enhancing customer satisfaction, and often provide benefits to members as a form of appreciation for their loyalty to a particular organization or business. In the food and beverage industry, customer data is collected to manage relationships with customers. One common application in many loyalty programs is a card-based system or membership card, which contains a unique barcode for each account that can be tracked by the Customer Relationship Management (CRM) system when the card is swiped during events [2]. However, as information accumulates exponentially over time, businesses must leverage big data technology to handle and analyze this vast amount of data. In [2], implementing machine learning is effective in identifying customers who would benefit from specific promotions. Nonetheless, the authors suggest developing algorithms to improve loyalty programs. Focusing on He & She Café, UTP, the same problem arises where regular customers do not receive their loyalty rewards despite visiting the café several times. Two problem statements identified in this study, the leads this research further which are:

i. The difficulties to identify regular customers of He & She Café
   Many loyalty programs, such as membership cards, have been introduced to improve customer retention and satisfaction. However, not all businesses can afford to develop their own loyalty programs. At the He & She Café branch in UTP, no membership card program has been implemented yet, making it difficult to identify regular customers. Additionally, the workers at Café miss the opportunity to identify their regular customers, potentially leading to a loss of customer retention.
ii. The difficulties to study daily customer behaviour, preferences and name
   Gaining insights into customer behaviour is essential for businesses as it allows them to build connections with current customers and attract new ones. To accomplish this, it is recommended to have a database that stores customer details, enabling the tracking and analysis of their behaviour and preferences. However, without a membership program in place, the lack of a database can make it difficult to accurately study and predict customer behaviour.

This paper presents a proposed solution for addressing the issue of recognizing customers through face recognition using image processing and artificial intelligence. The objective of this study is to develop a Python-based convolutional neural network (CNN) model that can accurately identify customers based on their facial features at He & She Café. The ultimate goal is to create a system that can capture a customer's face and classify them as a regular customer or not.

2 Literature Review

2.1 Flipped Classroom

The flipped classroom is an instructional approach that reverses the traditional learning environment by delivering direct instruction through online resources, allowing in-class time for active learning and application of knowledge. In the flipped classroom, students are provided with the pre-class activity and learn the material before the class starts. During classroom time students need to work on theories and share ideas through discussion with peers and teachers. After the class, students reflect upon the feedback they have learned in class and use this to understand more in their learning. The flipped classroom approach focuses on the "deep learning" also known as higher-level cognitive skills. The pre-recorded videos used in a flipped classroom are prepared by lecturer or teacher, who explains the content and offers examples. This section provides an overview of the flipped classroom model and its core components.

According to [3], the concept of a flipped classroom by researchers is defined more from the perspective of the implementation process and the essence of learning, and its definition can be roughly summarized as the learning process usually includes two stages which is knowledge transfer and knowledge internalization. The flipped classroom is an inverted of these two stages, where learners complete the transfer of knowledge by watching pre-recorded videos before class, and students complete the internalization of knowledge in class through various forms of learning activities, such as group discussions, homework assignments, and individual teacher tutoring.

According to [4], the flipped classroom method has gained lot of interest worldwide where students can take part actively in their learning whether offline or online. Students are portrayed as self-directed learners who find out new information without depending on teachers. The notion of flipped learning is opposed to the traditional teaching and learning strategy. The term itself means it "flipped" the old technique. In a flipped or inverted classroom, learners are given pre-class activity materials to read, study, and review on their own time. Not only that, hands-on lab and programming activities and other resources also provide this fundamental support for learning, allowing for more in class time to be focused on higher levels of learning, from application to assessment.

The research on flipped classrooms was based on Bloom's updated taxonomy of cognitive domain theory. This taxonomy categorizes learning into six phases. The explanation is organized from the most basic to the most complex. In flipped classrooms, students' progress from the lowest level of remembering to the greatest degree of creating. The success of a flipped class is measured by the student's understanding level. It is measured based on the fact that the student's learning before the class is comparable to that of the teacher's lecture in a traditional classroom, and that the students have affected the content of the class during the class (Fig. 1).

2.2 Face Recognition

Face recognition technology is an application of image recognition that involves the identification and authentication of individuals based on their facial features using a camera or video-based system. According to [5], face recognition verifies the identity of

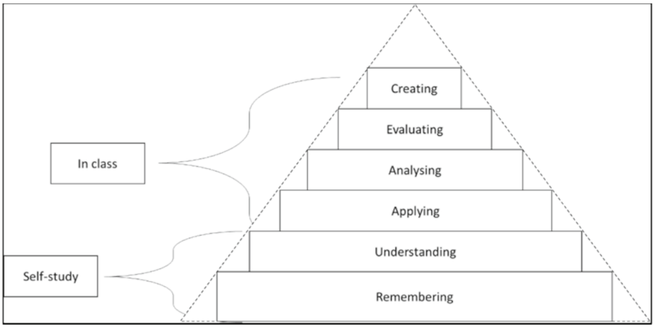

Fig. 1. Bloom's updated taxanomy in the flipped classroom.

individuals by matching their faces with a database of static images or videos. Developing effective face recognition systems is a complex task that requires addressing multiple factors. As highlighted in [6], there is a need to handle variations in face features and shooting conditions, including factors like pose, lighting, expression, and background. The security field particularly emphasizes the importance of face recognition for identity authentication through biometric systems [5–7]. The increasing popularity and versatile applications of face recognition technology indicate its ongoing evolution to maximize its potential in various domains.

2.3 Machine Learning

Machine learning, a subset of artificial intelligence (AI), employs algorithms to enable systems to learn and recognize patterns akin to the human brain [8]. It grants machines the ability to independently learn and analyze problems. There are three main categories of machine learning: supervised, unsupervised, and reinforcement learning, Supervised learning involves using labelled features during the learning process, such as training a model with labelled image data [8, 9]. In contrast, unsupervised learning does not rely on predicted outputs and instead allows the model to autonomously simulate human brain processes until it achieves its objective [8, 9]. According to [8], machine learning demonstrates high recognition rates and robust scalability, which is supported by [9], indicating that algorithms like Principal Component Analysis (PCA) and Support Vector Machine (SVM) outperform others like Naïve Bayes in terms of accuracy. To summarize, machine learning is a potent tool that enables systems to learn and recognize patterns similar to the human brain. This technology holds immense potential across various fields and will continue to shape the future of artificial intelligence.

2.4 Deep Learning

Deep learning, introduced in 2006 according to [5], has rapidly evolved and developed since its inception. As mentioned in [8], it is one of the earliest applications in image processing that imitates human-like object recognition. [6] highlight the advantage of deep learning in learning hierarchical representations of the world, reflecting a sequential system. These findings indicate that the intricate network architecture of deep learning enables effective extraction of complex facial features. Deep learning can be seen as a multilayer network comprising interconnected trainable elements with weights [6]. Inspired by the human brain, deep learning architecture aims to replicate the depth of brain tissue structures by constructing multiple layers of networks to solve problems and express complex functions [5, 6]. In summary, deep learning is well-suited for addressing complex challenges, and employing deep learning algorithms for facial recognition shows promising potential in replicating human-like face detection and recognition capabilities.

2.5 Convolutional Neural Network

The convolutional neural network (CNN) is a widely utilized deep learning algorithm that was initially introduced by LeCun for handwriting recognition [2]. CNN finds extensive application in image and face recognition, as mentioned in [7] and [10]. The CNN algorithm employs convolution methodology to extract features from input data, resulting in an increased number of extracted features. As outlined in [10], the primary objective of CNN is to obtain abstract features as the input data progresses through deeper layers. CNN is classified as a feed-forward or sequential neural network, consisting of multiple layers that receive input information and produce output for each layer. The typical layers found in a CNN structure include the convolutional layer, nonlinear layer, pooling layer, and fully connected layer [10]. Figure 2, illustrated in [11], provides a schematic representation of the structure of a convolutional network.

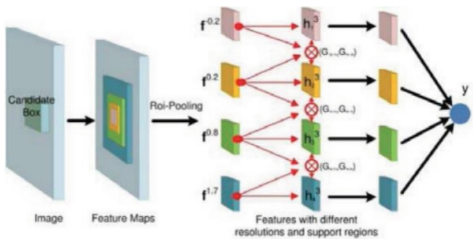

Fig. 2. CNN Schematic.

To conclude, CNN is a widely used algorithm for image recognition, particularly in face recognition. This is due to its unique layers - including convolution, non-linearity, pooling, and fully connected layers - which enable the processing and execution of complex processes while maintaining a lower number of parameters than traditional artificial neural networks.

1) *Convolutional Layer*
   In convolutional neural networks (CNNs), the convolution layer plays a vital role in processing image data [6]. As highlighted in [7] and [10], the convolution layer is responsible for extracting features from images, regardless of their positions. This characteristic is particularly valuable in face recognition applications, where facial

features can appear in varying positions within an image. Hence, the convolutional layer is an essential element of CNNs for face recognition as it allows the model to learn and extract important features from input images, enabling the identification of individual.

2) *Nonlinearity Layer*
In neural networks, a nonlinearity layer, also known as an activation function, is employed to modify or restrict the output of the networks, preventing them from exceeding certain boundaries or becoming excessively extreme [10]. These nonlinear characteristics play a vital role in achieving accurate face recognition, particularly when dealing with variations in facial expressions and poses. While not obligatory, incorporating a nonlinearity layer in the network aids in capturing complex relationships between the input image and the associated features, resulting in improved accuracy and reliability of face recognition outcomes.
3) *Pooling Layer*
According to multiple studies [5, 7, 10, it is widely acknowledged that the pooling layer plays a crucial role in reducing the dimensionality of input images while retaining important features that are critical for achieving accurate outcomes. In face recognition applications, it is vital to extract features that are resilient to variations in poses and expressions while simplifying the input for efficient processing by subsequent layers.
4) *Fully Connected Layer*
The Fully Connected Layer (FCL) is responsible for taking the outputs from preceding layers, e.g., convolution, pooling, and non-linearity, and utilizing them as input for a classifier. However, the FCL is associated with a notable drawback due to its large number of parameters, leading to computational complexity [10]. To mitigate this issue, techniques like dropout can be employed to reduce the parameter count and enhance computational efficiency. In face recognition applications, FCLs are employed to transform the features extracted from previous layers into an output that represents the predicted identity of the input image. To address the challenges posed by the FCL, techniques like dropout can be employed to reduce parameters and mitigate overfitting.
5) *Transfer Learning*
Transfer learning involves the utilization of a pre-trained model as a foundation to train a new model. This method has been emphasized for its efficacy, as highlighted by the scholarly works of [12] and [13]. The essence of transfer learning revolves around capitalizing on pre-trained models like LeNet-5, VGG-16 Net and others [13], which have already learned meaningful features from large-scale datasets, resulting in substantial time and computational resources saving.

A prominent advantage of transfer learning is its ability to attain high accuracy with less data and computation. Pre-trained models lay a robust foundation, encapsulating general knowledge that can be tailored to specific tasks. This is especially valuable when the data for the target task is limited. Transfer learning has demonstrated its utility in various domains, including medical image analysis, where it has shown promise in achieving high accuracy [13].

In conclusion, transfer learning expedites the training process, enhances model performance, and reduces the need for extensive data and computation. Its adaptability makes it an invaluable tool in the fields of machine learning and deep learning research.

3 Methodology

Applying the flipped classroom methodology in an Artificial Intelligence (AI) subject can be an effective way to engage students and enhance their learning experience. The flipped classroom approach involves shifting the traditional lecture-based learning to a more student-centered model, where students engage with course materials and activities outside of class, and class time is used for interactive discussions, problem-solving, and collaborative work. Flipped classroom techniques can be achieved by:

i) Define learning objectives where students need to define learning objectives for every topic delivered weekly. Specific concepts, skills, and knowledge areas are determined throughout the course.
ii) Pre-recorded lectures are prepared for students to watch outside the class. The content of pre-recorded lectures should cover the objectives for each topic covered.
iii) Assign pre-class activities related to pre-recorded lectures including quizzes, exercises and hands-on programming activities.
iv) In-class activities such as group discussions, presentations, hands on projects and problem-solving sessions.
v) Assessing learning outcomes is important to ensure that the assessments align with the defined learning objectives.
vi) Continual improvement to make sure the learning experience runs smoothly. Feedback from learning output are used to make necessary adjustments to the course contents and activities.

A final year project on predictive analytics has been implemented using flipped classroom techniques. For each project development, each phase was implemented using flipped classroom techniques as mentioned above. The continual improvement was applied to the project output to increase the accuracy and performance of the analytics model. To implement a predictive analytics face recognition project, a predictive analytics model using deep learning algorithm was developed. For face recognition, a deep learning model which is Convolutional Neural Network (CNN) was adopted. CNN is widely used for learning and extracting meaningful features from images, making them well-suited for face recognition applications. The first phase to apply CNN algorithm for face recognition is dataset preparation.

The dataset employed in this study includes photographs sourced from two distinct sources: Labelled Faces in the Wild (LFW) and images of nine undergraduate students from UTP. The LFW dataset encompasses more than 13,000 colored JPEG images of faces collected from the Internet. These images generally have an average size of 250 $\times$ 250 pixels. Figure 3 showcases a selection of facial images belonging to different individuals obtained from the LFW database.

This project has gathered a dataset consisting of 332 unprocessed images distributed among 19 distinct classes. Each class contains a varying number of images, ranging

Fig. 3. Some face images of different individuals of the LFW database.

from 13 to 20. The collected images undergo an image preprocessing phase. The dataset is split into a training set, comprising 65% of the images, and a testing/validation set consisting of the remaining 35%.

The second phase of the CNN algorithm for face recognition is modeling, where a model is designed and trained to learn the features of the input image, such as the shape of the face, the position of the eyes and the nose.

The proposed model utilizes VGG-19 and Xception as pre-trained models for implementing the transfer learning technique. The proposed model consists of several key components, including a functional layer (VGG-19/Xception), two convolutional layers followed by a ReLu activation function, one max-pooling layer, a flatten and dropout layer, and two dense layers with Softmax serving as the classifier.

Model evaluation is the third phase of the CNN algorithm, where the trained model is evaluated based on the chosen evaluation metrics.

Two models were constructed using different pre-trained models. The performance of the proposed models was evaluated based on accuracy, top-1 error, and top-5 error. The top-1 error rate measures whether the top predicted class matches the target label, while the top-5 error rate assesses whether the target label is among the top five predictions.

The models are subjected to training and testing to evaluate their ability to accurately identify individuals form the given input. Table 1 presents the results and offers a concise overview of the structure of the proposed models.

Table 1. Results of proposed models

Model	Parameters				
	Pre-Trained	*Batch Size*	*Top-1 Error*	*Top-5 Error*	*Accuracy*
1	VGG-19	32	90.74%	76.85%	65%
2	Xception	32	93.52%	70.37%	66%

The last phase of the CNN algorithm is deployment, where the trained model will be deployed into a production system to provide face recognition functionalities.

Considering the lower top-5 error and slightly higher accuracy of Model 2 (Xception), it demonstrates better performance in correctly identifying the target class within the top predictions. Therefore, Model 2 is the preferred choice to be deployed as the back end for the prototype system web application. Figure 4 shows that the web application is successfully integrated with the system to provide a working prototype.

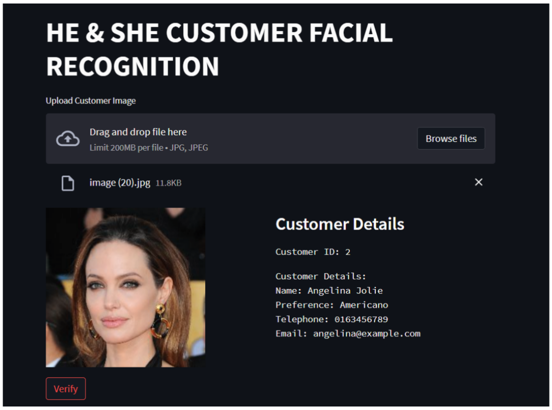

Fig. 4. Interface of the web application prototype.

4 Conclusion and Future Work

The flipped classroom approach required detail planning and techniques. It is essential to create a supportive and engaging learning environment that encourages active participation and collaboration. By implementing the flipped classroom methodology in AI related courses, deeper understanding, critical thinking, and practical application of AI concepts among students can be offered. Facial recognition system is one of the case studies implemented using flipped classroom technique and has shown a good performance output and evaluation. The model that has been trained was able to classify and identify customers based on their facial features and labeled images of their faces. The model was successfully able to verify the status of the customers.

With the advancements in science and technology, facial recognition systems have gained popularity, particularly in the security industry. However, other industries like food and beverage have yet to explore the potential benefits of this technology. Hence, the author proposes implementing a facial recognition system as an advanced loyalty program for He & She Café at UTP. The proposed system utilizes a convolutional neural network algorithm, consisting of eight layers: a functional layer, two convolutional layers, one pooling layer, one flatten layer, one dropout layer and two fully connected layers. Two models are trained using 332 images from the combination of LFW database and photos of nine undergraduate UTP students, and one of them is selected as the preferred model to be deployed into a web application prototype. Although the evaluation results show that the model did not achieve the desired accuracy, it still exhibited correct predictions. Therefore, further refinement of the model is necessary to improve its accuracy.

Despite the progress made, there are limitations and areas for improvement to develop a robust model capable of accurately predicting customers' faces. Recommendations include increasing the size and quality of the training dataset, modifying the layers of the model, hyperparameters tuning and continuously testing and evaluating the model until it achieves the highest possible accuracy. Additionally, reducing the time required for face recognition and verification should be a priority for future work. Once the model reaches the desired accuracy level, it can be deployed as a functioning system.

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The Impact of Multimodal SDGs-Related English Storytelling among, University Volunteers

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Abstract. The present research examines the impact of multimodality approach of digital storytelling (DST) on university students who volunteered for an international University Social Responsibility (USR) project. In this study, DST was realized in the form of a community engagement project integrated in partnership between two universities namely Universiti Tenaga Nasional (UNITEN) in Malaysia and Ming Chi University of Technology (MCUT) in Taiwan. The project was intended to promote English language via digital English storytelling among elementary school children in both countries. A total of 20 university students comprising 8 undergraduates and 12 post-graduates were recruited as storytellers for the project. They attended a three-day seminar on English storytelling in MCUT, Taiwan to prepare for the responsibility. The students were required to work in small groups of four to create their digital stories in the target language, English, incorporating 2–3 Sustainable Development Goals (SDGs). In total, the group of storytellers completed 5 sessions of storytelling in Taiwan and another 5 sessions in Malaysia. A semi-structured interview was conducted among the storytellers at the end of Phase 1 (Taiwan) and Phase 2 (Malaysia) to explore possible impacts of their involvement in the English digital storytelling activity as well as learning points gained from the experience. The findings reveal 4 overriding themes for meaningful learning opportunities gained from their involvement in the project and another 3 emergent themes related to the digital landscape. Future implementations of international community engagement projects among universities is recommended to discover possible new impacts for university students.

Keywords: English storytelling · digital storytelling · community engagement · university students

1 Introduction

University education entails more than learning from within the four walls of a classroom. Nowadays, university students benefit from learning opportunities provided via university international collaborations and experiential learning initiatives which includes

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involvement in community engagement projects, corporate social responsibility (CSR) and university social responsibility (USR) programmes. This type of experiential learning relates to adult education principles appropriate for university eco-system. When university curriculum is complemented with real-life practice, students can implement what they have gained in the classroom, and explore new experience, knowledge and capabilities.

Learning is not limited to studying and receiving knowledge and skills, but also giving to the community. This study aims to examine the impact of university student involvement in an international community engagement project promoting digital English storytelling to primary school children. The USR project was organized by two universities namely Universiti Tenaga Nasional situated in Malaysia and its international partner, Ming Chi University of Technology (MCUT), which is situated in Taiwan. The researchers seek to determine if the students involved in the community engagement project have gained some significant impact from their international community engagement experience. Therefore, the guiding questions of this study are: a) What are some learning points that you have gained from the experience? b) How can digital storytelling skills help you now and for work/ employability?

2 Literature Review

2.1 Education in the 21st Century

The 21st century can be imposing on university students particularly in meeting local and global challenges like Industry 4.0, exponential economy, and social dilemmas. Graduates are confronted with employability issues and changing expectations at the workplace. Among the top demands which is closely related to educational contexts is talent and expertise in digital technology and multimedia literacy [1]. In fact, digital narratives and multimodal texts have become the norm nowadays.

University curriculum today has become more dynamic encompassing not only curriculum but also learning opportunities beyond the classroom. There are many community engagement projects organized as a collaboration between institutions of higher education and their larger communities for exchange of knowledge and resources [2].

Volunteerism among university students goes beyond local collaborations and is often linked to care, citizenship and social responsibility [3]. Similarly in Malaysia, universities provide a platform for students to acquire competencies outside the classroom for professional and personal development [4].

2.2 Digital Storytelling

This USR storytelling project aligns with the constructivist concept of learning which entrusts students to curate their own experience. Learning in constructivist environment embraces a social activity that encourages students to share ideas, help and encourage one another, work in groups as well as engage in conversations, discussions and collaborations [5]. To make the initiative more relevant with contemporary educational USRs, the project includes the multimodal approach which advances digital storytelling combining digital media with creative teaching and learning.

Digital storytelling for educational purposes is based on constructivism, which can be a powerful tool [5]. Animation-based digital storytelling is seen as a strategy to enhance communication and English language learning with multimodal resources in a variety of language use contexts [6–8].

This way, storytellers can employ various modes of communication to express their message and creativity which includes language, gesture, images, music, dress, etc. Utilizing digital multimodality, students can produce works by combining several available resources like texts, images, hyperlinks, emoticons, drawings, and photographs [9].

3 Research Methodology, Data Collection and Participants

This study is exploratory. Both researchers gathered data on students' experience creating and delivering digital English storytelling for the USR project. Therefore, the qualitative approach seemed the most appropriate utilizing in-depth individual semi-structured interviews as data collection instrument.

Furthermore, the researchers employed purposive sampling to understand and gain insight from a sample from which the most could be learned (Merriam, 2009). In the context of this study, the most convenient sample to illuminate the research questions was students who volunteered as storytellers for the USR project.. Thus, twenty students representing MCUT and UNITEN were approached and invited to participate in the study.

All 20 students expressed interest in participating in the study. 18 participated in semi-structured interviews in August 2023 after they completed Phase 1 (Taiwan) and Phase 2 (Malaysia), after which data saturation was reached. The first author arranged for audio-recorded interviews based on corresponding research questions.

For the purpose of data analysis, the audio-recorded semi-structured interviews were transcribed and subjected to thematic analysis [10]. The researchers read through the data multiple times, divided responses into segments/categories of information, then labelled them with codes and finally collapsed codes (similar codes) into themes relevant to answering the research questions.

3.1 Storytellers

The USR project delivered a total of 5 storytelling sessions in Taiwan and another 5 storytelling sessions in Malaysia. This also means that the group had to write 5 stories which relate to the 17 SDGs. Consistent with the constructivist approach to learning, student volunteers were divided into 5 groups with 2 representatives of MCUT and UNITEN in each group.

Selection for MCUT student volunteers was handled by MCUT International Office. All students comprising masters and PhD students were invited to attend an interview for selection, and 10 qualified for the project. As for UNITEN, selection was handled by the Edu-tourism Unit, College of Continuing Education. The invitation for participation was sent to all students and 58 students attended the interview. Finally, 10 students were selected to represent UNITEN storytelling team.

In total, the USR English Storytelling team consisted of 20 university students with 11 post-graduates and 9 undergraduates. The nationalities is diversified which includes 1 Indian, 1 Pakistani, 2 Thai, 2 Vietnamese, 2 Taiwanese, 3 Indonesians, and 9 Malaysians.

3.2 Selection of Schools

- To begin, both MCUT and UNITEN decided on neighbourhood areas for the USR English Storytelling project.
- Ming Chi University of Technology (MCUT) has chosen New Taipei City as location with three elementary schools namely Taishan Elementary School (June 5, 2023), Tongrong Elementary School (June 7–8, 2023) and Yixue Elementary School (June 7, 2023). One of the schools is a smart school. All three schools are near to the university with access to public transport. This makes it convenient for the storytellers to travel by themselves to the schools as per schedule.
- As for Universiti Tenaga Nasional (UNITEN), the areas selected are Putrajaya and Selangor. The first school in the list is Sekolah Kebangsaan Putrajaya Presint 16(2) (August 7, 2023) which is situated close to the university. Another school which is Sekolah Kebangsaan Dato' Abu Bakar Baginda (August 9, 2023) is in the neighbourhood. It is located in the village called Kg Dato' Abu Bakar Baginda where UNITEN often conducts CSR projects like UNITEN-UMW bamboo tree planting, Sg. Air Hitam River Clean-up and Mudball River Revival. It is also the location for UNITEN Edu-tourism. The third school is Sekolah Kebangsaan Sungai Tua Baharu (August 10, 2023). It is related to UNITEN for UNITEN-MyCOLD PEKASA River Clean-up project at Sungai Tua and academic research at Batu Dam. UNITEN has arranged for bus trips to take the storytellers to all the schools due to varying distance.
- Both UNITEN and MCUT adhered to the school procedures in order to conduct the USR programme in the school involving school children. This includes arrangement for class hours as each storytelling session requires a total of 90 min which entails two class periods. Some schools conducted the sessions in regular classrooms, while several schools offered bigger space like the library and school hall.
- As basic requirement, all schools should provide wide screen, projector, computer, PA system and 2 microphones. All schools agreed with the request.

3.3 Training

Most of the students have experienced storytelling in school, in their village, or at home with younger siblings. However, they have not received any proper training to prepare digital storytelling materials nor equip themselves as storytellers. Since they passed the interview, it is good indication that they have some talent in telling stories i.e. tone, modulation of voice, and facial expressions. Also, they show interest in handling primary school children.

Selection was made slightly earlier for UNITEN students. With ample time to prepare for the international trip to Taiwan, the college managed to conduct a special workshop to equip students with the essential skills on Content Motion-graphics. Students learned how to design attractive slides, set backgrounds, split frames and insert motion-graphics for the characters and illustrations.

When the USR project commenced in Taiwan on 1st June 2023, students had to go through a compulsory three-day Storytelling Seminar. The seminar provided training to equip students with necessary knowledge and skills related to storytelling and Sustainable Development Goals (SDGs). The SDGs which is also known as Global Goals were introduced by United Nations in 2015 in its aim to end poverty, protect the planet and attain peace and prosperity by the year 2030. There is a total of 17 SDG goals, and the USR Storytelling project would ensure that all the goals are included and embedded in the stories. Also, the students used the opportunity to work in their groups to create SDGs-related stories with close guidance from the trainers. The 3-day seminar followed the schedule given below (Table 1).

Table 1. Seminar on storytelling

Day 1	Introduction to 17 Sustainable Development Goals (SDGs) English Storytelling Elements and Skills
Day 2	Brainstorming ideas for Storytelling Sessions Ensuring 3 SDGs and content motion-graphics Make powerpoints in small groups
Day 3	Finalize powerpoints in small groups Group Presentations

Time was limited for the seminar as it was only conducted during the day; nevertheless, students instantly developed motivation to produce effective slides in their small groups. With good cooperation among members, they were seen to push limits and practised the storytelling until the presentation day.

3.4 Storytelling Sessions

- In each country, the students were scheduled to deliver a total of 5 sessions of storytelling. They also had to prepare 5 stories with SDGs embedded. Hence, two of the schools would carry out two sessions of storytelling.
- It was agreed with the schools that the storytelling sessions would be suitable for children in Primary three and Four; hence, the schools tried hard to accommodate this specification.
- While one group is on duty as storytellers, the rest of the team would stand around the classroom to support the story or assist the children.
- The storytellers conducted three stages of the storytelling session: 1) set induction (vocabulary, introduction to context) 2) storytelling (slides, narration, acting, props, music) 3) activity sheet (questions to check understanding, SDGs, application). Throughout the session, the students were reminded to invite active participation from the children.

4 Findings and Discussion

Thematic analysis of student interviews revealed that all university students who were involved with the USR English Storytelling project have gained significantly from the experience. Further, the students discovered that they could still learn new applications and implications of the digital technology.

4.1 Research Question 1: What are Some Learning Points that You Have Gained from the Experience?

There are 4 overriding themes for Research Question 1. Firstly, the students realized that learning can also take place outside the classroom. As presented in Table 2, Student #5 mentioned that one of the schools in Taiwan keeps a farm at the backyard for real-life learning experience. In fact, the whole class visited the farm after the storytelling session about animals. Although learning outside the normal classroom is feasible, Student #13 highlighted that classes carried out outside the classroom should perhaps be planned carefully so they would be exciting and interactive.

Table 2. Theme 1

Theme	Selected Interview Excerpts
Learning can take place outside the classroom	One learning point would be that of conducting activities in places other than a standard classroom. For example, there was a school in Taiwan that had a Mini Farm in the school. During a storytelling that involved animals in the jungle, we were given the opportunity to explore the Mini Farm while promoting the awareness to keep our ecosystem safe from destruction in order to protect these animals from extinction. (S1) In the classroom, most of the knowledge were shared based on theoretical. Though there are some that involve project and presentation, students will only get few skills built due to the circumstances which they only need to work around people they know and comfortable with, which is their friends and lecturers. Through volunteer program outside the classroom, the learning can be lifted into bigger aspect. (S6) … it has to be a fun way to teach and interact with the children for example learning SDGs and English through storytelling (S13)

The second theme that emerged from the analysis is a common challenge in any international team. In the context of this USR project, each storytelling team consists of 7 nationalities. In the beginning, it was quite difficult for the students to acclimatize with members from different background and cultural practices. They had some difficulties with language (Student #17) and dealing with different perceptions and ideas. Over time, they could blend with each other and achieve unity in diversity (Table 3).

Table 3. Theme 2

Theme	Selected Interview Excerpts
Unity in Diversity	I gain new knowledge from different perspectives. People from around the world I've met including Taiwan, Vietnam, Thailand, Indonesia, Pakistan, India and many more… when I meet different people from different background, I was able to learn and understand different perspectives and point of view. I may point out A is a great option, while my friends' view is vice versa (S5) I have learned cultural differences between Malaysia and Taiwan. It is interesting to learn how we are near but so different in various aspects such as food because of our historical differences. I also learned how to interact with foreigners. Learning to welcome them with a minor language barrier is very hard but fulfilling (S17) Interacting with students from Taiwan and Malaysia exposes you to different cultures, traditions, and languages. This experience fosters cultural awareness and sensitivity, helping you appreciate and respect diversity. It also teaches you the importance of adapting your storytelling approach to suit different cultural contexts (S3)

The third emergent theme is unique for the project as illustrated in Table 4. Based on the findings, many students expressed relief that they could finally understand children learning habits and behaviours particularly in the classroom. The common challenge with children is short attention span, and that they would appreciate active learning and exciting ideas. Realizing this situation, Student #13 even brought a lightsaber as prop for the storytelling session to gain more attention from the children. It was a huge success.

Table 4. Theme 3

Theme	Selected Interview Excerpts
Understand children	It helps you understand that the challenges and aspirations of young learners can be quite similar regardless of where they are from. You learn how to tailor your storytelling to cater to the age group's cognitive development, attention span, and learning styles (S3) I've learned that the kids love listening to stories, I mean when I was little I was the same ^-^. Storytelling is a creative way to interact with the children and teaching them values. Of course, the story has to be exciting as well. Put aspects that kids would love to see like violence >:). My story had a fight scene where I pull out my lightsaber and fight my teammate. In both countries, that scene was loved by majority of the children (S13) I have learned about how to handle the kids in the class and how they choose to express the feelings and creativities through the body language including how they communicate with us (S16)

The final theme regarding learning points that students have gained from their involvement in the community engagement relates to their communication skills. Table 4 below illustrates aspects of communication skills that have improved over the duration of the USR project for over 3 months. This includes engaging with young audience, use of body language and facial expressions, as well as enhanced confidence in delivery and presentation (Table 5).

Table 5. Theme 4

Themes	Selected Interview Excerpts
Enhance communication skills	Storytelling is a powerful tool for communication. Through this experience, I refine my communication skills, learning how to convey complex ideas and concepts in a simple and engaging manner, suitable for elementary school students. I also gain insights into effective non-verbal communication, such as body language and facial expressions (S3) The act of sharing a story can improve communication skills, including the ability to convey emotions, engage an audience, and articulate ideas effectively (S4) I get to broaden my interpersonal skills. Meeting with new people, learning how to blend in and communicate with new people. This volunteerism activity boosts my confidence level and help me in my working life. Through volunteerism, I get to learn about community and work together with ethics (S6) It is an amazing project that gives me opportunity to learn how to attract attention of crowd and convey ideas to other people simply (S15)

To conclude, it can be deduced that students who participated in the community engagement project have gained benefits on professional and personal basis. Experiential learning implies learning that take place outside the classroom, and this approach has been proven effective at appealing to diverse groups of students [11]. It enhances non-cognitive skills and develop proficient English speakers and young, creative thinkers [4, 6]. Most importantly, as this project has a unique audience namely children from elementary schools, it is interesting to note that the students have understood children's learning habits, attitude and behaviour over time.

4.2 Research Question 2: How Can Digital Storytelling Skills Help You Now and for Work/Employability?

The findings present 4 emergent themes that capture the impact of digital storytelling skills among the university students in the project. Table 6 below shows that the students have learned and discovered new ways and platforms to assist them in the creation of the stories. This reiterates the significance of multimodality in curating exceptional ideas and presentation that would appeal to the children.

Table 7 below illustrates a very interesting impact among the students which is effective communication. Indeed, students learn that they have to think of creative,

Table 6. Theme 1

Theme	Selected Interview Excerpts
Expand knowledge on digital technology	Other than that, we also learned to utilise powerpoint to create our stories. I wouldn't say I'm a pro at this multimedia task, but I know the basics and the traits to make our product more interesting (S13) Working with technological devices for us Gen Z students is no longer strange. However, after the recent trip, having to work with children, I felt even more effective when presenting with supporting technical tools such as sound, images, video,… very lively moving and inspiring! (S14) … when preparing the power point slides, we can use captivating motion and sound effects to enhance the quality of the slides. (S1) Improve my curiosity. I realized that whenever I do some digital task related, I always learnt something new most of the time. I finally know platform I can use for a better design, platform for better enhance and quality and many more. Digital world is more than what I imagined, I'm ready to explore more this accessibility when the upcoming event comes occur (S5)

effective and attractive ways to compose their ideas and deliver the stories. Materials will have to grab the attention of children immediately, and delivery will have to be "engaging and memorable" (Student #12). Particularly when the audience is young like the children in the USR project, presentation materials and style will have to be precise and concise, as minimal as possible.

Table 8 below depicts the students' concern for employability and job skills. Student #8 started working immediately after the project ended in August 2023. As a young engineer, he reflected on the positive impact of his presentation experience gained from the project against workplace environment ad expectations. Student #6 claimed to have discovered how to work with technology based on the digital landscape provided in the USR project. Another compelling and competitive value for employability is creativity. On this note, Student #13 was glad to have honed his creative skills in curating a suitable story for the children. In short, today's digital era seems to be technology-driven, so having digital skills and the ability to shape the future of workplace is the next competitive edge for university graduates.

The abovementioned findings relate to the fundamental role of technology in education nowadays. As the technological knowledge and skills become mainstream in schools and universities, it becomes necessary for university students to keep updated and become familiar with as many platforms as possible as highlighted by Student #6. In

Table 7. Theme 2

Theme	Selected Interview Excerpts
Effective communication	Creating presentation slides for the children helped me understand the importance of having easy-to-understand presentation slides because not only does this apply to children, but also in the future with employers (S11) Digital storytelling skills teach you how to convey information and ideas in a compelling and engaging manner. Effective communication is a critical skill in virtually every profession. Whether you're presenting a project proposal, leading a team, or communicating with clients, the ability to tell a compelling digital story can set you apart (S3) The key to digital storytelling is to have minimal but interesting content within the slides which enables detailed verbal explanation. Much like now, or for work, employers would appreciate if the content within the presentation slides is kept at a minimum which makes it easier for them to navigate through the points (S11) Increase the effectiveness of communication. It can be used to share information, ideas, and emotions in a way that is engaging and memorable. This is extremely useful especially for marketing, sales or advertising job (S12)

Table 8. Theme 3

Themes	Selected Interview Excerpts
Competitive edge	As now all industries are operating with high reliability on technologies, this experience has given me an insight on how to adapt with the current demand of the industry. Also, creating own slides and presentations does help me to boost my creativity and challenge me to think critically on how to work with technology (S6) It helps me in terms of presenting my projects to supervisors in a more interesting yet easy to understand way. This further improves my quality as a skilled engineer (S8) In terms of creativity, I definitely would have an advantage… Together, my friends and I came up with a story that will share the importance of SDG and learn english while also creating a fun atmosphere where the kids can learn happily. I would say that will definitely help with my work skills (S13)

the case of digital storytelling, stddues have found it as an effective tool to support learners' language learning and digital skill acquisition which calls for training programmes for multimodal pedagogy [12, 13].

4.3 Conclusion

The SDG-s related English storytelling USR project was aimed to promote English storytelling as language enrichment activity among primary school children. In tandem with the current advancement and dependence of technology in education, the project keeps abreast with the digital landscape by introducing digital storytelling.

As storytellers, the university student volunteers had to prepare effective stories for the audience. Since they do not major in education nor child psychology, they have to understand children habits, attitude and behaviours from reading, discussions and observation. Indirectly, the project was a learning experience for them too. This impact gives them a valuable experience as reflected in the following excerpt:

> I don't think the content in the book can give me a profound experience, but after actually participating in the activity, in addition to memories, this project and the stories of each group are unforgettable to me (S9).

Another impact shared by the student volunteers relates to the use of technology in the project. Youths nowadays are very familiar with technological updates, so digital environment may not impose any challenge. Nevertheless, digital English storytelling for children is a new experience as they had to discover the multimodalities of digital storytelling to meet the expectations of the young learners. This is illustrated in the following excerpt:

> Working with technological devices for us Gen Z students is no longer strange. However, after the recent trip, having to work with children, I felt even more effective when presenting with supporting technical tools such as sound, images, video,… very lively moving and inspiring! (S14).

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Unraveling the Benefits of International Exchange Program: Perspectives of Students

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Abstract. This phenomenological study aimed to explore the impact and benefits of an international student exchange program between a university in Malaysia and Thai-land. The study extended over a duration of two weeks, involving a total of 18 participants who were registered full-time students at the university. The participants selected were from various courses and majors as to ensure a diverse representation. Individual surveys, interviews, testimonial video clips, and essays were employed as part of the data collection methods. These varied methodologies encouraged sharing of experiences, reflections, and recommendations for enhancing the program outcomes. The findings of this study discovered that the participants benefited in the program as they experienced a unique opportunity to widen their intercultural understanding and learned to appreciate other cultures in our inter-connected world. Moreover, the program also facilitated the realization of inter-personal relationships among participants and allowed them to engage in new experiences. Notably, the participants offered a wide range of valuable recommendations to improve future implementations of the program. Their suggestions focused on refining the activity schedule, enhancing pre-trip preparation and bonding activities, and further optimizing educational outcomes to maximize the bene-fits for all participants.

Keywords: intercultural exchange · student experience · culture diversity · education

1 Introduction

One promising prospect for students to expand their educational perspectives and cultural understanding beyond the conventional learning environment is by participating in a student exchange program. These programs provide students with a unique opportunity to venture beyond their home institutions and immerse themselves in diverse educational environments offered by host universities in foreign countries [1]. This immersion is not merely about attending classes; it's a comprehensive experience that includes cultural exposure, language acquisition, and personal growth. They have been evidenced to change attitudes, enhance intercultural competence and form institutional as well as

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intellectual networks [2]. The involvement of students for these foreign student exchange program has the capability to alter students' worldviews and behaviour in their lives. By providing significant exposure to a variety of cultures, perspectives, and ways of life during the program, it is able to foster a more open and inclusive mindset for these students. In addition, the students are able to embrace diversity and appreciate the richness of global cultures. The necessity to live and study in a foreign country during the program accords to the adaption of new norms and cultures, communication across language barriers, and steering in unacquainted social settings. These challenges allow the students to cultivate better well-rounded education and interpersonal skills for workplace in the future. Furthermore, student exchange programs create opportunity for the students to form valuable international rapports and friendship beyond academic learning. Diverse international relations ranging from peers, professors, and professionals from around the world can be established for future collaborations that generates boundless prospects for the students and the universities.

The significance of international exchange programs lies in their potential to go beyond traditional classroom learning and offer a comprehensive range of educational outcomes. As the student engages in real world experiences that encompass diverse cultures, language and learning environment in the exchange program, they are able to incorporate deeper and meaningful educational outcomes beyond textbooks. Besides that, it provides an essential avenue for fostering cross-cultural understanding, promoting academic growth, and nurturing personal development among students [3]. When students immerse themselves in a foreign culture, they are exposed to different ways of life, traditions, and worldviews. These experiences help creates an avenue to remove stereotypes and boosts appreciation of diverse cultures in the interconnected world. In addition, as the students ventures into different universities for the exchange program, they are able to experience different teaching and learning methodologies as well as wide-ranging academic perspectives. This exposure can help the students intellectually to develop better critical thinking skills and adapting to new academic norms easily in their future undertakings. The character of each students can be developed for better resilient and self-confidence as they venture into a new environment and leaving their comfort zone. They may learn to be more independent and develop better problem-solving skills through these transformative learning experience in the exchange program.

The primary aim of this research was to explore into the valuable benefits perceived by students through the implementation of intercultural exchange programs. Specifically focusing on short-term activities, this study sought to explore how these programs provide exceptional opportunities for undergraduate students to engage in diverse aspects of knowledge management related to English learning, dialects, culture, religion, folk plays, and cooking in the context of Malaysia. These immersive short-term activities intend to provide a concentrated dose of cultural experiences and learning opportunities over a relatively brief period. The learning of new language and exposure to different dialects in the host university provides an opportunity for the students to appreciate linguistic diversity in one's country. The students will also able to expand their cultural horizons through exchange of traditions and customs among participants in the program. Besides that, as the program includes visits to different places of interest, the participants is given the prospect to deepen their understanding on diverse religion and culture of the country. The inclusion of folk plays and cooking activities offers the participants a unique cultural experience through artistic expressions and culinary diversity.

By analyzing the student perspectives, this study aimed to shed light on the enriching experiences that students encounter during their participation in the intercultural exchange program. It sought to identify the ways in which these activities contribute to their educational journey, personal growth, and intercultural competence. Furthermore, the research gathered valuable recommendations from participants to improve future programs. These suggestions were aimed at enhancing educational outcomes and maximizing the benefits for all participants.

2 Methodology

This paper employs a phenomenological research design to explore the impact and benefits of an intercultural student exchange program held at a private university in Malaysia. The study utilizes a qualitative approach to describe the experiences of incoming exchange students participating from a university in Thailand. The students enrolled in the program for a duration of 2 weeks, and the total number of participants was 18, comprising 15 females and 3 males. The sample size for a valid phenomenological study typically ranges from 5 to 25 participants, making it suitable for this research [4, 5]. All participants in the study were Thai citizens and regular full-time students at the university, registered in various courses representing different majors to avoid bias in the research. The participants were selected using a non-probability and convenience sampling approach throughout the research [6, 7].

In order to enhance local language proficiency, participants were required to take language courses which includes the Intercultural Communication, English Language and Communication (Workshop), and Bahasa Malaysia. Besides that, additional courses and activities such as Religion and Culture, Traditional Malaysian Games, Malaysian Food and Cooking, Traditional Malaysian Arts, and local tours were integrated into the program with the aim to foster cultural awareness. The engagement in these cultural events allowed the participants to gain a deeper understanding of Malaysia's cultural identity and norms. The majority of these classes comprised short lectures, hands-on practices, collaborative debates, and engaging events.

The data for this study were gathered using multiple methods, including individual surveys, interviews, testimonial video clips, and essays. Through the surveys, participants were presented with probing questions that encouraged them to reflect on their learning experiences and offer suggestions for enhancing the program. Moreover, as part of the data collection process, participants were requested to create short testimonial videos, wherein they shared their personal insights and reflections about their learning journey throughout the program. These videos served as valuable visual representations of their experiences and added a dynamic dimension to the data collection process. The combination of surveys, interviews, written essays, and testimonial videos allowed for a comprehensive exploration of the participants' perspectives and provided rich insights into the effectiveness and impact of the program from multiple angles.

3 Results and Discussion

The resultant output of this study emphasizes on discovering and underlining the various benefits achieved through the intercultural student exchange programs be-tween universities, while also probing into the recommendations that can further enhance future undertakings. The research is divided into two comprehensive sections, each addressing specific aspects of the study. In the first section, an in-depth analysis is presented, clarifying the multitude of benefits and significance that student ex-change programs bring to the participants. By examining into the experiences and perspectives of the students involved, the research sheds light on the transformative impact of these programs on their personal and professional growth. Notably, special attention is given to the development of intercultural competencies and the bolstering of students' confidence in applying the acquired skills within their future work environments. In the second section, the research probes into a detailed exploration of the recommendations for refining and optimizing future intercultural exchange programs. Drawing from the participants' feedback and suggestions, this section provides valuable insights into the aspects that can be improved to ensure even more enriching and effective student exchange experiences.

3.1 Benefits of Intercultural Student Exchange Program

According to the valuable feedback from the students who participated in the program, it is evident that the experience has brought about significant positive changes in various aspects of their lives. The program has had a profound impact on their personalities, broadening their understanding of different cultures and backgrounds, and fostering strong interpersonal relationship with others. Moreover, the educational aspect of the program has demonstrated significant advantages in enriching life experiences. Further elaboration on how these intercultural exchange program benefits the students and the host university is described in the following findings.

Recognizing Diversity in Cultures and Backgrounds. The participants enthusiastically express that engaging in this program has opened up wonderful opportunities to explore deeper into the diverse cultures and backgrounds of the host country. They have gained valuable insights into various aspects, including language, historical background, politics, traditional games, food, and arts, all of which have contributed to their broader understanding of the host nation's cultural identity and heritage of the community. This immersive cultural exchange has played a pivotal role in fostering empathy and acceptance towards different worldviews and traditions, allowing the participants to embrace the richness of cultural diversity. A participant shared a comprehensive perspective on an interesting linguistic aspect related to culture. Specifically, they highlighted the similarities in using suffixes at the end of sentences to soften the tone and increase friendliness in communication. These finding sheds light on how language and cultural nuances are interconnected, and how certain linguistic features can be used to convey social cues and foster a more amicable atmosphere in conversations. A participant stated:

> *In Malaysia, they often use words like "la" or "ya" at the end of sentences, which is similar to "na" in Thai. It's a way to be polite or friendly in their speech.*

In addition to that, the participants also mentioned that there are interesting similarities between both countries when it comes to food. Both cultures prefer dishes that include carbohydrates as a staple in their meals, and they share a fondness for spicy flavors. A participant stated:

Similar to Thailand, rice and noodles are the main staples in Malaysia, and they are rich in carbohydrates, providing ample energy. The cuisine in both countries is known for its delectable flavors, characterized by a delightful combination of greasy, creamy, and sweet tastes.

The understanding of cultural diversity plays a vital and pivotal role in enhancing communication and minimizing misunderstandings between countries. In today's interconnected world, the significance of comprehending and respecting different cultures cannot be overstated [8]. This skill becomes particularly crucial when we travel to foreign countries or interact with individuals from diverse cultural back-grounds within our own country. By embracing cultural awareness, we can foster better collaborations, strengthen international relations, and pave the way for a harmonious global community in the future.

Fostering Strong Interpersonal Relationship. An invaluable and positive aspect of the program lies in the participants' capacity to engage in meaningful social experiences within the community. Recognizing the crucial role that social networks play in student life, the participants discovered that they could effortlessly form strong bonds with one another. Sharing common interests and participating in various activities during the program facilitated the development of genuine connections and friend-ships among the participants. The participants stated:

During this program, we made many friendships with the enthusiastic, amiable, and caring group of students from the host university. We got along well, shared special experiences, and learned from each other about culture, friendship, and life. We are determined to stay in touch and make our friendship last for a long time.

These social interactions not only enriched their overall experience but also fostered a sense of belonging, making the entire program journey even more enjoyable and fulfilling. The ability to forge such meaningful social connections highlights the program's success in creating a conducive and inclusive environment for students to connect, learn, and grow together which in line with the findings of other researchers [9].

Educational Life Experiences. The participants were filled with excitement at the prospect of meeting new people from diverse cultures and ethnicities who still shared similar personalities. They eagerly looked forward to immersing themselves in new educational and life experiences through these out-of-class activities. A participant stated:

The lifestyles of Malaysians and Thais are not vastly different. While it's true that we have distinct languages, cultures, and backgrounds, what unites us is the kindness and open-mindedness to learn and understand from one another.

The opportunity to engage with individuals from different backgrounds and learn from their unique perspectives was something that truly captivated them. It provided the participants an opportunity to expand their learning horizons, nurture meaningful rapports, and gain valuable life experiences in a new environment. These findings are also found to be in alignment with the other literatures [10].

3.2 Recommendations for Improvement

The participants enthusiastically shared numerous valuable recommendations aimed at enhancing the exchange program and maximizing its benefits. In the prospect of the educational activities, the participants emphasized the necessity of the host university to ensure that the activity schedule is provided in a more detailed and comprehensive means, complete with an exact timetable for each event. This would facilitate all participants to effectively prepare and plan for their involvement in the program, ensuring a seamless and organized experience. The different level of details in the program will enable the participants to effectively participate in the activities as they will be prepared mentally to be fully engage for each program.

Furthermore, the participants highlighted that it is essential to foster bonds between themselves and the host university students before the trip. Therefore, it is highly recommended that additional preparation activities such as ice-breaking or pre-meeting are organized prior to their arrival in the host country. By organizing these preparatory sessions, the participants will have the opportunity to familiarize with one another, thereby fostering a sense of cohesion among themselves. These suggested activities will enhance the overall experiences of the student exchange program by having a supportive and inclusive environment from the initial stage of the program.

4 Conclusion

International student exchange program has the capability of offering a multitude of positive impacts and benefits for its participants. Through the implementation of various intercultural activities, students were given the opportunity to expand their awareness of different cultures and backgrounds, opening their minds to the rich diversity that exists in our interconnected world. The exchange program not only provides involvement on academic pursuits, it is also able to fosters strong interpersonal relationships among participants. Furthermore, the participants were able to enjoy new life experience abroad in the host university. Accordingly, several valuable recommendations have been presented to enhance the benefits of the program for future participants. This program stands as a testament to the power of cross-cultural interaction and serves as a stepping stone towards a more inclusive and interconnected global community.

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Technology-Enhanced Learning

A Preliminary Study on Augmenting Machine Vision Postgraduate Education with ChatGPT: Fostering Learning and Critical Thinking with Advanced Algorithms

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Abstract. This paper presents a pioneering approach to enriching the educational experience in a postgraduate-level machine vision course by integrating ChatGPT, an advanced natural language artificial intelligence (AI) processing model as a tool. Machine vision, a multidisciplinary and rapidly evolving field at the intersection of computer science and image processing, often poses challenges to learners trying to analyse and apply algorithms due to the complexity of comprehending and implementing advanced algorithms. By introducing ChatGPT into the curriculum, students were provided with an interactive, personalized tool to accelerate programming and implementation of advanced machine vision algorithms which allowed them the opportunity to study, apply and analyze these powerful algorithms, promoting both knowledge acquisition and critical thinking skills. In this paper, we discuss the integration process, present case studies demonstrating the advantages of ChatGPT, and outline future directions for this innovative pedagogical approach.

Keywords: machine vision education · ChatGPT · Natural Language Processing · pedagogy · artificial intelligence in education

1 Introduction

Machine vision programming is a critical area of study in the field of computer science and engineering. It involves the development of algorithms and techniques to enable computers to interpret and process visual information, which has applications in various domains such as robotics, healthcare, autonomous vehicles, and manufacturing. Machine vision is a core competency in automation applications of Industry 4.0 [1, 2], in cybersecurity and identity authentication [3] and in a host of consumer mobile applications. Due to its complexity, machine vision programming can be challenging for students to grasp, particularly when they are exposed to it for the first time [4].

Since 2023, natural language processing (NLP) artificial intelligence (AI) models like ChatGPT [5] have demonstrated remarkable capabilities in understanding and generating

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human-like text. Leveraging these models in education can provide students with a more interactive and personalized learning experience. AI has begun to be integrated in machine vision education to improve student engagement and comprehension of technical content [6]. AI may play a variety of roles in the learning journey which are only now beginning to be explore [7]. Conceptually, AI can act as an intelligent tutor, tutee or as a partner in the learning journey [8]. ChatGPT is a disruptive technology that has triggered a worldwide debate on its potentially positive and destructive role in education [9, 10]. In this paper, we explore the integration of ChatGPT into machine vision programming classes to enhance the learning process.

2 Methodology

The integration of ChatGPT into a machine vision class involves several steps:

2.1 Curriculum Alignment

Key topics and concepts in machine vision that students often find challenging were identified and a curriculum plan which integrates ChatGPT at appropriate points in the learning process was developed. Students face significant challenges at the post-graduate level to learn advanced and powerful algorithms to perform image denoising, to extract complex feature representations and to perform reliable object segmentation. Due to time constraints, only fundamental and elementary algorithms can be effectively learnt which are nearly always not practically applicable in modern use cases such as filtering. Two main challenges hinder the learning of advanced algorithms mainly (1) the complexity of the mathematics and algorithm of the (2) implementation of the algorithm in program code. The objective of this study is to apply ChatGPT and demonstrate improved ability of the student to learn and demonstrate competency in a range of advanced algorithms within the course duration of 12 weeks.

2.2 ChatGPT Integration

ChatGPT was integrated into the learning plan of students in 3 specific ways to facilitate learning of advanced algorithms and machine vision concepts. First students were shown how to utilize ChatGPT to develop code to implement an advanced algorithm. A list of advanced algorithms related to image denoising, feature representation and image segmentation was subsequently provided to students who were then challenged to develop program code to implement a selection of these algorithms with the aid of ChatGPT for tutorial assignments. With successful implementations of these algorithms, students were challenged to compare and contrast the performance and justify any advantages or limitations of each algorithm to theoretical concepts. Second, students were tasked to investigate state-of-art AI-enabled algorithms in image denoising, feature representation for classification and image segmentation respectively. Students were challenged to compare and contrast the performance of state-of-art AI algorithms with advanced algorithms developed through the tutorials. Thirdly, students were encouraged to utilize ChatGPT as a personal tutor to supplement their understanding of the selection of advanced machine vision algorithms and AI-enabled state-of-art algorithms, to complement to the instructional materials provided and interactions with the instructor.

3 Case Studies

To illustrate the effectiveness of integrating ChatGPT into machine vision postgraduate class, we present three case studies from this pilot investigation:

3.1 Case Study 1: Extended Coverage of Algorithms

Student A and student B are high performing students working as a team on the tutorial assignments. Student A and B implemented all the listed and recommended algorithms and performed a comprehensive analysis and comparison between them. ChatGPT helped both students to accelerate the software implementation of many complex algorithms, enabling them to learn and develop competency in many more alternative algorithms than would have been feasible without ChatGPT's assistance. As a result, the students were able to incorporate a variety of quantitative assessments of the algorithms which further enriched their comprehension and sense of mastery of the topic.

3.2 Case Study 2: Code Debugging Assistance

Student C had no prior exposure to machine vision and limited programming experience and had significant difficulties writing simple code. ChatGPT helps Student C generate working program code which implemented one machine vision algorithm which the student was able to independently learn and understand and explain on a line-by-line level. ChatGPT assisted the student in identifying beginner level difficulties in writing program code, debugging and correcting errors and comprehending the purpose of each line of code. Student C successfully completes the tutorial at an acceptable competency level and gains confidence in their coding abilities.

3.3 Case Study 3: Improved Understanding and Nuanced Critical Thinking

Student D struggles with heavy workload and unable to devote sufficient time to study the materials. With the help of ChatGPT, the student was able to reduce the time and effort to learn the concepts of machine vision. Student D was able to prepare an insightful and nuanced comparison of the advantages and disadvantages of advanced algorithms versus AI-enabled algorithms with the aid of ChatGPT, thus demonstrating a firm conceptual grasp of the algorithms, their advantages and disadvantages that would not have been possible in the limited course duration without ChatGPT.

4 Discussion

The integration of ChatGPT into the learning activities of the course was a success. Overall, all students demonstrated improved comprehension of machine vision concepts and develop competency to apply and evaluate a broader range of advanced algorithms than typically possible in a semester. Through a series of case studies, we have identified 3 key benefits of integrating ChatGPT into post-graduate courses that enhance the learning experience of open and distance learning students.

First ChatGPT provides personalized learning experience to individual students. ChatGPT can generate explanations and guidance based on individual students needs and progress in response to specific questions about the learning content. This assistance is provided on-demand with 24/7 availability, enabling students to seek assistance at their convenience, which is particularly valuable for asynchronous and remote learning. Utilized as a personal tutor, ChatGPT provides continuous and constructive feedback throughout the semester to promote iterative learning.

Second, in contrast with fears about its potential misuse in academic work, ChatGPT encourages critical thinking as the conversational style of interacting with the tool promotes socratic dialog. ChatGPT encourages students to ask questions and engage in discussions, fostering critical thinking skills as they explore technical concepts in depth. Students can pose open-ended questions, prompting them to explore deeper insights and analyze problems more comprehensively with the aid of conceptual scaffolds generated by ChatGPT. As a new technology, interacting with ChatGPT is engaging and enjoyable which reduces the frustration of learning or understanding complex subject matter and making it more helpful to encourage students to pursue alternative methods of learning rather than traditional textbook study.

Thirdly, ChatGPT removes a critical impediment in the learning of machine vision algorithms. Conventionally, the student's capacity to learn and master an algorithm is limited by their ability to program the algorithm correctly in software. Writing and debugging software code for complex and mathematically oriented remains a challenge for many students and debugging to identify errors in the code is time-consuming and not a value-creating process. ChatGPT has both the capability to recommend code snippets and software libraries to accelerate the development of prototype software code and to identify and explain errors in code created by the student. The feedback provided to the student is immediate and can be iterated as many times until a successful software program is devised. This is a unique and personalized learning experience which is not possible to be delivered via conventional tutorial sessions.

While the integration of ChatGPT into machine vision postgraduate course has shown promising results, there are several avenues for future exploration. There is opportunity to fine-tune the integration of ChatGPT to further enhance learning by adapting ChatGPT responses to the individual student's learning style and progress. The use of ChatGPT can be enhanced by generating self-check and self-assessment questions as an aid to student learning. There is a need for more rigorous evaluation of the benefits and limitations of ChatGPT in the student's learning journey. Presently it is unclear how this evaluation could be performed but the results will be informative towards honing ChatGPT on the specific aspects of learning that is truly beneficial for the student. Finally, the use of ChatGPT in academia has triggered a variety of debates around the ethics of AI-driven education including privacy, bias and accuracy of content. These concerns will need to be carefully identified and methods to mitigate their negative effects need to be developed.

5 Conclusion

The integration of ChatGPT into machine vision programming classes represents a promising approach to enhancing the learning experience for students. By providing personalized, on-demand assistance, ChatGPT can help students overcome challenges in implementing advanced algorithms and open opportunities to accelerate competency and develop a deeper understanding of complex machine vision concepts. As technology continues to advance, the use of AI-driven educational tools like ChatGPT is poised to play an increasingly significant role in shaping the future of higher education especially in accelerating students' ability to implement, study, apply and analyse advanced and complex algorithms.

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A Comprehensive Review of Technology Enhanced Learning – A Pathway to Education 4.0

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Abstract. Currently, technology is developing rapidly, new trends are evolving, and the aspirations of all stakeholders are changing. TEL facilitates novel techniques and tools. However, it is not the only source to inculcate students' understanding. The principal aim of this paper is to perform a critical review of the role of TEL in improving the quality of the teaching and learning process to nurture future talents to position themselves in the changing world. Blended learning is a method developed on the constructivist learning theory, situational awareness, and learning & education dissemination theory that integrates the traditional teaching model with full utilization of modern ICT to achieve the best portfolio of various teaching elements in the teaching process. The development of the Moodle system followed the philosophy of the constructivism theory, which proved to be an effective tool for teaching management globally. It is based on self-instructed modules that offer a user-friendly learning environment. Education 4.0 has brought the blueprint for education in the era of Industry 4.0. It integrates humanist ideas with the digital world.

Keywords: Technology Enhanced Learning · Blended Learning · Moodle · Education 4.0

1 Introduction

It is recognized that learning and developing a person requires four essential elements: brain, mind, experience, and school. Since the beginning of modern civilization, the intrinsic properties of matter, how the universe originated, and how the human mind works are profound, thought-provoking questions [1]. Until now, such questions have been challenging to catch; one of the reasons could be the absence of powerful research tools. With the beginning of the 21st century, the world is extensively outpouring scientific research on the mind and brain, the processes of thinking and learning, and competence gain [1]. Therefore, in the last two decades, such efforts have revolutionized the study of the mind, which has significant educational implications. However, the emphasis on the new learning theories urges innovative approaches to curriculum design, teaching, and assessment rather than conventional teaching and learning methods [1]. According to John Dewey [2] quotation. "If we teach today's students as we taught yesterday's,

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we rob them of tomorrow." In explaining his quote, Dewey simulated the development of instruction methods and structure with how technologies develop. As a result of the progress in the instruction process, it should aim to reestablish inputs after a certain period [2]. Figure 1 illustrates various techniques that could be purposefully chosen to achieve the desired teaching and learning goals [1].

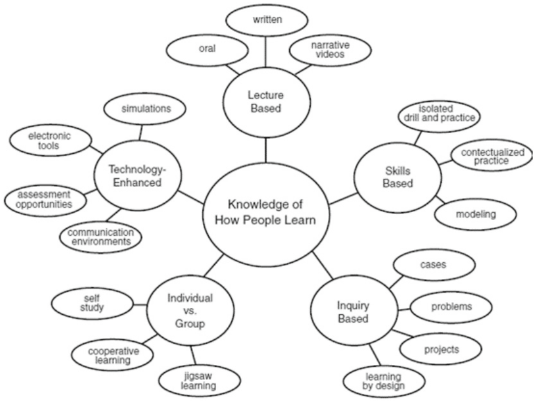

Fig. 1. How People Learn – Various Techniques and Tools [1]

Books and lectures are productive modes of knowledge communication for learning, intriguing ideas, and refining students' abilities for making critical judgments. But it is insufficient and requires other activities to draw out students' level of understanding by using meta-cognitive strategies to evaluate their learning [1, 3]. The statistical analysis shows that students spent only 14% of their time at school, 33% for sleeping, and 53% at home and community. Therefore, considering the proportion of time students spend in after-classroom environments should be accounted for optimizing learning. The traditional approach, where students are regarded as empty vessels filled with knowledge, is no longer practical and requires redesign. There are three principles suggested to remodify the strategies for teaching and learning [1]; teachers must capitalize on the preexisting understandings that students possess, some subject matters must be taught in depth, supported by some examples in tandem with the concept used at work that may be built firm foundation of factual knowledge. The third principle demands integrating metacognitive skills into the curriculum. Four attributes are recommended for implementing such principles for cultivating the learning environment [1, 4].

The first attribute defines that the classrooms must be learner-centered. The teaching method should value the learner's knowledge, skills, and attitudes. Therefore the student's preconceptions on the subject matter could broaden their understanding. The second attribute suggests developing a knowledge-centered classroom environment, where the emphasis is given to what is taught (information, subject matter), why it is taught (understanding), and what competency level to be sought. The third attribute concerns formative assessment design focus on the visibility of students thinking to teachers and students. It should allow the teacher to assess students' preconceptions, determine the position of every student in the developmental corridor from informal to formal thinking, and design instructions accordingly. It is believed that learning is influenced in indigenous manners by the context in which it takes place. Therefore, the fourth attribute requires a community-centered approach to develop classroom and school norms and connections to the outside world that support core learning values.

At the beginning of the 21st century, information and communication technologies (ICT) were embedded in the teaching and learning environment, creating technology-enhanced learning (TEL). In the earlier phase of TEL, the development of e-learning models helped learners in developing competence and conceptual understanding; since then, online learning mode is constantly bringing in place new methodologies. On the other end, the onsite teaching methodology shifting towards new learning philosophy based on active learning or moving to blended learning with the support of technology as a unique resource. Hence, the TEL has brought revolutionary changes in teaching methodologies [3, 4]. Currently technology is developing at very rapid pace, new trends are evolving, and the aspirations of all stakeholders are changing. TEL facilitates novel techniques and tools, however it is not the only source to inculcate students' understanding. The principal aim of this paper is to perform a critical review of the role of TEL in improving the quality of the teaching and learning process to nurture future talents to position themselves in the changing world.

2 TEL – From e-Learning to Artificial Intelligence (AI)

The TEL journey began with Web 1.0, which was the time when websites were managed by HTML code, and graphics quality was very poor. Web 1.0 was a one-way communication model, where developers only controlled content, and the internet users were passive [5, 6].

The evolution to Web 2.0 can be regarded as a breakthrough that blurs the developers' and users' boundaries. It allowed internet users to create specific content without holding specialized (IT) competencies. The development of Web 2.0 can be regarded as the milestone of TEL, which appeared in Education 2, where some information channels, resource sharing, video services, discussion forums, chats, instant messaging, and email appeared in the teaching and learning process. The evolution of Web 2.0 to Web 3.0 brought artificial intelligence (AI) into the ICT environment, making a real difference to leapfrog in TEL. With the development of AI, computers can perceive information like a human brain, which enables them to create faster and more accurate results [6, 7]. In short, Web 3.0 is based on an integrated Web environment, which allows machines to understand, and catalog data in a human-like manner, i.e., computer programs could perform certain activities without the presence of a human being [7]. The education experts termed this era Education 3.0, where teachers and learners are embarked on a unique, personalized, and self-determined journey. The experts foresee that education could change work contexts with the fourth industrial revolution [8].

Technology contributes significantly to reshaping the education style, which never happened before. It is influencing all levels of education. Now, universities are shaping students to position themselves in an unpredictable future with new job needs, and they could be resilient enough to tackle new challenges with technology influence. Now, universities offer better learning opportunities and efficient support to communicate and utilize skills. Therefore, technologies are becoming the main drivers of modern educational methods and a causing factor to strengthen the economy and industry [7, 8].

3 Related Theories for TEL in ICT Environment

3.1 Blended Learning

Blended learning is a method developed on the constructivist learning theory, situational awareness, and learning & education dissemination theory that integrates the traditional teaching model with full utilization of modern ICT to achieve the best portfolio of various teaching elements in the teaching process [4]. Blended learning integrates teaching resources, teaching media, learning environment, learning theories, learning forms and methods, well-structured and unstructured learning practices, and performance support. Figure 2 illustrates an octagonal chart of blended learning connotations [4, 7]. In the blended learning process, the lecturer's responsibility is to teach and organize students, where students are involved in self-disciplined learning. Figure 3 illustrate the blended learning process.

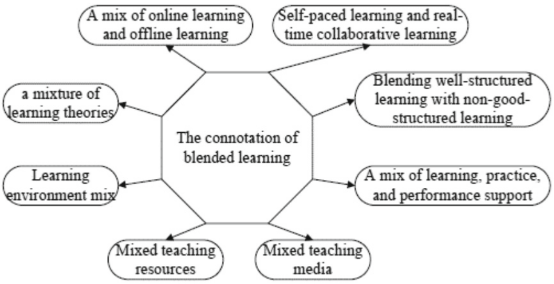

Fig. 2. Octagonal chart of blended learning connotations [4]

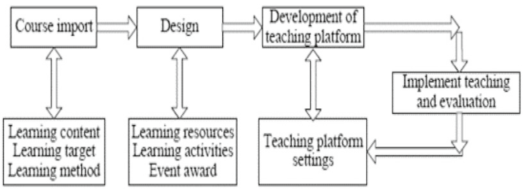

Fig. 3. Blended Learning Process [4]

4 Moodle System

The development of the Moodle system [4] followed the philosophy of the constructivism theory, which proved to be an effective tool for teaching management globally. It is based on self-instructed modules that offer a user-friendly learning environment. In the

Moodle system, different functions and permissions are granted according to the roles of various actors, i.e., administrator, teacher, and students. Figure 4 illustrates the roles and functions of each actor.

5 Education 4.0 – A Blueprint for TEL

1. Education 4.0 has brought the blueprint for education in the era of Industry 4.0. It integrates humanist ideas with the digital world. The following are the principal aspects of Education 4.0 [10].
2. Internet 4.0 services facilitate flexible remote learning opportunities for students at their convenience and choice.
3. Computer applications enable personalized learning experiences for students.
4. It is based on the Bring Your Own Device (BYOD) approach, where students use digital media to plan their study.
5. Practical activities are the major segments, which include projects where students can gain organizational, cooperation, and time management skills.
6. Data interpretation is essential; students can translate their theory into figures and do logical reasoning.
7. Educational achievements are evaluated differently than traditional methods; students can be assessed during learning.
8. In the teaching process, the opinion of students is essential. It should be accounted for during the designing and updating of the curriculum.
9. The primary education responsibilities will be transferred from teachers to students.

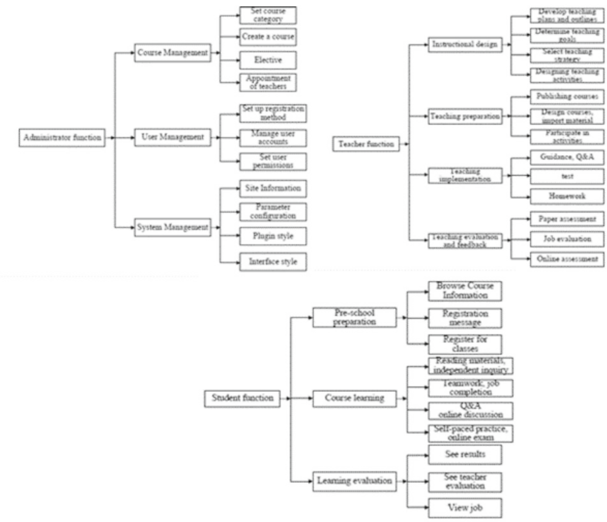

Fig. 4. Role and functions of various actors in Moodle [4]

6 Conclusions

- With the beginning of the current millennium, technology is considered an essential instrument in education. Computer-based technologies hold great promise both for increasing access to knowledge and as a means of promoting learning.
- The public perspective could be capitalized by the capacity of information technologies to centralize and organize large bodies of knowledge; people are excited by the prospect of information networks, such as the Internet, for linking students around the globe into communities of learners.
- Education 4.0 offers a vision for realigning education for the future that should be flexible and enable students to position themselves in the industry 4.0 at the career point.
- Artificial intelligence can significantly contribute to adapting changes as required with special educational needs.

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Alluring Learning on Computer Component Module Using Augmented Reality

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Abstract. Technology's rapid evolution has prompted corresponding shifts and improvements in educational practice and theory. The advance of technology is based on making it fit in so that current methods of teaching and learning need to move into technology era. The attitude of 21st century learners may differ from that of prior generations in terms of both their learning and their manner of thinking. As a result, perhaps it can help students keep engaged and improve their knowledge of what they're learning through the creation and use of cutting-edge technological applications in the classroom. In this study, the author proposes an idea for developing an Augmented Reality application that may be used as a supplementary tool in educational settings. The goal of this project's design is to harness technological progress in education by upgrading the standard of the teaching and learning environment and by incorporating a community-based, experiential learning approach. Development on this project will benefit the students and provide them with a complementary feature in completing the academic tasks. The preliminary results show that the approach to developing this project has been well received and acceptable.

Keywords: Experiential learning · students' engagement · augmented Reality

1 Introduction

A rise in educational quality may result from technology's ability to provide content of consistent quality at scale. One of the key comparative advantages of technology is its capacity to diagnose students' starting learning levels and allocate students to relevant difficulty courses and tasks. New ways of interacting with digital surroundings are being often provided by means of immersive technologies in the current era of digitization [1] (Solmaz, S, 2021). Immersive technologies have gained popularity in recent years to improve teaching and learning in a variety of fields. Some scholars have suggested that AR has the potential to improve learning in STEM (Science, Technology, Engineering, and Mathematics) education. AR systems are distinguished by the integration of physical and virtual environments, the alignment of digital material with the physical world, and

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real-time interaction. The use of augmented reality also allows for the visualization of previously inaccessible scientific phenomena like magnetic fields and fluid dynamics [2].

It is highly intriguing to integrate Augmented Reality and Virtual Reality in schools or colleges because these technologies are also a part of the Industrial Revolution 4.0. The value of AR is expected to grow by around $5.3 billion as a result of VR and AR's adoption in the classroom, while the value of head-mounted VR tools is expected to rise above $640 million [3]. Moreover, there also are consequences for students when handling online learning methods like easier losing their focus. As we shall see, augmented reality (AR) has tremendous promise for use in the classroom. Recent developments in hardware have made AR more user-friendly and affordable, and widespread adoption of mobile technology has increased its availability. Augmented reality could be a present-day technology that brings digital content within the style of 3D objects, sounds, and text elements into a real-world environment. AR in education helps scholars master a subject more efficiently by creating an immersive literacy space. Through the use of AR, educators are afforded new ways to facilitate students' conceptualization of abstract ideas. Teachers can improve their ability to engage the students in learning by taking advantage of the opportunities for experimentation and collaboration that augmented reality (AR) technologies provide.

An existing method of lecturing appears to be less efficient and effective because many students find it difficult to focus on the screen for lengthy periods of time while enrolled in online courses. There is a higher tendency for students to become distracted by social media when they are learning online [4]. This is because the session might become rather uninteresting if the student's participation in class consists solely of sitting and listening and the longest students can focus is generally for only a couple hours only. After that, they will start to lose their attention. Using AR to create immersive, remote learning environments is a feasible alternative for governments and schools to use at this key juncture in their efforts to improve education. AR technology is currently advanced enough to allow large groups of students to assemble and learn while minimizing the risk of exposure. Students can engage in effective learning by utilizing augmented and virtual reality which not only transforms their comprehension of the fundamental concepts and abilities they must master, but also connects their learning to the real world [5]. It is realistic learning in real time during a pandemic, and it is far more fascinating than sitting in a classroom imagining what they can now observe.

In this research, its offer some perspectives on how both schoolteacher preceptors and pupil preceptors fared with this environment and punctuate the openings for programme enhancement and for reflection on the proposition and practice. Furthermore, this research paper represents the thought of applying an Augmented Reality application to allure the training process and power for further understanding with enhanced Teaching and Learning environments. AR technology will be used both within the classroom and for distance learning, furthermore as in any.

2 Literature Review

Education and electronic learning are quickly adopting and integrating new technologies, which has led to the development of effective and innovative solutions. The use of computer-assisted training to teach students basic library skills such as how to access information for study and research is an alluring approach [6]. With the enormous potential of AR, libraries may engage their user base to improve the effectiveness of teaching and learning. As augmented reality (AR) improves student comprehension more than standard librarian training, it is claimed that introducing AR to the library skills curriculum improves student learning outcomes.

The alluring attraction of artificial intelligence (AI) technology appears to have the same effect on individuals, encouraging them to over trust these systems, even if they have just observed the system fail. A potentially doubly alluring combination is presented by the AI-powered neurotechnology that has started to emerge in recent years, especially those based on electroencephalography (EEG) [7]. Considering the potential alluring learning of these technologies, the scientific validity and the challenge of both unfounded claims and overuse need to be monitored, while at the same time providing active support for their continuous development and correct application.

AR combines real and virtual worlds, supplementing the real world with computer-generated virtual objects in real-time [8]. When it comes to AR, one of the most prevalent definitions states that technology should combine actual and virtual things, align them with one other, and interact with the user at the same time in a real-world context. AR can be called a mixed reality technology because it incorporates virtual things into the user's real environment, allowing for interaction with virtual material. Examples of mobile AR applications are Star Chart applications. This mobile application provides real-time stars sign according to the current location based on GPS that being provided. This application is specifically for anyone that wants to know and learn about star signs. Because of advancements in mobile technology and the widespread availability of smartphones, augmented reality's potential as a teaching tool has greatly expanded. Smartphones and tablets are perfect for facilitating augmented reality (AR) experiences due to their powerful processors, graphics technology, and numerous inbuilt sensors.

Educators now have a wide range of options for involving their learners in innovative learning tools. Engagement in difficult problem-solving tasks and fulfilment of learning objectives are made possible by such technologies. Despite the abundance of literature on the topic of augmented reality in the education, many educators still lack a strategy for designing lessons that considers the most recent discoveries from the field of learning sciences and instructional design [9]. However, A large majority of the students in the research had never used AR in the lesson before, and they had a hard time figuring out how to successfully implement it across subject areas. Despite this, users recognized the value of AR and claimed that they would most likely utilize it in the future. AR could be used in a lot of different fields because of how much emphasis there is on hands-on and immersive learning. Its growing popularity has led more and more university labs and centres to focus on how it could be used to teach and learn.

The availability of inexpensive portable devices with cutting-edge capabilities that enable the deployment of AR-based apps, as well as awareness of AR, are the primary factors of AR acceptability in the educational setting. Some researchers have said that augmented reality (AR) could help teach skills that are especially useful in the science, technology, engineering, and math (STEM) fields. These skills include spatial ability, practical skills, conceptual understanding, and learning through scientific inquiry [8]. AR technology is often talked about in terms of the two main ways it can track information from the real world. AR is a popular technology that has become a big part of research and education in the past few years. Systematic reviews of research and applications have found that augmented reality (AR) has the potential to be used in educational settings.

Due to advancements in Augmented Reality technology, students now have the opportunity to learn in a setting that mixes real-world and digital resources. But it is worthwhile to investigate if contemporary information technology may benefit all educational audiences [10]. In several research, new technologies or learning environments have been used to give greater material. However, it is important to look at how these surroundings or technology affect various pupils with varied personal characteristics. Numerous research has included augmented reality (AR) in learning, but few have focused on different learners. It is possible that augmented reality (AR) can assist high school pupils in better grasping the ideas and building the model step-by-step than other types of virtual learning environments. AR classrooms and proved that educational AR applications were overwhelmingly good in the long run.

3 Methodology

The illustration of Fig. 1 depicts the suggested system architecture for this AR mobile learning application. When users start interacting with the Fot-R, all the learning material is saved from the application itself for API and will be shown to their mobile devices. In addition, on mobile applications, there will be mobile logic and functioning that running by using Unity and Vuforia for Augmented Reality view. It also integrates with Sketchable as the main API for 3D model for AR feature that user will be seen from their mobile phones. The system is easy to use since all the learning material was saved throughout the interaction process, and if any improvement and modifications are needed, the developer will release them via the application updates. For functioning of the AR that are running by using the application server which Firebase includes with AR repository to run the functionality. For front-end point of view from student and instructor, there are no difference of User Interface design for both parties since both of them have similarity thought which is willing to learn a new thing. While on back-end side which are the button functionality and database which need to fully be functioning before releasing to the users. This required a lot of work for Firebase since it also works on database and needs extra cautions if server having trouble and error in short time. This mobile application will be tested out with a few of students and give any feedbacks if there are any of errors occurred. Therefore, for back-end and front would probably runs smoothly in the application since counter any errors when developing. This application already encountered any errors that face during usability testing process occurred among the testers from UTP community.

Basic computer components have been chosen as the starting point for this project's Computer Component for AR or called Fot-R application since there are many additional subjects and information relating to this subject that might be developed. As a result,

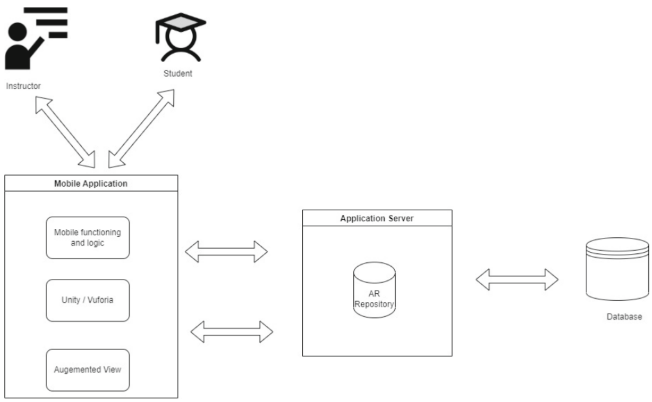

Fig. 1. System Architecture

the writer believes that the subject of Computer Components is becoming a popular one, and that students often struggle and require time to master the basics of hardware components and a few of them still confusing of functioning and useful of the hardware.

4 Result and Discussion

4.1 Information Gathering

An online survey was conducted to get information regarding mosquitoes and mosquitoes repellent phone application. The survey is being done using Google survey form which is an online survey form that is being provided by Google. The survey is being distributed to students with expertise in computer systems from various institutions with diploma and bachelor's degree levels, and the participants of the online survey are 50 respondents. There are twelve questions that are being asked in the online survey.

From the respond of the online survey, the participants appear to be knowledgeable and experienced in working with computer components. Most of them believe that the computer syllabus should be more focused on education and that this technology should be recognized as an essential part of the educational process. Fortunately, they appear to be aware of augmented reality technology and they also believe that implement Augmented Reality as support tools while studying the subject will be very helpful to deepen their comprehension and thus generate increased their involvement.

Figure 2 shows the frequency chart for main question in online survey shows more than 50% of the respondents have previous experience when dealing computer component and agree that computer syllabus should be more focused in education. However, 28% of respondents appear to be unaware of the significance of technology in education. This leads to the conclusion that there is still space for improvement in order to make everyone delighted with the importance of this technology.

There are 78% agreed and think that by having a supporting tool in the process of improving their understanding when learning computer component syllabus. It's clear that there is a need to provide students with a support tool, especially when there are a lot

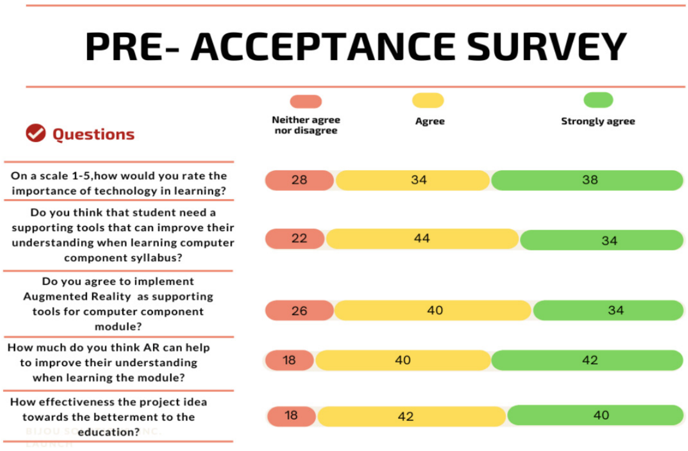

Fig. 2. Frequency chart

of theories to cover, and students truly need something that can assist them improve their understanding. In addition, a large part of the respondents, or 74%, supported the idea of creating an augmented reality application as a supporting tool for computer component modules. This is related to the fact that most students acknowledge that an augmented reality application may be created to serve as a supporting tool in education, according to studies conducted in the past by other researchers. Furthermore, 82% of respondents believe that using an AR application would help them better comprehend what they are studying about computer systems. This feedback is very significant since it can reinforce the project's overall goal, which is to enable the students to deepen their knowledge of the computer component module.

Overall, its demonstrates that 82% of respondents are giving a positive rating on the effectiveness on the implementation of the AR Application. To ensure that the implementation of the application is successful, the developer must address this type of issue, particularly in ensuring that users are satisfied with the application and that it can assist other users in using the application. This is since the greater the number of users of the application, the more it can assist students in improving and enhancing their academic.

4.2 The Application

The development of application consists of two users that will interact with the application which are lecturer and student itself. The development for Fot-R application interface, features and functionality including the back-end side with Augmented Reality using Unity, Firebase and Visual Studio as main applications to run the application smoothly. The contents being provided in the application were collected from lecturer slide as guidance so that it aligns of what being taught in the class session.

The application interfaces show in Fig. 3 focuses on simplicity and is easier to interpret by user to understand on how the application works. A sidebar allow user to select the button named "Slide 1" for note page, "Quiz" for practices and "Camera (AR)" for the AR features. This function is built because the student may be interested in going

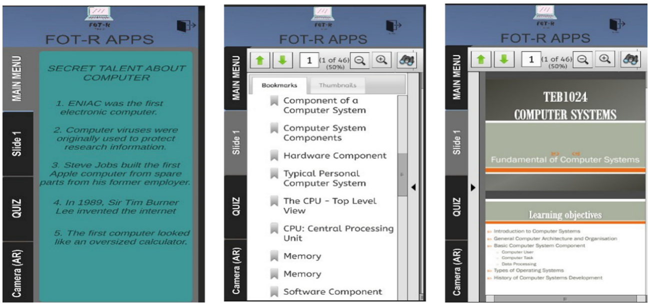

Fig. 3. Learning features.

through the notes. It also provides the bookmarks and thumbnails that enable users to quickly select which the key points that they want to learn or search from the slides given. On top of that, the notes can zoom in and zoom out if user wants to get the big picture of the contents if the picture does not clear to them. Moreover, they also can insert any number of pages that they want to key in in the input field at top of the screen since these usability enables for ease the user when dealing a huge number of slides.

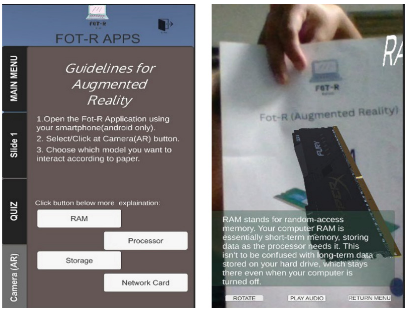

Fig. 4. AR Features

The main features highlighted in Fig. 4 allow users to use the navigate the AR features to learn the developed computer components. Current function provided a page of AR where user been provided with a few targets’ pictures and focus to device’s camera to scan the target picture. On the function there are also other additional features such as “Rotation”, “Audio” and “Return” once their select their choices of the 3D model that they want to see in detail. As illustrated in Fig. 4, once user click at RAM button, it will redirect into next UI which showing the other three button functionalities as stated in the above explanation. For rotation button, allow the model to rotate 180° for close and see-through model. This functionality to make 3D model more interesting and attractive for students since it can move around instead of standing alone. While for “Audio”, the user will hear the audio that read back the text if user want to hear instead of reading the text that shown the explanation regarding the selective model. If user want to exit the AR page to return at Main Page, they can click at "Return Menu" button to end the activities session.

The develop augmented reality application, however, will be accessible for android phones. The major target of the application's development is to display a few slides and explanations linked to the computer field. It is intended that students will engage with the application to improve their practical part rather than theoretical part only. This proposed idea will make student increase their imagination thought in technology field.

4.3 Discussion

Although AR is not a new technology, it needs to fully utilize the potential in the educational field. AR-based learning represents an advanced wave in educational theory through the use of novel learning tools that provide the presence of a real environment in a way that permits students to move about while utilizing this mechanism. Student engagement and visualization abilities can both be boosted through the use of AR features in education. The feature that implements also helps teachers to explain well and make the students easily understand on what they are taught. In addition, a study of students who expressed an interest in using AR technology to enhance their education revealed overwhelmingly positive responses. When the full potential of AR technologies is uncovered, its useful features will be applied more broadly across all areas of education, enhancing the effectiveness of teaching and learning.

Students' interest and knowledge of the Computer System course is projected to be significantly impacted by the augmented reality application, which can assist educators in conducting lectures with clear examples. By helping lecturers and students alike, this application has the potential to improve the quality of instruction for everyone involved in the classroom or even in the room. Students will find this subject becomes more exciting to learn since it applied with practical part and interact with the modest technology.

A usability study conducted shows the AR features increase their likelihood to utilize the application, and 50% believe that the AR Camera feature is the most intriguing and valuable feature for them. As indicated previously, in the early stages of design and development, the augmented reality (AR) feature is intended to become the main appeal and most engaging feature that can entice the user to utilize the program as an instructional tool for the introduction to computer component module. This demonstrates that the goal of building the application may most likely be achieved based on the feedback from the users. Additionally, a future-focused third question was added to glean insight into what areas respondents felt needed improvement. This is due to the fact that the developer views the current app as a beta version of the very first release, and thus believes that there is always room on which improvement is required to ensure the app's continued reliability, as well as to enhance the app's contents and functions, and that a consistent update will ensure the application's continued benefit to its user. As a result, 40% of the respondents think that the AR Camera still needs to be improved.

To ensure that the user will not experience any hardship or complication when using the application, the developer makes every effort to keep the application as simple as he can when creating it. The respondents' ratings, which indicated that they were all pleased with the application overall, were also influenced by their level of satisfaction. The developer believes the goals of building the application are achievable because users are satisfied with the generated application, as evidenced by the high rating of satisfaction with using the application provided by the respondents.

5 Conclusion

Adopting a new education-supporting is important to avoid falling behind the rest of the globe, which is advancing toward technological progress and introducing new educational aids. With the present epidemic of people utilizing and working with technology, especially those who work in the educational service sector, particularly teachers and lecturers, more than they did in the past, any type of supporting tools that can be developed would be quite useful for them. Much farther, the initial survey results show that a complementary tool for the Computer System course would showing greater in enhancing students' comprehension of the application's covered learning topics. Consequently, the anticipated outputs of the study would be useful as a teaching and learning aid.

Furthermore, it may be concluded that the users are pleased with the application based on the results of the user usability testing survey. This can be demonstrated by the respondents' affirmative responses. According to the poll, all respondents agree that the application may assist students with their studies, particularly when they are studying about the Introduction to Computer Components topic. Lastly, based on the good response from respondents, the author feels that the application's purpose and users' expectations are realizable.

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Assessing Self-directed Learning in a Mobile Technology Context: An Intrinsic Motivation Approach

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Abstract. Recent literature in the use of mobile technology in higher education indicates that mobile technology is essential in order to provide an environment that supports self-directed learning. Researchers and academics have long championed the need to cultivate independence in students' learning at tertiary institutions. The goal for conducting this study is to investigate the significance of intrinsic motivation (perceived enjoyment) and its role in the adoption of mobile technology to aid self-directed learning. Consequently, this study further investigated the influence of extrinsic motivators (effort expectancy, perceived expectancy) towards perceived enjoyment. Results obtained supported the relationships between effort expectancy-perceived enjoyment, performance expectancy-perceived enjoyment, and perceived enjoyment-behavioural intention to adopt mobile technology for aiding self-directed learning. This study was able to provide further insights on the central role of intrinsic motivators in efforts to cultivate self-directed learning. Crucially, it also deepened the understanding of the relationship between extrinsic motivators and intrinsic motivators that should be further examined in future research.

Keywords: perceived enjoyment · self-directed learning · mobile technology

1 Introduction

In the past few years, the practice of student-centered learning (SCL) has remained integral in higher education [1–3]. Consequently, in contrast to teacher-centered approaches, SCL emphasizes cultivating a self-directed learning environment where the students make the decisions on the learning materials they would like to undertake and the subsequent learning methods to adopt [4]. Tertiary education administrators and educators certainly play key roles in promoting and cultivating a self-directed learning environment for their students. In fact, the Covid pandemic has accelerated self-directed learning as the pandemic has necessitated the need for the students to learn from home. Studies have also demonstrated that online learning fostered learning independence [5, 6]. Subsequently, the post-pandemic transition has seen the continuance of online learning and the emergence of hybrid learning (mix of in-person and online learning) in many higher

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education institutions [7]. Studies have also elucidated positive responses and attitude amongst the students towards online learning [8, 9].

Gaining important insights into the students' learning styles, various learning strategies could be implemented through online activities to enable self-directed learning. In line with this, such online learning activities are made possible largely due to advancement in mobile technology. The pervasiveness of mobile technology has undoubtedly changed learning and teaching practices of educators and students. Prior studies have shown that mobile technology promotes self-directed learning and increases students' engagement [10–15]. Notably, drawing from the work of scholars in the field of mobile learning, positive implications can be observed on the students' academic achievements [16–20].

Numerous studies have elucidated factors leading to the successful use of mobile technology for supporting teaching and learning [1, 21–23]. Though learning is conventionally viewed as a serious endeavour, studies have shown when students enjoy their lessons or when learning are delivered in a fun and light-hearted environment, positive impact were observed [24–28].

Accordingly, the purpose of this study is to investigate the influence of intrinsic motivators on the intention to use mobile technology for self-directed learning amongst tertiary students in Malaysia. The objectives of this study are two-fold: One is to investigate the relationships between extrinsic motivators (performance expectancy, effort expectancy) and intrinsic motivator (perceived enjoyment), and secondly, to examine the influence of the intrinsic motivator on the behavioural intention to use mobile technology to aid self-directed learning. The subsequent sections will discuss the theoretical background and hypotheses, followed by the research methodology and the results obtained. Lastly, this paper discusses the implications of the results obtained as well as limitations and future research direction.

2 Theoretical Background and Hypothesis Development

2.1 Underpinning Theory

The Unified Theory of Acceptance and Use of Technology (UTAUT) has four constructs – performance expectancy, effort expectancy, social influence, and facilitating condition [29]. In the literature of technology acceptances, the UTAUT model is considered one of the most applied models. All four constructs have been consistently validated in studies of students' acceptance of mobile technology in higher education [30–35]. Of particular interest in this study is performance expectancy and effort expectancy. Performance expectancy is an extension to the Technology Acceptance Model's (TAM) [36] perceived usefulness construct, and is described as the belief that using a specific technology will bring about certain advantages [29]. Effort expectancy on the other hand expands on TAM's perceived ease of use and is defined as the "level of convenience and usability" that users feel when using a particular technology [29]. Both constructs encompass extrinsic motivations, forms of external rewards associated with the adoption and use of specific computing technologies. In various studies on the adoption of mobile technology, strong relationships have been revealed between performance expectancy and behavioural intention [37–42], and between effort expectancy and behavioural intention [37, 38, 40, 43–45].

Intrinsic motivators has certainly gained recognition among scholars of technology adoption in recent years. Whilst extrinsic motivators have long been deemed powerful predictors, as user experience with technology continues to evolve in line with the advancements in system and mobile applications, intrinsic motivators are viewed as equally important. Venkatesh [46] proposed intrinsic motivations in the form of system-specific perceived enjoyment and computer playfulness as antecedents of perceived ease of use. Over the years, perceived enjoyment has been associated with various computing technologies related studies, and is defined as the level of enjoyment that are felt when using a specific technology [46]. In the context of mobile technology acceptance, perceived enjoyment has demonstrated a strong influence on acceptance and adoption [39, 47–51].

2.2 Performance Expectancy, Effort Expectancy and Perceived Enjoyment

In organizational behavioural studies, the effect of extrinsic motivators on intrinsic motivators have been investigated. Fischer et al. [52] study revealed that extrinsic motivators moderated the relationships between intrinsic motivation and the creativity and performance of knowledge workers. Extrinsic motivators were also found to support intrinsic motivations that encouraged employee-level innovation [53]. Interestingly, Peng and Fu [54] compared and found intrinsic interest in learning English culture to be more important than extrinsic motivations. These notable studies underlined the need to investigate the effect of extrinsic motivators on intrinsic motivators relating to the intention to use mobile technology to support self-directed learning. This study thus proposes to investigate effort expectancy and performance expectancy's relationships to perceived enjoyment. The following hypotheses are proposed:

H1. There is a positive relationship between effort expectancy (EE) and perceived enjoyment (PEn).

H2. There is a positive relationship between performance expectancy (PE) and perceived enjoyment (PEn).

2.3 Perceived Enjoyment and Behavioural Intention

Numerous studies have validated the positive influence of perceived enjoyment on behavioural intention to adopt and use computing technologies. Recent studies such as by Mitchell et al. [55] found that intrinsic motivation is linked with behavioural intention in the use of workplace gamification. In addition, Nabipour Sanjebad et al. [56] also found significant relationship between perceived enjoyment and behavioural intention to adopt mobile learning, and the significant impact of enjoyment on using smartphones for learning by Cao and Nguyen [57]. Notwithstanding, perceived enjoyment was also shown to be important as a mediating construct, such as mediating the influence of perceived informativeness on usage intention of augmented reality applications [28]. Based on the current review of literature, a positive relationship is expected in this study between perceived enjoyment and behavioural intention to use mobile technology to support self-directed learning (Fig. 1). Therefore, we propose:

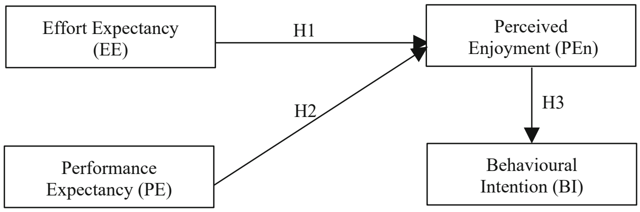

Fig. 1. Research model

H3. There is a positive relationship between perceived enjoyment (PEn) and behavioural intention (BI).

3 Methodology

3.1 Procedure and Participants

An online survey was disseminated to students of higher learning institutions in Malaysia. Using the non-probability convenience sampling approach, a total of 153 valid responses were obtained over a duration of approximately three months. Respondents anonymity was assured and no personal data were collected. A large majority (104, 68.00%) were females, and more than 50.00% of the respondents were in their early 20s. Most of them were pursuing their bachelor's degree (100, 65.40%). The respondents' detailed profile is shown at Table 1.

3.2 Constructs' Measure

Both effort expectancy (EE) and performance expectancy (PE) were measured by adopting the 4-scale items and 6-scale items respectively from Venkatesh et al. [29]. The scale items ranged from Strongly Disagree to Strongly Agree. Perceived Enjoyment (PEn) were measured using 4-scale items ranging from Strongly Disagree to Strongly Agree [58, 59]. Behavioural intention's (BI) 9-scale items were adopted from Hannafin and Land [60] and Venkatesh et al. [61], ranging from Strongly Disagree to Strongly Agree.

Table 1. Respondents' Profile

Category	Number	Percentage
Gender		
Female	104	68.00
Male	49	32.00
Age		
<21	52	33.99
21–25	87	56.86
26–30	12	7.84
>30	2	1.31
Education		
Certificate	1	0.70
Foundation	4	2.60
Diploma Degree	38	24.80
Bachelor Degree	100	65.40
Postgraduate Degree	10	6.50
Course		
STEM	80	52.3
Non-STEM	73	47.7

4 Data Analyses and Results

4.1 Data Analysis

Using SmartPLS 4.0.9.5 version, confirmatory factor analysis was applied by means of structural equation modelling with partial least squares (PLS-SEM). Following the PLS-SEM guidelines, a two-stage approach was undertaken to analyze the data [62]. In the first stage, the measurement model was examined to assess the inter-item reliability, convergent validity, and internal consistency reliability. The discriminant validity of the constructs was assessed by applying the Heterotrait-monotrait ratio of correlations (HTMT) [63, 64]. The second stage entailed the examination of the structural model to test the hypotheses' significance and predictive power of the model.

Since data for the independent variables and dependent variable were collected in a single survey, single source bias was assessed using the full collinearity method [65]. All constructs were regressed to extract their variance inflation factors (VIFs). Each of the construct's VIF value is less than 5.0, thus it is concluded that single source bias is not a serious issue in the data collected [65]. Table 2 presents the collinearity test results.

Table 2. Full Collinearity

Construct	BI	EE	PE	PEn
VIF	1.701	3.322	3.248	2.021

[a] Note: BI = Behavioural Intention; EE = Effort Expectancy; PE = Performance Expectancy; PEn = Perceived Enjoyment

4.2 Results

Results from the assessment of the measurement model showed that all the constructs' item loadings and average variance extracted (AVE) are greater than 0.50, thus displaying inter-item reliability and convergent validity at the construct level [62]. To affirm the internal reliability, the composite reliability (CR) values are above the threshold of 0.70 [62, 66]. Table 3 presents the measurement model results.

Table 4 shows that all the HTMT values to be below 0.90, hence indicating that acceptable discriminant validity is satisfied and we can conclude that the constructs are distinct from each other [63, 64].

Multivariate skewness and kurtosis were assessed and the results showed that the data is not multivariate normal – Mardia's multivariate skewness (Mardia's multivariate skewness ($\beta = 6.653$, $p < 0.01$) and Mardia's multivariate kurtosis ($\beta = 38.432$, $p < 0.01$). A 5,000 sample re-sample bootstrapping procedure was performed to extract the path coefficients, standard errors, t-values, p-values, confidence intervals and effect sizes [62, 67]. Figure 2 and Table 5 present the results of the structural model assessment.

All hypotheses are supported. H1 postulated a positive relationship between Effort Expectancy (EE) and Perceived Enjoyed (PEn) ($\beta = 0.304$, $p < 0.01$), while H2 postulated a positive relationship between Performance Expectancy (PE) and Perceived Enjoyment (PEn) ($\beta = 0.432$, $p < 0.01$). Both EE and PE explained 49.0% of the variance in PEn ($R^2 = 0.490$). The hypothesis H3 that postulated a positive relationship between PEn and Behavioural Intention (BI) to use mobile technology to support self-directed learning is also supported ($\beta = 0.526$, $p < 0.01$) with a R^2 value of 0.277.

Table 3. Convergent Validity

Construct	Item	Loadings	CR	AVE
Behavioural Intention	BI1	0.791	0.932	0.606
	BI2	0.858		
	BI3	0.863		
	BI4	0.794		
	BI5	0.665		
	BI6	0.784		
	BI7	0.667		
	BI8	0.738		
	BI9	0.817		
Effort Expectancy	EE1	0.894	0.927	0.761
	EE2	0.867		
	EE3	0.836		
	EE4	0.891		
Performance Expectancy	PE1	0.800	0.918	0.652
	PE2	0.877		
	PE3	0.827		
	PE4	0.790		
	PE5	0.802		
	PE6	0.741		
Perceived Enjoyment	PEn1	0.930	0.964	0.870
	PEn2	0.945		
	PEn3	0.931		
	PEn4	0.925		

[a] Note: Average Variance Extracted (AVE); Composite Reliability (CR)

Table 4. Discriminant Validity (HTMT Ratio)

Construct	BI	EE	PE	PEn
Behavioural Intention				
Effort Expectancy	0.683			
Performance Expectancy	0.620	0.893		
Perceived Enjoyment	0.560	0.691	0.722	

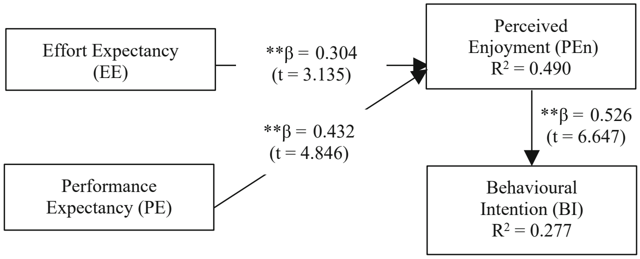

Fig. 2. Structural model (**p < 0.01)

Table 5. Hypothesis testing

Relationship	Std. Beta	t-value	p-value	BCI LL	BCI UL	f2	Decision
H1: EE → PEn	0.304	3.135	0.001	0.141	0.458	0.063	Supported
H2: PE → PEn	0.432	4.846	0.000	0.280	0.570	0.128	Supported
H3: PEn → BI	0.526	6.647	0.000	0.377	0.638	0.383	Supported

[a] Note: Study used 95% confidence interval with a bootstrapping of 5000; BCI LL = Bias Corrected Interval Lower Limit, BCI UL = Bias Corrected Interval Upper Limit

5 Discussion

This study attempts to investigate the link between the practical benefits of using mobile technology, i.e. extrinsic motivations (effort expectancy,performance expectancy) and intrinsic motivation (perceived enjoyment) by suggesting that the realization of these practical benefits motivates students to use mobile technology by instilling enjoyment. This study also contributed to the investigation on whether intrinsic motivation in the form of perceived enjoyment promotes the intention to use mobile technology as a means for supporting students' self-directed learning endeavours.

Consistent with the authors' expectations from reviews of past and recent literature, results revealed that both effort expectancy and performance expectancy positively influence the extent to which using the mobile technology for supporting learning is perceived to be enjoyable, which in turn improves students' intention to use mobile technology in their self-learning endeavours. In regards to the positive influence of extrinsic motivations on intrinsic motivations, this finding is in line with previous studies [53, 68–70]. Interestingly, Liu et al. [71] study revealed contrasting impact of extrinsic motivations on intrinsic motivations linked to academic performance, with extrinsic motivations having a negative impact on students who are highly intrinsically motivated whilst having a positive impact on students with low intrinsic motivations. Similarly, the study conducted by Suárez-Fernández & Boto-García [72] on the effect of time spent on leisure reading versus time spent on reading for job-related or learning reasons discovered that reading motivated by extrinsic factors enhances intrinsic motivations to read, but reduces reading time.

Likewise, the perceived enjoyment of using mobile technology enhances adoption intention to support self-directed learning. This finding is consistent with previous studies of mobile learning [39, 56, 73–75], which suggested that enjoying the use of mobile technology helps in motivating students' desire to use the technology in their self-directed learning activities. However, a previous study by Koenig-Lewis et al. [76] revealed that perceived enjoyment has no impact on the adoption intention of mobile payment applications. Similarly, the insignificance of perceived enjoyment on adoption of mobile shopping was reported by Wong et al. [77]. Subsequent studies however, revealed perceived enjoyment as a significance predictor of technology adoption intention [78–80].

6 Conclusion

The findings from this study make important contributions to the literature of student-centered learning and the use of mobile technology as a tool for achieving self-directed learning amongst students of tertiary education. Findings revealed the significance of extrinsic motivators as a precursor to realizing intrinsic motivations and subsequent adoption intention of mobile technology for supporting self-directed learning. In this way, this study contributes to the pervasive studies of technology adoption and suggests that motivations, both extrinsic and intrinsic, play significant roles. This broadens the concept of technology acceptance beyond the established technology acceptance models and theories.

This study links the factors of effort expectancy and performance expectancy as antecedents of perceived enjoyment, and the positive findings elucidated the correlations between extrinsic and intrinsic motivators. Thus, it is surmised that extrinsic and intrinsic motivations are not mutually exclusive and may influence the significance of each other. That being said, the main limitations in this study lie in the fact that students' learning styles differ across different disciplines, and vary across differing cultural and demographic backgrounds. Henceforth, the findings have limited generalizability since the sample was sourced from students of learning institutions in Malaysia. Future research may consider validating the findings across different disciplines of study, educational level, and country.

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Aptitude of Synchronous-Asynchronous Blended Learning in Stimulating Student's Comprehension for Thermodynamics Course

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Abstract. This research examines the effectiveness of a synchronous-asynchronous blended learning approach in stimulating student comprehension for the MEB2053 ME Thermodynamics course. The study aims to assess the impact of this approach on final exam scores, overall assessment grades, and students' perceptions of the course. Participants include all enrolled students, and data is collected through various assessments including a final examination, and a learning satisfaction survey. The results demonstrate positive student perceptions, highlighting the value of interactive videos and self-paced learning. Furthermore, a notable improvement in student learning performance is indicated by better exam 1 results and overall final scores, after implementing the blended learning approach. The findings affirm the efficacy of the synchronous-asynchronous blended learning approach in enhancing student comprehension, improving performance, and fostering an engaging learning experience for the thermodynamics course.

Keywords: Technology Enhanced Learning · Online Distance Learning · Student Performance and Perceptions · Engineering Education

1 Introduction

Higher education is facing increasing pressure to adapt to technological changes and integrate innovative teaching methods. The advancements in educational technology have brought numerous benefits to individuals and Higher Education Providers (HEPs). With the emergence of the COVID-19 pandemic, the need for online distance learning became even more crucial as physical classroom interactions were no longer possible. Transitioning to online platforms posed challenges for students and teachers [1]. The issue observed during online distance learning, especially on the traditionally challenging engineering course, such as MEB2053 ME Thermodynamics 1, is the minimal student engagement and interaction during online classes. These difficulties have severely

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impacted the overall learning performance of the students. The immediate implementation of technology features became necessary to ensure the continuity of teaching and learning activities.

Self-paced online learning has become popular for individual learners, offering flexibility in managing activities and time [2]. To address this, a blended learning approach integrating real-time interactions and self-paced activities aims to enhance students' comprehension of thermodynamics and improve academic performance. Figure 1 explains the blended learning setting quadrant [3]. Blended learning is defined as a learning approach that combines the strengths of synchronous and asynchronous strategies to achieve specific learning outcomes effectively. By utilizing appropriate combinations of these strategies, educators can tailor blended learning to meet the unique needs of different learning objectives.

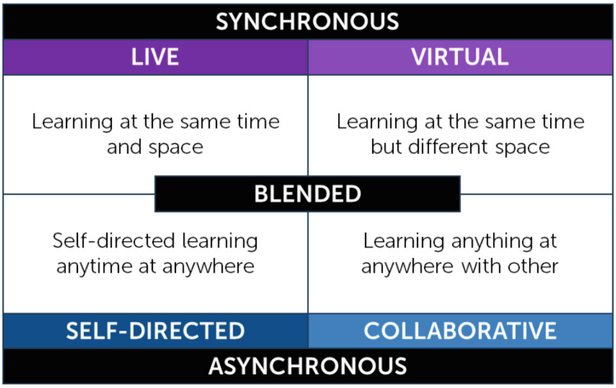

Fig. 1. Quadrant of Blended Learning Setting [3]

Albalawi's research explored teaching methods' impact on intermediate students' academic performance, finding no significant difference between face-to-face, virtual, and mixed approaches [4]. Various methods like face-to-face, blended, and online learning offer advantages, but student interaction remains crucial. Synchronous methods enable real-time communication, while asynchronous methods provide flexibility. Ambika et al. stressed the importance of diverse training delivery methods to effectively address teaching and learning variables in online education [5].

To bridge the gap between synchronous and asynchronous learning, a blended approach becomes essential. The value of blended learning in the context of undergraduate education must be systematically quantified and compared against conventional teaching and learning methodologies. This research aims to fill this gap by investigating the aptitude of a synchronous-asynchronous blended learning approach in stimulating students' comprehension of the thermodynamics course. By incorporating both synchronous and asynchronous elements, this approach aims to provide an engaging and student-centered learning environment that meets the diverse needs of the learners.

2 Methodology

The study included all students who were enrolled in MEB2053 ME Thermodynamics 1 during the January 2022 and May 2022 semesters. These participants were second-year students from the Mechanical Engineering Department. Three separate measures of student performance were used as dependent variables in this study. The first dependent variable (B-1) was the grade obtained by students in the final examination of the thermodynamics course. The second dependent variable (B-2) measured the overall performance of students in the course, taking into account various assessments and assignments throughout the semester. The third dependent variable (B-3) was based on a comprehensive learning satisfaction survey, which aimed to gauge students' perceptions and satisfaction regarding their learning experience in the course.

The study compared the impact of two independent variables on student performance. The first independent variable (C-1) was the synchronous learning approach, which involved scheduled sessions conducted solely through MS Teams. During this period, no assistantship was provided to the students, apart from lecture notes. This batch represented the uninterrupted synchronous learning system. The second independent variable (C-2) was the asynchronous learning approach, which was introduced during the May 2022 semester. This approach included enhanced asynchronous materials, such as interactive videos covering the topics before the synchronous sessions. During the synchronous sessions, the lecturer reiterated the key points and actively engaged students in discussions.

By employing this methodology, the study aimed to explore the impact of a synchronous-asynchronous blended learning approach on student comprehension of the thermodynamics course. The use of multiple dependent variables provided a comprehensive assessment of student performance, while the linear regression analysis allowed for a quantitative examination of the correlation between learning approaches and outcomes.

At the end of the course, students were asked to respond to a questionnaire consisting of Likert scale statements. The statements aimed to assess their perceptions and satisfaction regarding the teaching materials and learning experiences. The Likert scale ranged from strongly disagree to strongly agree. The statements included:

1. I am positive that this teaching material could enhance my performance.
2. I am looking forward to this kind of material for other courses/chapters.
3. Through the video features, I am able to pause, stop, and play whenever I want.
4. I am able to understand the phase change process better.
5. The pace of the video is appropriate for me.
6. Interactive guided videos help my comprehension.
7. I am looking forward to this kind of alternative material.

The responses to these statements provided valuable insights into the students' perceptions of the teaching materials and their impact on their learning experience. The Likert scale allowed for a quantitative analysis of the students' attitudes towards the materials and their level of satisfaction.

3 Results and Discussion

The study aimed to assess the impact of a synchronous-asynchronous blended learning approach on student comprehension and performance in the MEB2053 ME Thermodynamics 1 course. The results of the study provide valuable insights into the effectiveness of the approach and its influence on student learning outcomes.

Figure 2 exhibits the students' perceptions and satisfaction regarding the teaching materials and learning experiences that were examined through the Likert scale questionnaire. The survey showed positive feedback on the blended learning materials. 44% agreed the materials improved their performance and wanted similar resources for other courses. 44% also praised the video's convenience, while 67% reported better understanding of phase change. 89% found the video pace suitable for their needs, emphasizing the value of self-paced learning. 44% desired more interactive guided videos as alternative resources.

These results align with previous studies that have highlighted the benefits of blended learning approaches. Previous researchers emphasized the importance of providing different training delivery methods to address the diverse variables in teaching and learning [2, 5]. The findings of this study reinforce the notion that incorporating synchronous and asynchronous elements in the learning process can enhance student engagement and comprehension.

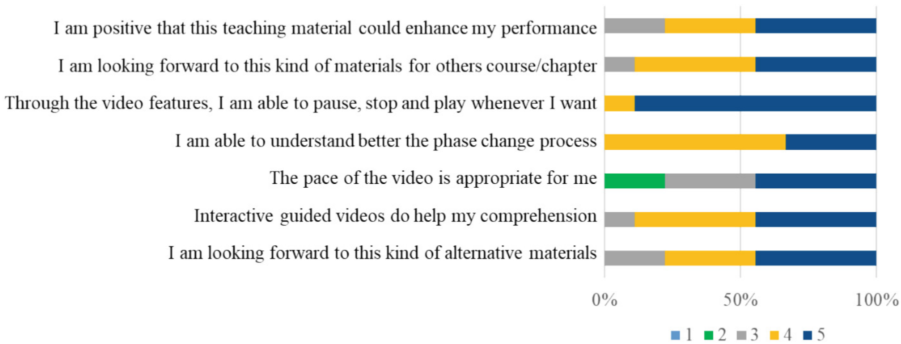

Fig. 2. Students' perceptions on asynchronous approach in the class

In addition to assessing students' perceptions, the study examined their performance in two key areas: the performance on Exam 1, which covered the chapter with the interactive video (the properties of pure substance), and the overall performance of the entire batch at the end of the semester (Fig. 3).

In January 2022, Exam 1 average was 57.5%, but with blended learning in May 2022, it improved to 61.9%, showing positive effects. Overall student performance in January was 73.2%, rising to 77.5% in May, indicating that self-paced learning and interactive elements contributed to the improvement. This improvement also suggests that the interactive video and the blended learning approach positively influenced students' understanding of the chapter's content.

These results are consistent with previous research by [4] and [6], which highlighted the effectiveness of blended learning models in enhancing student performance. The findings of this study provide further evidence that a blended learning approach, combining synchronous and asynchronous elements, can improve student comprehension and overall academic achievement.

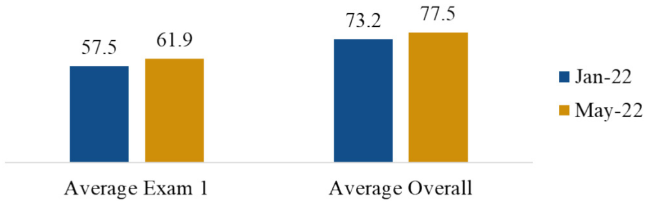

Fig. 3. Comparison of students' performance

Overall, the results of this study demonstrate the positive impact of the synchronous-asynchronous blended learning approach on student comprehension and performance in the MEB2053 ME Thermodynamics 1 course. The interactive video and enhanced asynchronous materials played a crucial role in facilitating students' understanding of complex concepts and improving their overall performance. These findings emphasize the value of incorporating technology-driven, student-centered approaches in higher education to enhance student learning outcomes.

Based on the remarks provided by the students, the results of the study indicate that the use of interactive videos in the blended learning approach had several positive aspects. The ability to control the speed, repeat sections, and have flexibility in watching the videos was appreciated by the students. The videos served as a useful tool for reviewing and refreshing their understanding of the topics covered in class.

However, some students expressed concerns about relying solely on interactive materials. They highlighted the importance of having a balance between interactive materials and traditional lecture-based teaching. They recognized that while the interactive videos were helpful, they should not be the sole source of instruction. The students valued learning activities and group discussions as complementary components to enhance their understanding.

Students found the interactive videos valuable for learning, with appropriate pace and helpful features like pausing and repeating. They acknowledged the importance of face-to-face teaching, emphasizing the value of group discussions and an instructor's presence. The students' remarks affirmed the positive impact of interactive videos in blended learning, providing flexibility and enhancing comprehension. However, they also recognized the significance of incorporating other methods like traditional lectures and group discussions for a well-rounded learning experience. A combination of interactive videos, collaborative activities, and face-to-face teaching optimizes student engagement and comprehension in thermodynamics.

4 Conclusion

In conclusion, the study demonstrates the effectiveness of a synchronous-asynchronous blended learning approach in stimulating student comprehension and improving performance in the MEB2053 ME Thermodynamics 1 course. The incorporation of interactive videos and enhanced asynchronous materials positively influenced student understanding and engagement. The students' positive perceptions and satisfaction further support the efficacy of the blended learning approach. The improvement in student performance on Exam 1 and the overall performance of the entire batch indicate the positive impact of the blended learning approach on student achievement. These findings highlight the value of integrating technology-driven, student-centered approaches in higher education to enhance learning outcomes. By leveraging interactive and asynchronous elements, educators can promote active engagement, improve comprehension, and optimize academic achievement.

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Blended Learning Implementation in STEAM Programs: A Vietnamese Case Study of Digital Transformation in Teaching

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Abstract. STEAM (Science, Technology, Engineering, Arts, and Mathematics), which is changing educational paradigms by incorporating art into STEM (science, technology, engineering, and mathematics) subjects. Blended learning is considered to be an innovative approach to develop students' competencies in STEAM program. Therefore, the main purpose of this study is to investigate how lecturers and administrators of a Vietnamese schools perceive the benefits and challenges of blended learning for developing students' competencies in STEAM programs. The qualitative data were collected from semi-structure interviews with one academic head, two heads of department and three full time lecturers from three Vietnamese schools. This paper also provides practical implications for the Vietnamese schools how to implement blended learning in STEAM programs effectively in future.

Keywords: Applied computing · Education · Collaborative learning

Additional Keywords and Phrases: STEAM Education · Blended learning · Competency

1 Introduction

STEM education faces tough challenges in terms of resource issues, decrease of interest in STEM related professions and courses, progress in innovation and lifelong education. In addition, many developed and developing countries face the lack of labor force with high skills and innovative mindsets for economic development as well as call for the need of reform in STEM education. Consequently, STEAM education has been emerged to address the above challenges.

Most importantly, to respond to the rapid change in the context of Industrial Revolution 4.0, students are expected to become skillful communicators, creators, critical thinkers, and collaborators (the "4Cs"). It also calls for the need of innovative teaching and learning activities to develop 21st century for students in general and students in STEAM programs in particular.

Instructors often choose to employ blended learning strategies to better prepare their students for university and careers in today's more technologically-focused society [1].

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Blended learning is a catalytic approach to education that combines the advantages of online learning, where students and teachers can employ the educational technology to open the open world of knowledge, with the combination of face-to-face sessions and beyond class support [2]. In addition, students are able to acquire the crucial 21st century skills necessary for success in a society that is more dependent on technology because of the blended learning phenomenon that arises from the pedagogical practice of blending face-to-face instruction with innovative technologies [3]. Instructors are urged to give students greater opportunities to practice and enhance their 21st-century abilities by designing learning materials utilizing appropriate blended learning strategies [4]. Importantly, the culture of blended learning opens the door to individualized and authentic lessons that target the specific knowledge and abilities of each learner at their individual, optimal rate of acquisition [1].

2 Literature Review

2.1 STEAM Education for Developing 21st Century Skills

Students are actively involved in their own learning and develop the 21st-century skills necessary for global competence through STEAM education. In particular, STEAM education aims to improve students' cognitive development as well as their ability to think critically, solve problems, and be creative [5]. The 4Cs of 21st-century abilities include creativity, critical thinking, collaboration, and communication, and they are all interwoven into STEAM education. Students work together to generate original answers to contemporary issues and to communicate their findings to others. The students' communication skills will therefore increase. Students can feel free to take risks in a risk-free atmosphere thanks to STEAM education. In a calm and unstructured setting, students will be able to share fresh ideas, which will promote creativity. Group discussions are a part of STEAM education, which improves student collaboration. Finally, STEAM education encourages students to think critically about a range of topics, which promotes critical thinking skill [6].

2.2 Benefits of Blended Learning for Developing Students' Competencies

Several studies supported the findings, as blended learning was used to increase students' 4Cs (Communication, Collaboration, Critical Thinking and Creativity) skills. Many prior research show that collaboration and communication between students and between students and teachers occur more frequently in blended learning courses [7]. According to [8], lecturers had opportunities to understand students' learning individually in order to support their "active learning and reflective learning" in blended learning courses. According to the findings of [9], after applying blended-problem-based learning, students are capable of developing critical thinking abilities in order to develop basic skills, provide further explanations, suggest solutions to issues, and draw suitable conclusions. Interestingly, the findings of the research by [10] revealed that blended learning, defined as a combination of online and face-to-face learning, significantly improved students' creative thinking skills.

2.3 Challenges of Blended Learning for Developing Students' Competencies

Previous studies have identified a number of main challenges of blended learning for students. Blended learning made it more challenging for students to arrange their virtual and real-world objectives and required a greater time commitment to participate in the discussion on a regular basis [11]. Later, [12] described blended learning as a burden, both physically and intellectually. [13] found that students had difficulties with self-discipline and time management in relation to their own studying. In the meantime, the findings of [14] reported that some students were not autonomous in their online learning and were not actively engaged in their offline classes. Many students, for instance, found it difficult to assume responsibility for their own studies at home since they are easily distracted. Therefore, these individuals were unprepared for active learning in offline classrooms since they were unable to observe the entire course videos or fully comprehend the video content [14]. Last but importantly, several students would delay doing their homework until the last minute and would occasionally encounter technological difficulties [15].

In summary, there are currently few studies on the benefits and challenges of implementing blended learning in STEAM programs at schools from the viewpoints of various stakeholders at the same time. To close the research gap, this study should be carried out.

3 Methodology

The research site is a Vietnamese school system with multi campuses throughout Vietnam and provides multi programs besides the national education program including STEAM, Robotics, IT, Personal Development Program, Global English… The semi-structured interviews will be employed to investigate how **one academic head, two heads of department and three full time lecturers** at three campuses of the school system to investigate benefits and challenges as employing blended learning for developing students' competencies. The interview participants come Hanoi and Can Tho campuses.

For two key reasons, the current study has employed the semi-structured interview using open-ended questions to elicit the viewpoints of interviewees: (i) The semi-structured interview is useful for collecting comparable data since all interviewees respond to the same set of questions [16]. Therefore, interviewer bias will be minimized using this method [17]; and (ii) The semi-structured interview is practical for many important tasks, particularly since more than a few "open-ended questions" request inquiries [18, p. 493].

4 Findings

4.1 Perceptions Toward Benefits of Blended Learning for Developing Students' Competencies

Six interviewees responded that the blended learning aimed to promote student's competencies as follows: 4C (Communication, Collaboration, Critical thinking, and Creativity) skills, problem-solving skill, foreign language skill, time management skills, and lifelong learning skill.

The Academic Head at Can Tho campus (AH1) shared how blended learning enabled students to develop the following skills:

"Offline sessions help students gain skills in collaboration, communication, problem solving, and critical thinking." (AH1)

The Head of Personal Development Program Department at Can Tho campus (H2) also mentioned about offering an active learning environment to promote students' problem-solving skills as implementing blended learning. Besides, he also highlighted about building up the life-long learning skills for students.

"They can study and solve problems by themselves. Students can have independent *judgments to determine which content to focus on in their future learning and working." (H2)*

Additionally, The Head of Social Science Subjects at Hanoi campus (H1) stated that blended learning provided opportunities to develop students' competencies listed below:

+ *Independence*
+ *Responsibility*
+ *Creativity*
+ *Foreign language skill*

The Global English lecturer from Hanoi campus (L1) noted about the ways of obtaining critical thinking and problem solving as the peer review and assignments were conducted seriously during their blended courses.

If peer review is done in a serious way, it can help students learn how to think critically. Students can learn to be creative and solve problems if they take the time to do their assignments carefully and seriously. (L1)

The natural science lecturer from Can Tho campus (L2) presented about the time management skills as student self-study online learning materials before engaging in offline sessions. L2 also agreed with H1 about developing foreign language skills as students had opportunities to self-study online courseware (slides, videos, quiz, and Assignment) in English.

As mentioned, they learn time management by meeting course deadlines and submitting the certificate on time. These two classes have English subtitles, not Vietnamese, which improves students' foreign language skills. Students require listening and reading abilities to comprehend them. (L2)

Lastly, the Information Technology lecturer from Hanoi campus (L3) stated that student could be confident to think and create solutions for a new problem and master knowledge if they studied the blended courses seriously.

4.2 Perceptions Toward Challenges of Blended Learning for Developing Students' Competencies

Six interviewees showed that the blended learning faced some key challenges to promote students' competencies during the blended learning implementation as follows: not being familiar with self-study in the blended learning method, the inconvenient agenda of offline sessions, the ineffective assignment peer review, lack of engagement in the offline sessions, and the incompatible learning content.

The AH1 commented the 1st challenge – the student habit of learning.

They've taken notes from offline instructors since school. Students—even parents—complained when we mixed online and offline learning. Parents inquired why the teacher didn't lecture. The university's idea is to manage and organize students' self-learning, but our students' lack of this habit of learning is the first challenge. So they should've learnt the active learning skills since school to prepare for self-study in higher education. (AH1).

Next, H1 noted about the agenda of offline sessions are not convenient for students.

For the offline sessions, Saturday meetings are difficult for students to come. Without attending offline classes, some pupils might not understand the lessons well.

Additionally, H2 pointed out the issue of the assignment peer review. This might a risk affecting the quality of blended learning implementation.

The integrity of the students' peer reviews has been compromised. They consistently give one another highly positive reviews, but it is impossible to verify the accuracy of those evaluations.

Similarly, L1 also complained about of the assign peer review. Furthermore, she also presented about lack of interaction both between students and students, and between students and lecturers.

Peer review is not very good because many people review without thinking. People who only wrote "haha, hihi, hoho" still got a grade. This kind of peer review doesn't work. Students have little direct engagement with their instructors and the peer. (l1)

Importantly, regarding the learning material, L2 mentioned about the disagreement between content of the course and the level of students.

The course learning materials are complicated and are incompatible with the students. (L2)

Lastly, L3 described about the limitation of the assignment peer review.

The limitation of this method is that it empowers students to evaluate each other. People with bad learning attitudes in the peer review will affect people who have good ones. (L3)

5 Discussions

5.1 Perceptions Toward Benefits of Blended Learning for Developing Students' Competencies

The findings of interviews noted that blended learning could enable student to develop 4C skills including communication, collaboration, critical thinking, and creativity. These results agree with the findings of [7, 8], and [9]. Additionally, it was found that blended learning also enhanced time management skills. This is quite right with the finding of [19] as revealing that the blended learning model was a more effective method for teaching self-management skills than the traditional learning. Interesting, blended learning can be an effective way to build up student's lifelong learning skill. This was also mentioned in the finding of [20] in which blended learning would be truly successful only if it attempted to improve pedagogy by transitioning from an information transmission model to a pedagogy customized to the needs of lifelong learners.

5.2 Perceptions Toward Challenges of Blended Learning for Developing Students' Competencies

This interview revealed that students were unfamiliar with being autonomous in their online learning and lack of self-discipline as well as still required the much presence and direct support of the lecturers as they were used to experience at their high schools. This aligns with the result of [13, 14]. Furthermore, inconvenient agenda of offline sessions made them challenging to arrange their time to attend. This challenge is found in the result of [11]. The lack of engagement in the offline sessions is also an issue faced in the blended courses, similar to the result of [14]. Seriously, three interviewees emphasized that the assignment peer review was not conducted seriously as students did not put much effort and time to do as required. Lastly, the learning content that is really complicated can make a great burden for the students in this case, aligning with the finding in the study of [12].

6 Conclusion

The interview findings indicated using blended learning in STEAM program can be beneficial for students' competencies as follows: 4C (Communication, Collaboration, Critical thinking, and Creativity) skills, problem-solving skill, foreign language skill, time management skills, and lifelong learning skill. On the other hand, blended learning also faced the challenges in developing students' competencies in STEAM programs. The challenges are listed below: not being familiar with self-study in the blended learning method, the inconvenient agenda of offline sessions, the ineffective assignment peer review, lack of engagement in the offline sessions, and the incompatible learning content. It is implied for practices, the school needs to improve the following dimensions: (1) monitoring and controlling the assignment peer review in a serious manner, (2) building an electronic tool aiming for reminding them about the deadlines in their blended courses, (3) and creating the learning activities tailoring to students' own needs to encourage them to actively engage in offline sessions.

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Collaborative Learning in Control Systems Using a Revised Team-Based Approach

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Abstract. Teaching control systems courses solely through lectures are only sometimes effective in preparing students for practical applications and problem-solving scenarios. A revised team-based learning approach has been implemented in a control systems course to address this issue. The objective is to help students better understand control system concepts, promote cooperation and teamwork, and enhance their problem-solving skills. This paper details the changes in the course learning outcomes since the implementation of team-based collaborative learning, which was partly based on student evaluations. Additionally, the survey used to evaluate the revised team-based collaborative learning approach demonstrates that the revised version effectively teaches technical content and improves problem-solving, professional development, and interpersonal team skills in a junior-level control systems course.

Keywords: Team-based Learning Approach · Student-centered Learning · Control Systems Course · Collaborative Learning · Revised Approach

1 Introduction

Studies in education have proven that implementing student-centred active learning techniques positively impacts students [1]. Active learning entails involving students in the learning process by encouraging them to think critically, tackle problems, work with their peers, and apply their knowledge in practical situations. Educational research has shown that student-centred active learning has numerous benefits [2, 3]:

- It helps improve retention and understanding as students are more likely to remember and comprehend what they have learned by actively engaging with the material.
- It enhances critical thinking skills as students are encouraged to analyse information, evaluate different perspectives, and apply necessary thinking skills to solve complex problems.

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- It increases motivation and engagement by creating a more engaging and interactive learning environment.
- It helps improve collaboration and communication skills, as many active learning strategies involve group work and collaborative activities.
- It better prepares students for real-world challenges as active learning approaches often simulate real-world scenarios.
- It promotes increased diversity and inclusivity by encouraging participation from all students, regardless of their background or learning style.

Teachers have several options for student-centred active learning strategies that they can use in the classroom [4, 5]. One method is problem-based learning, where students work in groups to find solutions to real-world problems or scenarios [6]. Another is project-based learning, where students undertake long-term projects to explore their interests and develop critical thinking, problem-solving, and collaboration skills [7]. Inquiry-based learning fosters students' curiosity and improves their ability to ask questions, investigate, and discover new knowledge independently. Collaborative learning involves group work and activities that promote communication, teamwork, and idea exchange. In the flipped classroom approach, students acquire new content outside of the lecture and then apply and enhance their understanding with the teacher's supervision during interactive activities, discussions, and problem-solving exercises in the flipped classroom approach [8, 9]. Simulations and role-playing activities provide an immersive learning experience, allowing students to engage in problem-solving and decision-making in a realistic context. Finally, Team-based learning (TBL) emphasises collaborative learning in teams. In TBL, students are organised into diverse groups and participate in a structured process involving individual and team-based activities [10].

Among the above student-centred active learning strategies, TBL benefits students and instructors by promoting engagement, teamwork, communication, and critical thinking skills [10, 11]. TBL fosters individual accountability and prompt feedback, leading to deeper learning and knowledge transfer. Instructors act as facilitators, promoting meaningful interactions and a supportive learning environment. In TBL, students are divided into diverse teams based on their abilities, backgrounds, and perspectives. Before each class, students study preparatory materials like readings, videos, or online modules to ensure all team members understand the upcoming topic. At the start of each session, teams take an individual readiness assurance test (iRAT) to gauge their grasp of the materials. Then, they take the same test as a group, known as the team readiness assurance test (tRAT), to encourage discussion and collaboration. Following this, teams engage in application exercises (AEs) where they apply their knowledge to solve problems or complete tasks while discussing and debating ideas. The instructor is a facilitator and resource, offering guidance and explanations when necessary. This approach promotes essential professional skills such as communication, collaboration, critical analysis, and problem-solving [12–14]. The overview of the TBL process is shown in Fig. 1.

According to [15], students could learn course material more effectively and develop professional skills through TBL compared to traditional lecture-based instruction. This spurred an endeavor to employ TBL as the control systems course's primary teaching and learning technique in the Departments of Electrical and Electronic Engineering at the Universiti Teknologi PETRONAS (UTP), Malaysia, and Alliance University (AU),

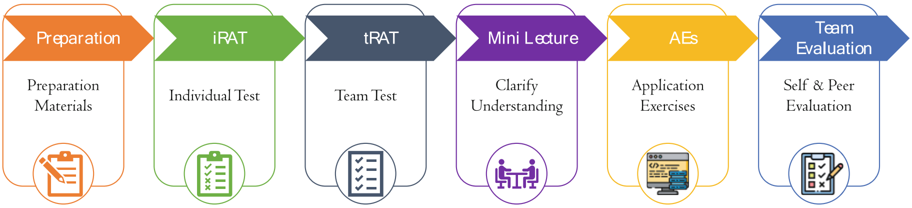


Fig. 1. Steps in revised team-based approach.

Bangalore, India. The control systems courses at UTP and AU both cover different technical aspects. At UTP, the course mainly focuses on transfer functions, time-domain analysis, stability analysis, and the design of PID controllers. On the other hand, the course at AU introduces linear time-invariant systems and focuses on Laplace transforms with a brief overview of state space formulation. Both methods provide a foundation in time/frequency analysis of strategies and feedback control, and the learning outcomes are detailed further in subsequent sections.

Implementing TBL in the control systems course at both universities presented practical challenges. These included students needing more motivation to study independently and learn new material before class and difficulties with group work participation during class. Modifications were made to the traditional TBL approach to address these issues, resulting in positive outcomes. This paper briefly overviews the changes made to successfully implement TBL in the control systems course at both universities.

2 Conventional TBL Approach

In the TBL approach, the instructor creates teams of 5 to 7 students for the entire semester, ensuring diversity in gender, talent, ethnicity, and other pertinent criteria to develop effective learning units. The variety of the team provides group dynamics problems that prepare students for the job. Furthermore, the distribution of talent among teams is consistent to avoid practical issues created by some teams completing projects substantially earlier or later than others. The team size of 5–7 provides enough intellectual resources to complete group assignments successfully. The course is divided into eight major content units, each lasting for 1–2 weeks and 3 phases, as explained below.

In Phase 1, students will be given reading assignments for a 1–2 week unit. This phase is intended to provide students with an excellent introduction to the topic without requiring them to comprehend it fully. This phase occurs outside of class and before any formal classroom discussions. After the allotted preparation time, the first-class session will include a Readiness Assurance Process, which will involve a brief, objective readiness test on the assigned reading. Each student will take the test individually and again as part of their team. Both test scores will be recorded and contribute towards their final grades. If needed, the instructor may briefly lecture on areas where the students struggled on the readiness test. The goal of Phase 1 is to ensure that students have a basic understanding of the material, enabling them to engage in more comprehensive learning through group work.

During the second phase of the content unit, which takes about 2–3 weeks, students will work in teams to tackle more complex applications and issues related to the concepts they learned in Phase 1. The biggest challenge for educators using TBL is creating practical assignments that help encourage teamwork. The tasks must be challenging enough for team members to require assistance from one another but also precise enough that they cannot be broken into smaller portions and allocated to various team members. Fortunately, textbook problems are perfect for group assignments in the control systems course, making it easier to create practical lessons. The goals of this phase are twofold: to assist students in achieving the necessary level of conceptual comprehension and to aid in developing their teamwork capabilities. This is achieved through a designated group work protocol, which includes being prepared for class, utilising practical interpersonal skills, and completing assignments as a cohesive unit, unlike in PBL. The instructor provides consistent feedback on student's grasp of course content and collaborative growth during this group work.

During Phase 3, students will take an individual summative exam on the content covered during the 2–3 week period. Their grades for that course section will be determined by their exam scores.

3 Revised TBL Approach for Control Systems

The authors of this paper have implemented TBL in two semesters while teaching the control systems course at both universities. While incorporating, four modifications to the traditional TBL method have been proposed. These modifications include (i) Using the course learning outcome, (ii) Reducing team size, (iii) Reducing readiness cycles' length, and (iv) Modifying problem-solving design. In a course, the learning outcome statements define the knowledge, understanding, and skills students should possess by the end. These statements usually reflect the course's objectives and guide the development of lectures and the evaluation of student progress. The control systems course at UTP and AU comprises five significant modules, each with a content-related learning outcome. Therefore, the course has five learning outcomes in Tables 1 and 2. Apart from these technical outcomes, a sixth non-technical outcome is included in the revised TBL approach, which requires students to produce a logbook demonstrating teamwork readiness and involvement. This outcome evaluates students' progress in non-technical professional skills, motivates them to prepare for lectures and participate in teamwork assignments, and addresses the practical challenges of using conventional TBL in both universities' courses.

Another suggested change in the traditional TBL process is the size of learning groups. Originally, teams of five to seven students were proposed, but it was found that some students may need to be noticed or are unwilling to participate at the junior level in larger teams. To address this problem, a group of three has proven more effective in providing sufficient intellectual resources to solve the issues and minimise the possibility of students avoiding participation. Additionally, a three-person team can easily communicate among all members and arrange their chairs in a circular pattern in the Learning Hubs. These changes encourage participation in group work and help students develop valuable teamwork skills.

Table 1. Using the course learning outcome for the control systems course at UTP.

Course Learning Outcomes for Control Systems Course at UTP	
At the end of the course, the students will be able to:	
CLO1	Identify and formulate effective control strategies for complex systems
CLO2	Develop and analyse system models using mathematical and engineering principles
CLO3	Analyse and enhance the system performance of the dynamic system
CLO4	Evaluate and enhance system performance using suitable analytical, graphical, and computational tools for the frequency response of dynamical systems
CLO5	Design and evaluate effective control strategies for complex system
CLO6	Produce a logbook demonstrating teamwork readiness and involvement

Table 2. Using the course learning outcome for the control systems course at AU.

Course Learning Outcomes for Control Systems Course at AU	
At the end of the course, the students will be able to:	
CLO1	Develop the mathematical model of the physical systems
CLO2	Analyse the response of the closed and open loop systems
CLO3	Analyse the stability of the closed and open loop systems
CLO4	Design the various kinds of compensators
CLO5	Develop and analyse state space models
CLO6	Produce a logbook demonstrating teamwork readiness and involvement

Further, it's essential to recognise that the initial reading material is just a tiny portion of the course content for students new to control systems. Control systems are structured hierarchically, meaning each new topic builds upon the previous one. To fully comprehend an issue, it's necessary first to master the material that came before it. However, this can be difficult for junior engineering students who need assistance understanding the fundamentals. The time required to reach readiness during the planning stage has been reduced to make the process more manageable. The updated version of TBL now includes a readiness assignment consisting of easy-to-understand problems and readings related to the new material that will be discussed during the following tutorial rather than waiting for a couple of weeks. Typically, the assessment covers only a few course content sections, not the entire course. There will be a brief test to complete the task at the end, but the instructor may only administer it with prior notice. This change encourages the development of professional skills related to independent learning.

The TBL strategy has been revised to focus on improving how student teams approach group work, emphasising enhancing problem-solving and teamwork skills. To accomplish this, a specific problem-solving method has been incorporated, emphasising practical interpersonal skill development. The process involves individual reflection on the problem, brainstorming as a team, considering different solutions, and then working together to implement the agreed-upon approach iteratively. The course uses textbook problems for group assignments and tutorials. The instructor selects problems of increasing difficulty to ensure that students meet the requirements by the end of the assigned period.

4 Evaluation of Revised TBL Approach

The revised TBL approach will be evaluated by measuring the students' achievement of both technical and non-technical course learning outcomes by the end of the control systems course at both universities. Thus, an evaluation survey was conducted at the end of the semester to determine the attainment of technical and non-technical course learning outcomes.

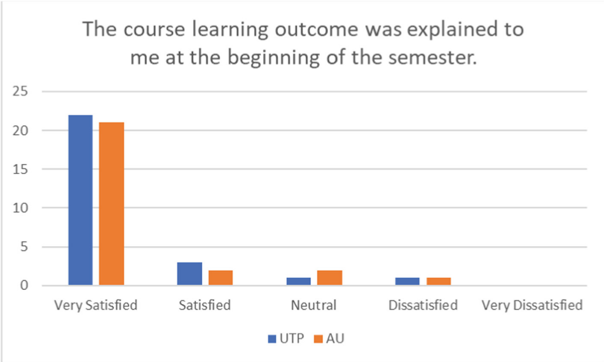
The survey questions related to the technical course learning outcomes used at both universities are given as follows:

- The course learning outcome was explained to me at the beginning of the semester.
- The course learning outcome helps me understand the expectations of what I should be able to do at the end of the course.
- The course outline helps me prepare for the teaching and learning activities throughout the semester.

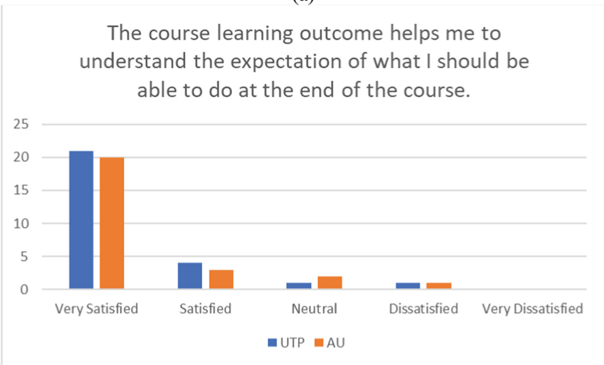
A technical survey on course learning outcome attainment has been conducted to assess a technical course's learning outcomes. The survey was completed by 53 students, 27 from UTP and 26 from AU. According to Fig. 2, over 85% of students reported being satisfied with their achievements. This high level of satisfaction can be attributed to the fact that students were informed of the course learning outcomes at the beginning of the semester. This helped them understand what they were expected to accomplish by the end of the course. Additionally, the course outline helped them prepare for their learning and teaching activities throughout the semester. Similarly, the students' self-reported attainment of all five-course learning outcomes, as given in Tables I and II, respectively, at UTP and AU, is shown in Fig. 3. The figure shows that attainment is between medium and high emphasis for all five-course learning outcomes at both universities.

Further, the survey questions related to the non-technical course learning outcomes (TBL) used at both universities are given as follows:

Q1. How beneficial was the team-based learning approach in enhancing your technical content learning of control system concepts?
Q2. How beneficial was the team-based learning approach to enhancing the development of your professional skills?
Q3. How often did you actively engage in discussions and problem-solving with your team members in the team-based learning setting?
Q4. How well did the team-based learning approach promote student collaboration and teamwork?
Q5. Can you apply the knowledge and skills learned through team-based learning in real-world control system scenarios?



(a)



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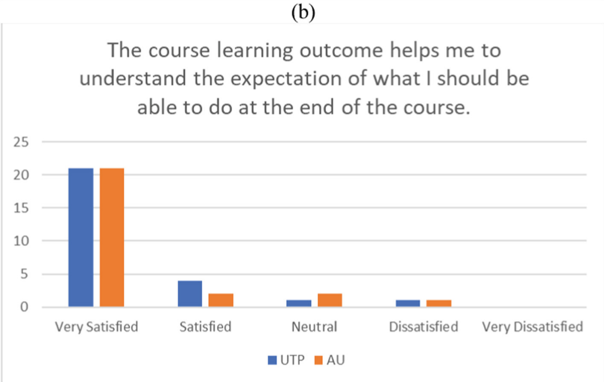

(c)

Fig. 2. Students' self-reported technical course learning outcome survey at UTP and AU.

Q6. How did the team-based learning approach contribute to your problem-solving skills in control systems?
Q7. Did the team-based learning approach provide opportunities to learn from your peers and their diverse perspectives?
Q8. Did the team-based learning approach enhance your ability to effectively communicate and present control system concepts?

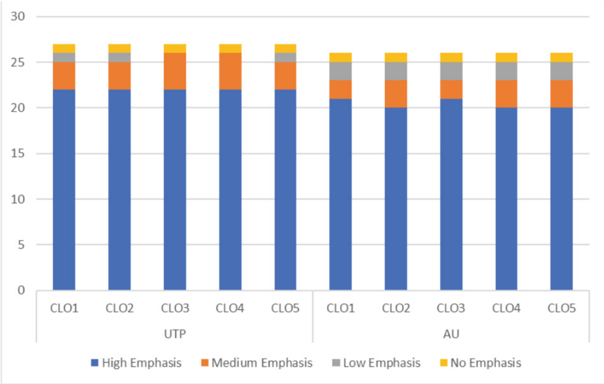

Fig. 3. Students' self-reported course learning outcome attainment at UTP and AU.

Q9. Overall, how satisfied are you with the team-based learning approach for the Control Systems course?
Q10. How did the team-based learning approach in the Control Systems course contribute to your ability to work effectively in a collaborative team environment?

Thus, a non-technical survey on the TBL-based course learning outcome attainment has been conducted to assess problem-solving, professional development, and interpersonal team skills. The survey was also completed by 53 students, 27 from UTP and 26 from AU. Thus, the students' self-reported non-technical survey on the TBL-based course learning outcome at UTP and AU is shown in Fig. 4. Based on the feedback; most university participants found the team-based learning approach beneficial in understanding control system concepts. Around 77.3% of the respondents felt it helped develop their professional skills. The team-based learning sessions effectively promoted collaboration, and most participants were actively engaged during these sessions. Of the 27 individuals who participated in team-based learning for control system situations at UTP, 15 have extensively applied the knowledge and skills gained. In comparison, eight individuals have used it to some extent. It's worth noting that no data is available for those who did not participate, and four individuals have utilised it sparingly. Overall, 60% of the participants from both universities reported a significant improvement in problem-solving skills, 40% reported some progress, and only 13% said the approach had no significant impact. Furthermore, most participants could effectively communicate and present control system concepts after the team-based learning approach. The feedback for the team-based learning approach in the Control Systems course was generally positive, with many students improving their teamwork skills through this approach.

Fig. 4. Students' self-reported non-technical survey on the TBL-based course learning outcome attainment survey at UTP and AU

5 Conclusion

A revised approach to TBL is proposed in this paper, which can be effectively implemented in the control systems course to enhance the development of professional skills and technical knowledge. This revised TBL method has been successfully tested in two universities across two semesters, incorporating four modifications to the traditional TBL approach. These modifications include utilising the course learning outcome, reducing team size, shortening readiness cycles, and modifying problem-solving design. A survey of students from UTP and AU found that most participants found team-based learning beneficial in understanding control system concepts. Respondents felt it helped develop their professional skills and promoted effective collaboration. Out of the individuals who participated in team-based learning at UTP and AU, they reported a significant improvement in problem-solving skills and could effectively communicate control system concepts. The feedback for this approach was generally positive, with many students improving their teamwork skills.

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Concept Mapping: A Tool for Integrated Cognitive and Affective Learning in Genetics Among Foundation in Medical Sciences (FMS) Students

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Abstract. Concepts in genetics are intricate and complicated when taught only through didactic lectures. Tutorials, case-based discussions, and small-group learning are essential for deepening conceptual and contextual learning in genetics. Seminar is a student-centered small group activity that elicits deep learning in students and imparts both self-directed and collaborative learning. Seminar is an educational tool that contributes to both cognitive and affective domains. Unfortunately, it lacks active and collaborative learning by students and proper assessment of outcomes. Concept maps (CM) are one of the approaches to overcome these challenges. Therefore, CMs were introduced for presentation during the seminar. Students (n = 87) were divided into groups, assigned topics in genetics that were covered in large groups during the lecture, and given time to create the CMs and present them during the seminar. At the end of each presentation, an evaluation was obtained from the other participants. The CMs, and their presentation were assessed using rubrics. A questionnaire was used to collect feedback from the students. The data obtained during the session showed that students were able to internalize what they have learned, work collaboratively on their ideas, and communicate effectively with their classmates. The results showed significant improvement in the final examination scores when compared to the mid-term assessment scores, and the feedback reflected the students' learning and motivation during the process. In conclusion, based on the feedback and the results of this approach, this method could be adopted as an integrated cognitive and affective learning and as an assessment tool.

Keywords: Concept map · Cognitive learning · Affective learning

1 Introduction

Concepts in genetics are often elusive and are often considered as a 'difficult subject' by the medical students. Didactic lectures are not sufficient to maximize student learning in genetics. Interactive activities and discussions enhance the student's learning. Small group learning such as tutorials and seminars embark active learning and ignite critical

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thinking and problem-solving skills and reflect attitudes [1]. Seminar, a student-centered teaching learning (T-L) method emphasizes the importance of active learning in students. Seminar is also a small group T-L activity in which the students prepare the content in groups under the guidance of an expert and present the knowledge they have gained in an organized presentable format. The art of communication, group dynamics, digital skills, cognitive learning, problem solving skills and attitude are part of the learning in this T-L method. The seminar contributes to both cognitive and affective learning domains. Unfortunately, there is lack of active learning among the students and is skewed towards passive learning with no interaction or discussion from the peers. Concept map (CM) is one such T-L method that can overcome this challenge.

CMs are visual representations that aid in organizing and relating information. CM summarizes and integrates the concepts, complex concepts are made easy to understand, and increases the 'role' of students learning [2]. They serve as a tool for internalizing the learning process. CMs are used for both individual learning and collaborative learning. It enhances self-directed learning and deep learning [3]. CMs foster the development of higher order thinking skills such as analysis, evaluation, and synthesis. CMs improve the ability of the students to communicate complex ideas effectively. Use of technology in CMs improves the sophisticated creation of CMs and their permanence aids in the long-term record of the students work and in assessment [4, 5]. It is a better approach for formative assessment and diagnostic assessment and has been used for summative assessment with reliable rubrics.

Hence, to foster active learning, an attempt was made to modify the seminar session in the genetic course with the introduction of CMs for presentation. The use of CMs with the help of technology was introduced to increase student involvement and motivation, and the outcomes of the CM strategy were studied.

2 Methods

2.1 Participants

The batch of 87 students enrolled in the foundation of medical science (FMS) programme were divided into sub-groups with five students in each group. The grouping followed the order of student attendance list. The topics were selected from the lectures covered and were randomly assigned to the groups using a tool, 'Wheel of Names'. After the allocation of topics, the students were asked to work in groups for two hours to outline the contents and prepare a CM. Use of technology such as Canva, mind Meister, CMAP or PowerPoint or any other digital/AI tool that they were comfortable with was encouraged to create CMs rather than conventional paper pen method. The students were asked to continue their teamwork online to finalize the CM they had prepared and present the map in 7 min followed by 3 min Q & A and feedback from the peers the next day.

2.2 Data Collection

The technology enhanced CM (TECM) were assessed using a simple rubric which covered the following aspects, (i) accuracy of concepts covered, (ii) relationship between the concepts using the links and linking words, (iii) differentiation of the topics using branches, (iv) hierarchy and integration between concepts, and (v) use of example to explain the concepts. Mid -term assessment grade scores and semester final exam grade scores were collected. Feedback was obtained from the students using a 5-point Likert scale regarding their learning experience and the usefulness of concept mapping approach in their learning.

Student performance was assessed using the mid-term and final exam scores. The test contained multiple-choice questions (MCQs) and Short Answer Questions (SAQs). Statistical analysis was conducted using SPSS (Version 21.0). The feedback obtained from the students is expressed as mean ± SD. The assessment scores were calculated using paired sample t-test.

2.3 Administrative and Ethical Considerations

Permission to analyse the data and the outcome of the teaching learning method using TECMs was obtained from the Head of the Department.

3 Results

The use of TECMs was introduced as a part of enhancing the teaching-learning activity. Instead of using PowerPoint with 10–15 slides for a seminar presentation, CMs were introduced. The students were encouraged to present the topic using one CM on a slide. All the students showed interest in the preparation of CMs during the first two hours. The students prepared CMs using CANVA and PowerPoint which were very familiar to them. Based on the assessment scores and feedback using closed and open-ended questions from the students, the following results are interpreted. The inferences and generalization of feedback form on the perception of the usefulness of the TECMs is using mean score. The mean score is interpreted based on the values obtained as follows: Strongly disagree: 1.0–1.8; Disagree: 1.9–2.6; Neither disagree nor agree: 2.7–3.4; Agree: 3.5–4.2; Strongly agree: 4.3–5.0.

The feedback from the students on the usefulness of TECMs were promising. Based on the results presented in Table 1, it is suggested that all the students strongly agreed that the presentation using TECMs were interesting. They agreed that working as a team in the preparation of TECMs were interesting. Some students who were individual learners preferred to opt for group study and use concept mapping method in their regular learning process. The students strongly agreed that this method of learning helped them to revise the topic. Additionally it helped them to comprehend the topic well as their understanding was better than the knowledge gained through the didactic lecture. The mean score of the feedback on the usefulness of the TECMs are highly significant ($t = 76.62$, $p < 0.001$) (Table 2). Preparation of TECMs was the first time experience for 73 students and around 63 students preferred group study using TECMs rather than individual study (Fig. 1).

The assessment scores before and after the use of CMs are detailed in Table 3. Mid-term assessment was conducted after the didactic lectures. The final exam was conducted after the introduction of using CMs in their learning during a seminar. According

Table 1. The mean score on the feedback from the students on their perception of the usefulness of TECM in their learning.

S. No	Question Items	Mean ± SD	Score interpretation
1	Presentation of a topic using concept maps was interesting	4.52 ± 0.68	Strongly agree
2	Concept map preparation as a teamwork was very interesting	4.48 ± 0.59	Strongly agree
3	Preparation of concept maps helped to revise the topic	4.55 ± 0.59	Strongly agree
4	Concept maps helped me to understand the topic better than the knowledge I gained through lecture	4.03 ± 0.98	Agree

Table 2. Mean score of the of the feedback.

Mean ± SD	t test	Significance
4.4 ± 0.53	76.62	0.000

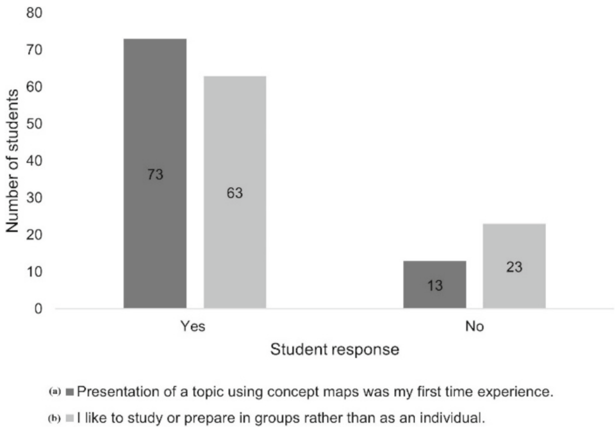

Fig. 1. Figure showing the experience (a) and interest (b) of students in using concept maps for learning.

to Table 3, final exam and mid-term assessment scores were strongly and positively correlated ($r = 0.659$, $p < 0.001$). The final exam marks excluding the continuous assessment marks also strongly and positively correlated with the mid-term assessment marks. There was a significant average difference between final exam and mid-term assessment ($t = 27.42$, $p < 0.001$) and between the external marks of final exam and mid-term assessment ($t = 11.84$, $p < 0.001$). On average, final exam scores were 16.62

Table 3. Assessment scores of the students before and after the use of TECM.

S. No	Paired scores	Mean ± SD	t test	Significance	Correlation (r)
1	Final Exam – Mid Term Assessment	16.62 ± 5.65	27.42	0.000	0.659
2	Final Exam (External) – Mid Term Assessment	10.06 ± 8.30	11.84	0.000	0.530

points higher than mid-term assessment scores (95% confidence interval (CI) (15.42, 17.83) and the external marks of final exam excluding continuous assessment scores were 10.06 points higher than mid-term assessment (8.30, 11.84).

The scores of the students seemed to be significantly improved than the mid-term assessment after the use of CMs. The feedback given by the students was reflected in the scores that they obtained.

4 Discussion

The essential requirement for a student is to apply the concepts they learnt in the classroom to different contexts. The use of traditional methods of teaching and learning limits the ability of the students to conceptualize the knowledge they have gained. CM is an educational tool that can be used for problem-solving exercises, plan studies, revision of topics, organize and relate the topics and facilitate the development of richer knowledge frameworks [6]. FMS is a course offered for students who complete Sijil Pelajaran Malaysia (SPM) conducted by the Ministry of Education to facilitate their smooth transition into medical or pharmacy program. Basic genetics is one of the subjects offered to the FMS students in the second semester. Genetics is a subject that deals with the involvement of genes in health and disease. Without understanding the basic concepts in genetics, it is not possible to understand the factors that contribute to the cause of diseases. The students often find it difficult to link the concepts in genetics and often complain that the contents are too high in genetics. Therefore, to facilitate the learning among FMS students and to inculcate contextualizing skills among the students, a concept mapping technique was introduced. Seminar is an instructional technique of higher order thinking skills. The seminar fulfills both cognitive and affective objectives. Seminars motivate and involve the participants through discussion and interaction with facilitators and peers. Participants expand their existing knowledge and ideas through discussion while also exploring new knowledge. Seminars generate and sustain interest, attention, problem-solving skill and critical thinking [7]. Therefore, the seminar was identified as a suitable platform to ensure the participation of all the students.

Utilizing CMs for learning provides opportunities for developing and practicing contextual thinking and collaboration skills [8]. Though didactic lectures are helpful in a way that the students gain knowledge and understanding of the topics. The students were able to comprehend in a better way than before. The students indicated that TECMs stimulated their thinking and understand the subject in a better way than before using the TECMs. They were able to link, relate the concepts, gain insights on the new and the existing knowledge in revising the topics for examination. The students gained lot of information from the TECMs made by fellow students. The students opine that the use of TECMs helped to revise the topic and expand the existing knowledge. From the results of the feedback (Tables 1 and 2), it is evident that all the students strongly agreed that the TECMs were useful and meaningful in their learning. The students expressed their interest and likeness for the teamwork skills in the preparation of the TECMs (Fig. 1). Around 63% of the students preferred group study rather than individual activity in the future. A study reports that when concept mapping was used as a supporting strategy for self-regulated learning as a part of problem-based learning (PBL), students demonstrated increase in cognitive and metacognitive functioning [9]. When the students draw the CM on their own and explain it to others, it helps them in their learning. CMs are used as an assessment tool to assess the students learning. The assessment of the rubrics used for the CMs (Data not presented) showed that all the students were excellent in creating TECMs fulfilling the essential requirements of a good CM as described in the data collection. There was improvement in the students' descriptive abilities in the presentation of the concepts. The collaborative working of the students to create TECMs also increased the confidence in the students and their participation in the group activity. Participation skill is the strong foundation for developing interpersonal skills, which was achieved using CM technique. It is crucial that educators ensure that students move from receiving phenomena where they can actively listen to internalizing the values that is evident when they apply their reasoning and thinking to what they have learnt and that set forth the attainment of the affective domain. According to Rubiyah et al., (2018) implementation of CM technique improved the students descriptive abilities and their collaborative skills among the school students [10].

According to Pilcher (2011) CMs improve the retention of knowledge [11]. The assimilation theory of verbal learning developed by Ausubel based on Piaget's genetic epistemology is considered the foundation of meaningful learning [12]. CMs are one form of meaningful learning that networks selected expressions and concepts [12]. CM based education helps avoid rote learning. CMs can be created both digitally and on ground which is essential during the unavoidable circumstances that we recently came across as the pandemic. CMs are useful at all stages of education. CMs promote curriculum development, systematizing relevant topics, and exam-taking. According to the results of using this approach as presented in Table 3, TECMs improved the retention of knowledge that is evident with the significant improvement observed in final exam when compared to mid-term assessment. This approach of using TECMs in the learning of students during seminar presentation improved the learning environment of students and resulted in better test scores in genetics. The students were able to apprehend the concepts in the final exam better than before the use of TECMs. The results of this approach confirm that concept mapping is a useful strategy to promote meaningful learning among foundation students.

In conclusion, the use of TECM resulted in significant improvement of test scores and promoted a deeper understanding and the relationship between the concepts in genetics among the foundation in medical students. This technique also facilitated a better learning environment among the students.

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Creating Authentic E-Examination Questions Using Authenticity Variables

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Abstract. The Ministry of Higher Education Malaysia has recently unveiled hybrid-flexible (HyFlex) education initiatives, allowing learners to experience a cutting-edge method that blends in-person and online learning. One of the notable challenges of HyFlex is the pedagogical aspect, specifically the significant hurdles encountered in assessing students in online learning. Academic integrity is easily compromised, particularly in online examinations. The integration of artificial intelligence, such as ChatGPT, adds an additional layer of complexity to this challenge. Consequently, there has been a growing need for improved question design based on the principle of authenticity. Although literature on authentic assessment exists, a systematic approach to creating authentic e-examination questions has yet to be established. This paper aims to investigate the effect of incorporating authenticity variables from authentic tasks and projects into e-examination questions. To understand the effect, we analyzed the performance and questionnaire responses of 153 students enrolled in a second-year subject across three semesters during the pandemic. Our findings demonstrate that the implementation of authentic e-examination questions using this approach effectively discourages academic misconduct amongst students. While students perceived the questions as more difficult, their performance remained satisfactory. We recommend replicating the approach outlined in this paper when creating rich context in injecting realism in examination questions.

Keywords: Authentic question · realism · e-examination

1 Introduction

In Malaysia, the landscape of online learning is shaped by various policies established by the Ministry of Higher Education. The online learning has been recognized as a valuable complement to traditional in-person instruction, manifesting in blended learning, and serves as an alternative pathway for adult learners pursuing higher education opportunities through Massive Open Online Courses (MOOCs) [1, 2]. The COVID-19 pandemic

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has compelled educators and students to adapt to the exigencies of "emergency remote teaching (ERT)," expediting the adoption of online learning [3, 4]. As part of the ongoing efforts to ensure continuity and pave the way for significant transformations post-pandemic, initiatives such as Substitute Blended Learning and Micro-credentials were introduced [5]. In June 2023, the Ministry announced the implementation of hybrid and flexible education initiatives, specifically the hybrid-flexible (HyFlex) approach, which allows learners to seamlessly blend in-person and online learning experiences [6, 7]. Despite the valuable insights gained from the ERT period, student assessment remains a significant challenge in the realm of online learning. The remote online examination environment increases the risk of academic misconduct, including cheating, thereby posing a substantial integrity concern [8].

During the emergency remote teaching (ERT) period, a multitude of literature and guides emerged to help educators tackle the significant challenge of conducting effective online examinations in the absence of proctoring systems. These resources aimed to assist in the conversion of assessments into an online format that could still provide valuable differentiation of student performance. Concerns such as academic integrity, time limitations, and exam formats posed difficulties for educators, especially those with limited prior experience in online teaching. Notably, countermeasures like shuffling questions and random drawing of questions were reported to be highly effective during that time [12]. However, relying solely on countermeasures proved inadequate, necessitating the transformation of examination questions suitable for physical examination settings into formats that align with the online environment using higher order thinking (HOT) questions [9–11]. A question arises regarding the appropriateness of converting existing examination questions into HOT questions, considering that examinations and tests, although widely used internationally, tend to assess lower order thinking skills in a decontextualized manner [13]. Therefore, framing, or rewriting examination questions using the HOT approach can be debated in terms of fairness and validity, as it may disrupt the constructive alignment of lower cognitive level learning outcomes. Our research question therefore looking at 'can lower cognitive level examination question be written using authenticity principle instead of HOT?' and 'to what extent authentic examination questions affect academic integrity?'. Consequently, this paper aims paper aims to investigate the effect of incorporating authenticity variables into e-examination questions. We demonstrate an alternative approach for generating exam and test questions while maintaining the desired level of cognitive complexity for the intended learning outcomes by employing the principles of authentic assessment. To achieve this, several variables derived from the twelve design variables introduced for designing authentic performance tasks and projects were utilized [14]. Among these variables, degree of authenticity and the students' choices variables were identified as seamlessly adaptable to existing examination questions, resulting in the creation of authentic questions suitable for online assessments. This paper showcases the use of these variables in the conversion of examination questions into authentic e-examination questions. By analyzing students' survey responses and performance, we seek to understand the impact of this approach on academic integrity. We hope for this approach to support educators in developing e-examinations that are well-suited for the HyFlex education environment, while ensuring the preservation of academic integrity.

2 Literature Review

Examinations are widely utilized for assessment on a global scale [15–18]. They come in various forms such as tests, quizzes, midterms, and final exams, among others. While they may have different names, examinations typically share common characteristics. They primarily assess knowledge reproduction and are typically conducted under controlled conditions, allowing a specific timeframe for completion. The questions are disclosed only during the exam, and invigilators are present to ensure students do not cheat and that the work is solely of an individual [19, 20].

However, when examinations need to be conducted online, particularly in remote and distance learning settings, the key features of examinations become compromised, providing students with greater opportunities to cheat [8, 21]. Consequently, preserving academic integrity becomes more challenging. Several strategies exist to mitigate cheating in online exams, such as opting for offline (face-to-face) proctored exams, designing authentic questions (e.g., utilizing subjective measures instead of objective measures), and reducing the weightage of exam scores in the overall course grade [11]. This paper specifically focuses on the development of authentic examination questions, particularly employing subjective short essay-type questions in online examinations.

One of the commonly employed methods to develop questions to overcome cheating is by utilizing HOT questions [10, 13]. Nguyen et al. [10] demonstrated how HOT questions can be formulated by incorporating real-life applications that require students to integrate learned concepts with additional information. The inclusion of irrelevant material serves the purpose of making the question more challenging for students to locate the answer online [22, 23]. They also proposed another approach involving the use of unique, precise, and straightforward questions. The rationale behind this approach is to enable students to leverage online resources for assistance while ensuring that the questions are specific enough for those resources to be unable to provide solutions. Essentially, this second approach aims to mimic "expert practice" [24].

The two approaches discussed by Nguyen et al. [10] are the process of simulating real-world work or expert practice, also known as "realism". Realism is a fundamental criterion in authentic assessment, alongside cognitive challenge, and evaluative judgment [25]. Realism, as the first principle of authentic assessment, entails presenting tasks or scenarios that mirror real-world situations beyond the academic realm [26]. Realism is incorporated by providing a genuine context that describes a problem to be solved. Questions can be crafted with a detailed context that simulates real-world situations, serving as a representation of professional performance. This context or "ornament" [10] serves as an embellishment or framework that is not essential for solving the problem itself. Nguyen et al. [10] observed that the context makes the examination question appear more challenging. Although context is un-necessary to solve the actual problem, creating a good context is not an easy task. Hence, this paper primarily focuses on illustrating how context can be developed using variables introduced by McTighe et al. [14], ultimately leading to the creation of authentic examination questions.

McTighe et al. [14] during the early stage of pandemic COVID-19 launched their book "Designing Authentic Performance Tasks and Projects," dedicated to K-12 teachers. They outline twelve variables to assist educators in designing authentic performance tasks and projects. Among the twelve variables, we noted that several variables can be adopted in creating authentic questions, particularly variable 5 (degree of authenticity), variable 6 (audience(s) for student product/performance (s)) and variable 9 (student choice).

This paper demonstrates the integration of variable 5 (degree of authenticity) and variable 9 (student choice), into examination questions; hence creating good context for the question fit for an online examination environment. We hope this approach provides additional clarity to the work presented by Nguyen [10] and Villaroel [13], ultimately reducing the difficulties associated with creating a context that injects realism into authentic test or examination items.

3 Methodology

The examination question, created by systematically incorporating authenticity variables, was tested during the COVID-19 pandemic (Semester 2 19/20, Semester 1 20/21, and Semester 2 20/21) when tests and examinations were conducted remotely in an online environment. One hundred and fifty-three (153) students from BET1263 Geology and Geomechanics subject in the Civil Engineering Technology Faculty, University Malaysia Pahang Al-Sultan Abdullah who sat for the midterm test participated in the study. The midterm test constitutes 20% to the overall subject mark and consist of two questions weighted 10% each related to soil formation, characteristics and its application. The gender distribution among the students was 37.3% male and 62.7% female. Out of the 153 students, 129 students (84.3%) took part in the survey regarding the test.

To understand the impact of the authentic question on academic integrity and the effect realism in the question, a survey questionnaire was administered. The survey encompassed various aspects, including personal information, internet connection and facilities, student preparation for the online examination mode, lecturer support, clarity of test instructions, the experience of answering the authentic examination question, and the effectiveness of the authentic question in preserving academic integrity. The survey results presented in this paper primarily focus on two main aspects: first, how the attachment of authenticity variables (context) influenced students' perception of the question's difficulty, and second, how students perceived the authenticity variables' ability to deter cheating. For each aspect, the survey questions were designed using a combination of a four-point Likert scale (ranging from 1 for "yes" to 4 for "no") for the first aspect, and a five-point Likert scale (ranging from 1 for "strongly disagree" to 5 for "strongly agree") for the second aspect. Additionally, several open-ended questions were included to allow students to express any additional concerns regarding the authentic examination question they experienced. The survey results were analyzed using simple statistical analysis techniques. Results from the survey were verified through examination of students answer script and student's score on the question.

Figure 1 shows variable 5 (degree of authenticity) and variable 9 (student choice), the two variables used in the creation of authentic examination questions. For each variable, there are four ways it can be attached to the question. Figure 2 provides an illustration of how variable 5.1 (degree of authenticity - context) and variable 9.3 (Student choice - same product, different focus) are integrated into the original face-to-face examination question. While the stem of the question assessing the ability to describe the formation of geomaterials and its characteristics which influence their engineering technology applications, remained unchanged across the cohorts, the "ornament" or context differed for each group.

1. Context (e.g., what kinds of problem do historians solve?)	**2. The use of real-world processes, tasks, tools, and quality standards** (e.g., what level of precision is necessary when designing a scientific experiment)
3. Impact on others (e.g., how might these findings help to improve society?)	**4. Personal authenticity** (e.g., how does the media impact how my family perceives important issues?)

(a) Variable 5 – Degree of authenticity

1. Same product, same focus (e.g., create a presentation on flood prone area in our community), and	**2. Different product, same focus** (e.g., create a presentation or mini documentary on flood-prone areas in our community)
3.Same product, different focus (e.g., create a presentation on flood-prone areas in our community's residential or recreational areas).	**4. Different product, different focus** (e.g., create a presentation or mini-documentary on flood-prone areas in our community's residential or recreational areas)

(b) Variable 9 – Student choice

Fig. 1. The four ways in attaching degree of authenticity variable and students' choice variable [27].

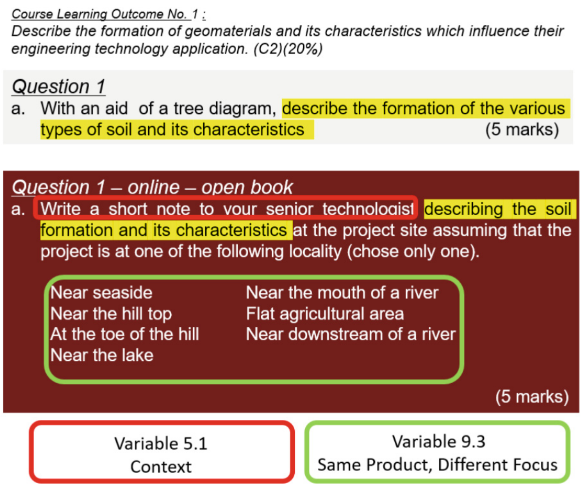


Fig. 2. Attaching authenticity variables to the original face-to-face examination question.

4 Results and Discussion

When examining students' individual answers to authentic examination question, it was found that none of the answers from the first cohort were similar, while there was significantly low percentage of similarity in the answers, approximately 5% of the second and third cohorts. This finding indicates significantly low occurrence of cheating and it was supported by the trend of students' scores, as depicted in Fig. 3 where there is no inclination of the score skewed to any sides. The absence of a significant similarity in answers suggests that there was no widespread copying among the students.

Most of the students (70.2%) perceived the test question as difficult when authenticity variables were introduced (refer to Fig. 4.). They indicated that they would have performed better if the question lacked the injected "ornament" or realism. These observations corroborate previous research findings [10, 22, 23]. Despite the difficulties faced by students, most of them passed the test, thereby achieving the intended learning outcome.

Interestingly, our findings reveal that a significant portion of students (71.7%) acknowledged that authentic test questions had a strong deterrent effect on cheating (see Fig. 5.). Results from the survey indicated that personal authenticity, particularly when it related to their personal data, such as describing the soil formation in their hometown based on the locality indicated in their national identification card, compelled students to work on the test answers themselves and provided an additional deterrent against cheating.

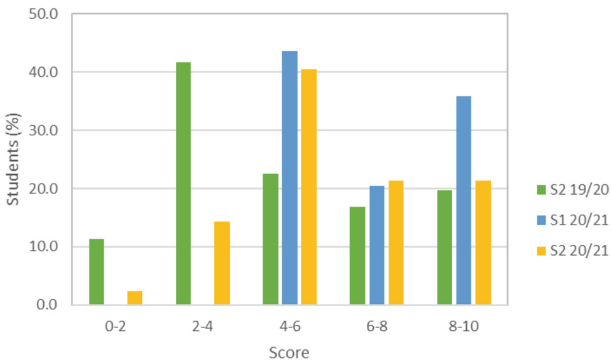
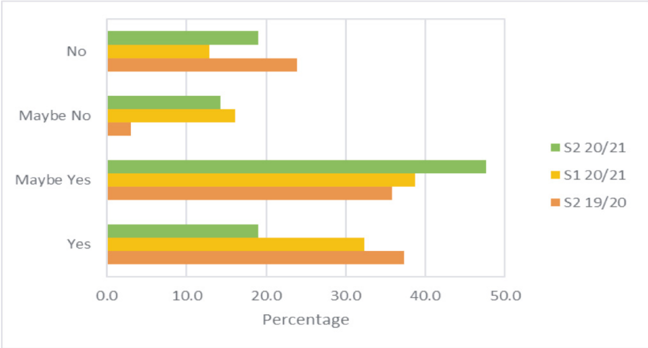
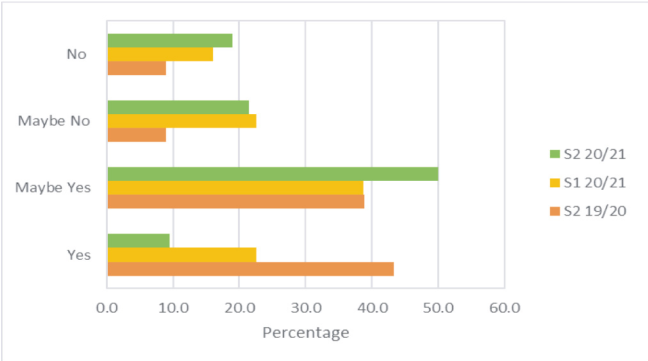


Fig. 3. The academic performance of students on authentic examination questions pertaining to soil formation.



(a) Difficulty perceived by students when context and/or personal authenticity being attached to the question



(b) Ability to perform better perceived by students if context and/or personal authenticity NOT attached to the question

Fig. 4. The perceived impact of authenticity variables on the difficulty level and performance as experienced by students when attached to the test question.

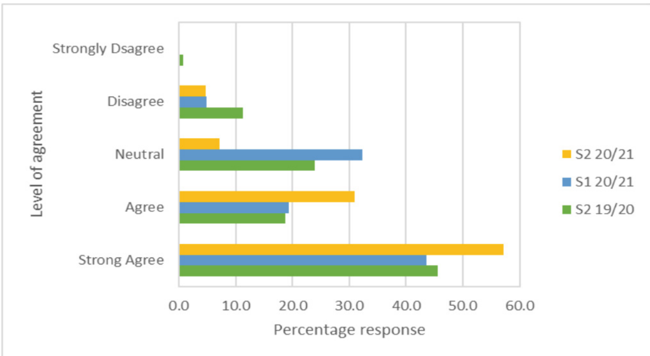


Fig. 5. Impact of authenticity variables as cheating deterrence.

5 Conclusion

With the rise in popularity of online learning following the pandemic, Malaysian higher learning institutions have recognized the significance of HyFlex Education. As academic integrity concerns become more complex, particularly with the integration of artificial intelligence, addressing these issues requires a focus on improving examination question design rather than relying on cheating countermeasures and/or anti-cheating software or technology. The principles of authentic assessment can be systematically integrated into face-to-face examination questions using authentic variables, hence creating rich context when injecting realism in examination. This approach effectively deters cheating in online examinations; hence, preserving academic integrity. Authentic e-examination questions can go beyond simply attaching authentic variables, as demonstrated in this paper. Exploring and utilizing task-based approaches that mimic real-life processes and professional tasks can be considered when designing e-examination questions in the future.

6 Limitations and Future Studies

A limitation of the study is that the data collected solely using a self-completion questionnaire does not allow further probing to generate further explanation from students such as in qualitative interviews. Furthermore, the use of a five-point Likert scale for rating may not be completely reliable, as different respondents may attach different values to different points of the scale.

Future research opportunities may adopt multiple sources of data such as semi-structured interviews to understand the impact of the above intervention on students more deeply.

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Customising Assignment Activity to Fulfil Work-Based Assessment Requirement Using Digital Logbook in Learning Management System

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Abstract. Customised assignment activities in Learning Management System could be good learning and assessment tools, to implement a digital logbook for work-based assessment, for both students and educators in monitoring and documenting students' learning, skills, and attitudes. The assignment activity for digital logbook was designed using the LMS platform (Moodle) and it represents a redesign initiative embracing technology and moving forward from the previous paper- based logbook. This paper presents an approach to enhance the functionality and effectiveness of assignment activity for digital logbook integrated with the LMS. This integration aims to leverage LMS, Moodle's features and capabilities to provide a more comprehensive and streamlined work-based assessment experience. In comparison to a paper-based logbook, the digitisation of a logbook using assignment activities in the LMS facilitates the School Administrator's time to compile a student's eligibility and records of infringement for sitting the Professional Examinations.

Keywords: Assignment activity · LMS · Moodle · Digital logbook · Work-based assessment

1 Introduction

Customised assignment activities in Learning Management System could be good learning and assessment tools, to implement a digital logbook for work-based assessment, for both students and educators in monitoring and documenting students' learning, skills, and attitudes. This digital logbook helps students under-stand the course learning outcomes, achieve a satisfactory level of competencies, and ensure consistency in their acquisition of knowledge, skills, and professional conduct during clinical training. A learning management system (LMS) provides the platform for the web-based learning environment by enabling the management, delivery, and tracking of learning [1]. This paper presents an approach to enhance the functionality and effectiveness of assignment activity for digital logbook integrated with the LMS. This integration aims to leverage LMS, Moodle's features and capabilities to provide a more comprehensive and streamlined work-based assessment experience.

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2 Methodology

The assignment activity for digital logbook was designed using the LMS platform (Moodle) and it represents a redesign initiative embracing technology and moving forward from the previous paper-based logbook. Besides being an environmentally friendly option to the paper-based logbook, the digital logbook has provided meaningful learning to students who track their learning activities and record clinical entries. It is convenient and not cumbersome like the paper-based logbook as it allows data entry at the point of care, with captured data being instantly stored in the gradebook. With the accessibility of live data of assignments used for digital logbook we can always access and evaluate the competencies.

With secured accessibility in LMS, the digital logbook also allows for data to be viewed by educators in real-time. Visuals, multimedia, and other related documents can also be attached with entries. Electronic logs can be easily viewed and securely stored in the cloud without risking the chance of getting misplaced like paper-based logbooks. For students, it served as a learning journal evidencing their learning and skills accessible anytime, anywhere on smartphones [4]. It has also provided mentors with a bird's eye view of students' mandatory requirements in training, including attendance, professional behaviour, clinical placement performance, and engagement in online teaching.

The assignment activity customisation within the digital logbook aligns with the curriculum's structure, following the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This approach ensures that it provides meaningful learning experiences supporting the achievement of course learning objectives. It reflects work-based learning, participation in online theory classes, mentor sessions, self-directed learning, research, continuous professional development, and community social responsibilities. Faculty feedback is provided for in every component. It records and assesses professional behaviour and conduct, and clinical placement performance in almost every teaching and learning activity during every posting. At the end of every semester, it is examined critically by School Administrators for completion and records of infringement of professionalism, ensuring eligibility for Professional Exams.

Gamification is now considered one of the most important features in any LMS. Based on an LMS Industry User Research report, gamification in LMSs was ranked fourth in terms of the topmost desired features [2, 3, 5].

The gamification element is added to motivate students to compete for better scores and recognition by using progress bars to provide feedback and show their proximity to the next level. Rewards were given to students who completed all tasks and adhered to the rules of assessment and gamification (Figs. 1 and 2).

Certificate of Recognition and Certificate of Excellence are awarded to deserving students who qualify with an exemplary score at the end of each semester, and also at graduation, respectively.

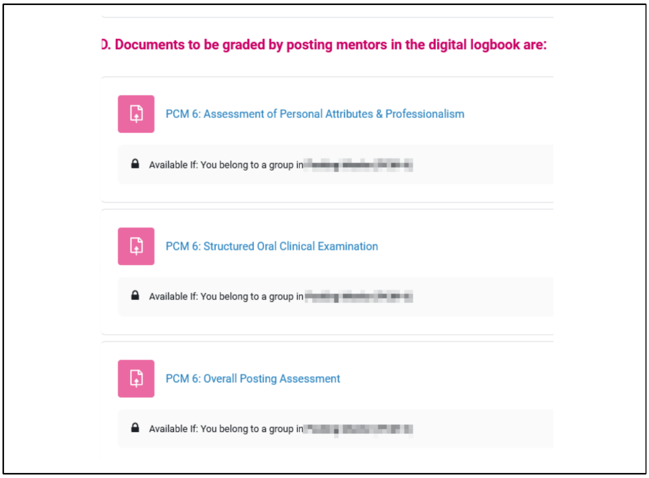

Fig. 1. Assignment activities in mentor sessions

Fig. 2. The progress bar dashboard

3 Result

The digitalisation of logbook data and the ability to customise assignment activities in the LMS allow preceptor to have multiple views of data in showing various components of professional behaviour. The gradebook in LMS has given preceptors a comprehensive overview of students' compliance with essential training obligations, such as attendance, professional behaviour, performance during clinical placements, and participation in online teaching. This data plays a vital role in evaluating students' competencies. Figure 3 shows the comprehensive view provided by the gradebook simplifies the process of collecting data on student progress for the Coordinator, Preceptors, and School Administrator.

The distribution of Certificate of Recognition across five semesters reveals a diverse pattern of student achievements in the digitalisation of logbook data. Table 1 presents a summary of the students' data throughout 5 semesters using the progress bar.

Specifically, 10 students did not receive any certificate of recognition, while 37 students were recognised with one certificate. 31 students demonstrated exceptional

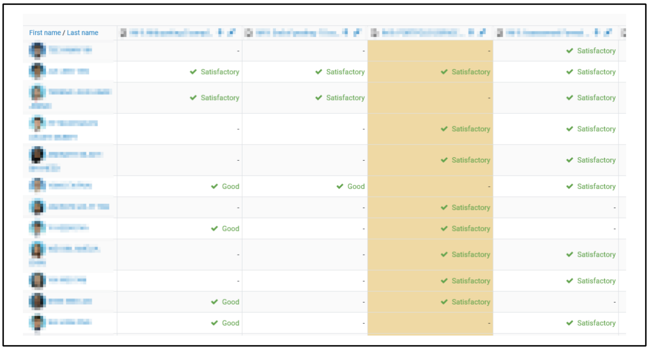

Fig. 3. The gradebook page

Table 1. Summary of the Students' Data

Number of Certificates Awarded	Total Number of Students
0	10
1	37
2	31
3	35
4	24
5	24
Grand Total	**161**

performance by receiving two certificates, and 35 students received a remarkable three certificates. 24 students presented outstanding dedication and excellence by obtaining four certificates. Furthermore, an outstanding group of 24 students consistently excelled throughout all five semesters, earning them the prestigious Certificate of Excellence.

4 Conclusion

The customised assignment activity in the LMS assists preceptors in evaluating students' personal attributes and professional behaviour during rotations in the digital logbook. At the end of each semester, these features are carefully examined to see if the students meet the requirements to take the Professional Examinations and progress to the next level of study. The gradebook's comprehensive overview streamlines the task of gathering student progress data for the Coordinator, Preceptors, and School Administrator.

In comparison to a paper-based logbook, the digitisation of a logbook using assignment activities in the LMS facilitates the School Administrator's time to compile a student's eligibility, records of infringement of professionalism for sitting the Professional Examinations and ensure expected levels of competency consistent with education standards in clinical training, are achieved.

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Determinants of Behavioural Intention to Use Mobile Augmented Reality Application in Education Among University Students in Malaysia

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Abstract. Being identified by Gartner, Inc. as one of the five distinct emerging technology trends in 2018, augmented reality (AR) has seen vast applications across various industries, including education because AR is capable to improve the effectiveness of teaching-learning process credit to the high interactivity and engagement between learners and the technology. Thus far, not many studies have been carried out to comprehend the driving forces in adopting AR as an educational tool although its usage rate among instructors and learners remains low. Given the need for more research to broaden our understanding of AR acceptance in education, UTAUT2 was applied as a theoretical foundation in this study to investigate the adoption of AR mobile app in the context of Malaysian higher education institutions. Using a quantitative approach, an online survey questionnaire was sent to 182 students in a government-linked university and only 163 complete responses were included for final analysis. The respondents were required to download and experience the AR mobile app before answering the questionnaire. The research model showed a strong explanatory power of 61.5% and the regression analysis revealed that performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivations had a significant positive correlation with adoption of AR mobile app. The findings filled the research gap by providing insights to the key stakeholders of AR in the education field to enhance learning experience and outcomes.

Keywords: behavioural intention to use · augmented reality · mobile app · education · UTAUT2

1 Introduction

Augmented reality (AR) is a technology that overlays digital information (in the form of text, graphics, and audio) with the users' real-world environment, in real-time [1]. Being recognised for its useful applications in various industries, AR is also highly relevant in transforming the education realm by creating an interactive and engaging classroom environment which enhances users' motivation in learning and improves

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academic achievement [2]. Yet, AR adoption remains a tough challenge thus it hinders AR from achieving its full potential in educational environment [3]. Ongoing effort is needed to determine the key success factors of AR adoption in an educational context.

2 Literature Review

2.1 Augmented Reality Applications in Education

AR has been widely acknowledged by scholars and teaching professionals for having unparalleled opportunities in the educational context as it offers numerous advantages for both instructors and learners [4]. AR makes learning new knowledge and mastering skills a less exhausting experience as the technology minimises users' cognitive load through enhanced information absorption and retention [5]. In addition, integrating AR into curriculum helps to improve learner's interest in the course [6] and accomplish targeted learning outcomes [7]. Notably, AR-facilitated learning environment is proven to be effective in elevating problem-solving skills among special needs students [8]. Despite the extensive benefits that AR can offer to enhance teaching-learning practices and outcomes, learners and instructors are lacking awareness and exposure towards the technology which has resulted in slow diffusion of AR [9]. Thus, researching on the determinants of AR adoption is imperative for a rapid proliferation of AR in education.

2.2 Gauging Behavioural Intention to Use Mobile Augmented Reality App

Literature review shows an abundance of studies on ITs adoption using various theories and conceptual models that evolved over time to better gauge users' adoption of ITs. Being recognised for its high explanatory power, the Unified Theory of Acceptance and Use of Technology (UTAUT) was synthesised through a comprehensive evaluation and integration of the earlier theories and models of ITs adoption [10]. UTAUT theorises that performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC) as core determinants of behavioural intention to use ITs in different cultural settings [10]. Then, UTAUT2 with a more predictive power was developed by extending the UTAUT to include hedonic motivation (HM), price value (PV) and habit (HB) as direct determinants of behavioural intention to use ITs [11].

3 Purpose of Study

Many studies on AR in education have been conducted in developed countries [9]. Hence, similar focus should be devoted to developing nations like Malaysia. Adapted the UTAUT2, this study aims to investigate students' behavioural intention to use AR mobile app in a selected government-linked university in Malaysia. This study supports the realisation of the Malaysia Education Blueprint 2013–2025 (Shift 7: Leverage ICT to scale up quality learning across Malaysia) through the creation of virtual learning environments to produce a more creative, innovative and competitive young generation. The AR mobile app is used in consumers setting rather than organisational perspective. Hence, it is appropriate for this study to apply UTAUT2 as an underpinning theory because it includes HM as one of the key determinants of ITs adoption [9]. This study excludes PV and HB because the AR mobile app is a free application, and it is new in the local educational context. Figure 1 depicts the research framework and hypotheses. Adapted from UTAUT2 [11], this study defines PE as "the degree to which students believe that using the AR mobile app will enhance their performance in learning"; EE as "the degree to which students believe that using the AR mobile app will be easy"; SI as "the degree to which students perceive that important others believe they should use the AR mobile app for learning"; FC as "the degree to which the students believe that organisational and technical infrastructure exists to support AR mobile app use"; HM as "the degree to which students believe that using AR mobile app is an enjoyable and fun experience" and behavioural intention to use as "the degree to which students predict, intent and plan to use AR mobile app as soon as it becomes available".

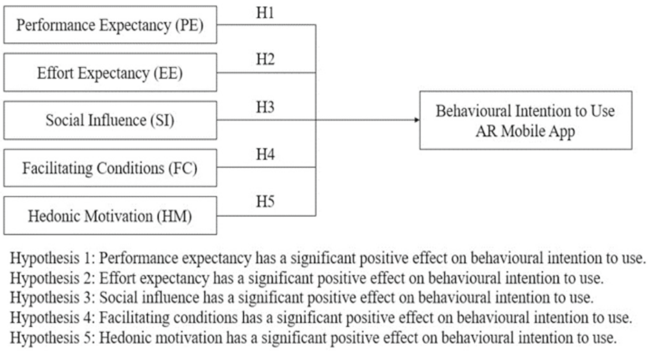

Fig. 1. Research framework and hypotheses

4 Methodology

This study applied quantitative research. Self-administered questionnaire was used in an online survey which targeted 182 students who were taking Malaysian Studies in a government-linked university in Malaysia. Those students were chosen as the target respondents because the subject promotes nation building through consolidating and broadening knowledge about Malaysia, in which the course content is consistent with the objective of the AR mobile app to educate users about Malaysian history, culture, and heritage. The respondents needed to use their own smartphone to download the app from the Google Play Store. The app was previously developed for the "When History Comes Alive" project in collaboration with the Melaka Museum Corporation [12]. When the respondents scan the respective QR codes and AR markers, they can interact with virtual objects (historian figures, traditional games, ancient beauty accessories) being superimposed in the physical environment via smartphone screens, which make learning the subject more interactive. Figure 2 depicts the development and user manual of the app.

Fig. 2. The development and user manual of the AR mobile app

The questionnaire was developed through adaptation from past study [12], which was later validated by subject matter experts. The items were measured using a seven-point itemised rating scale ranging from 1 = "strongly disagree" to 7 = "strongly agree". The data was analysed using IBM® SPSS® Statistics Version 27.0.

5 Findings and Discussion

Of the 182 collected responses, only 163 were complete and usable for data analysis (response rate = 89.56%), meeting the required minimum sample size of 148 set by G*Power (confidence level = 95%; medium effect size = 0.15) [13]. The respondents comprised of 79 male (48.5%) and 84 female students (51.5%), all aged between 19 to 23 years old. All respondents owned at least one smartphone and had experience in using mobile app, but only 29 respondents (23.9%) experienced AR mobile app before. 123 respondents (75.4%) utilised free Wi-Fi provided by the university and the other 40 respondents (24.5%) used their own mobile data network. High smartphone ownership and high Internet access made the students an appropriate group of respondents to study, especially when their usage experience of AR mobile app is still low. Reliability analysis was conducted to measure the internal consistency between the items measuring a construct. All constructs were reliable with a Cronbach's alpha of 0.800 and above (PE: 0.915; EE: 0.889; SI: 0.885; FC: 0.918; HM: 0.926; Behavioural Intention to Use: 0.905) [14]. Multiple linear regression analysis was performed to test the hypotheses. The adjusted R-square was 0.618, indicating that 61.8% of the variation in behavioural intention to use was explained by the five proposed constructs, which had a significant ($p = 0.000$) positive effect on behavioural intention to use, with HM being the strongest predictor ($\beta = 0.336$), followed by FC ($\beta = 0.226$), PE ($\beta = 0.148$), EE ($\beta = 0.116$) and SI ($\beta = 0.077$). So, all hypotheses were supported, and research objective was achieved.

Findings showed that HM positively affects university students' behavioural intention to use AR mobile app, such that its hedonic value influences AR adoption stronger than functional value, as proven in past studies [15, 16]. AR can deliver a fun experience by allowing users to interact with virtual objects in a real environment [17]. When students enjoy using AR educational tool, they will be more inclined to adopt the technology as it makes teaching-learning activities more entertaining [9]. Next, a positive correlation between FC and behavioural intention to use was found, signifying that learners must possess necessary resources and knowledge to use the app in learning activities. In line with past studies [9, 18], the results showed solid evidence that learners tend to use the app when it can be activated using their existing smartphone and get technical support from their instructor and course mates when they face obstacles in using the app. Also, PE was found to positively affect behavioural intention to use, implying that students' motivation to adopt the AR mobile app increases when the app has beneficial use to support them in completing their learning tasks more effectively and efficiently, as well as achieve better academic performance. The findings validated past studies in mobile learning technology context [9, 19, 20]. Moreover, findings showed that EE positively affects behavioural intention to use, demonstrating that learners are keener to adopt the app when it is easy to use. In line with earlier studies [19, 20], AR acceptance improves when it has a user-friendly interface that provides clear and understandable interactions to learners during classes because it is easy for them to become skillful at using it [9]. Lastly, a positive correlation between SI and behavioural intention to use was found, showing that students' adoption of AR mobile app increases parallelly with the social pressure and support from the participants in the teaching-learning environment [9, 21].

6 Conclusion

It is becoming more important for education institutions to continuously redesign and improve teaching-learning processes by integrating new approaches, innovative ideas, and emerging technology like AR to deliver an impactful education experience [22]. In terms of limitations, this study focused on behavioural intention to use from learners' perspective. Future research should examine actual behaviour as an endogenous construct and extend the scope to study educators' opinion towards digital educational technology adoption. Also, future studies should expand the scope to include other academic institutions such as primary and secondary schools because educators and learners with different age range might respond to digital educational technology differently.

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Developing Complex Problem-Solving Skills Among Physical Chemistry Students by Implementing Flipped Classroom Module

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Abstract. The transition from high school to a university program is a different environment with its demands, expectations, and challenges. The relationship between teacher and student improves the performance and quality of teaching but also the quality for those who follow lectures online. Flipped learning combines traditional face-to-face teaching techniques with online learning. A different approach is presented with an innovative technological environment to allow flipped classrooms by distributing videos, quizzes, and documents online before the lecture begins to solve complex problems. This study has been designed, implemented, and analyzed with the help of innovative information communication technology tools in solving complex problems related to electrochemistry among physical chemistry students. It employs the goal orientation which improves instructional material and enhances students' capacity to think critically, analyze the data, have in-depth learning, make difficult decisions, and solve complex engineering issues. Their performance is measured and studied using Microsoft Excel. The overall performance results showed that the flipped approach significantly had higher scores and grades in the May 2022 semester compared to the September 2021 semester without the incorporation of flipped learning.

Keywords: flipped learning · complex problems · physical chemistry · analyze · in-depth learning

1 Introduction

STEM education is important but demanding [1]. Most academicians agree that flipped learning and practical practice both strengthen STEM education. Practical learning is establishing connections beyond STEM disciplines in addition to linking knowledge and real-world challenges while flipped learning enables instructors to devote more class time to provide one-on-one support. The concept of switching from group instruction in the classroom to studying at home is known as "flipping", which also refers to in-class activities that allow for interaction between student-teachers. The formula for flipped teaching and learning is the same everywhere throughout the world even though it has been given different names, such as inverted classroom [2, 3], upside down classroom [4], reverse

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classroom [5], and flip teaching [6]. However, the methods used for at-home and in-class activities varied. Students have trouble learning and comprehending abstract ideas, such as solving complex problems and understanding the electrochemistry reactions, which might result in wrong misconceptions. Learning about chemistry necessitates an awareness of the interrelationships between the macroscopic, molecular, symbols, equations, and mathematical components. By examining how students learn and teaching how to use their analytical talents to comprehend complex problem-solving skills through the challenging topics of electrochemistry. The relationship between teacher and student improves the performance and quality of teaching. Researchers have shown that providing instructional information in various ways can improve students' problem-solving skills [7]. Furthermore, research shows that cooperative learning strategies enhance mathematical problem-solving abilities [8].

Chemistry academicians have traditionally found it challenging to comprehend molecular processes, as they are not visible. As a result, scientists used patterns to organize information and communicate using representational approaches [9]. The flip pedagogy was used in many chemistry courses, and it was demonstrated to significantly increase student performance [10, 11]. Although the flipped pedagogy seems to have started in a classroom setting for chemistry classes, the majority of the research work was used in and published from chemistry courses in higher education [12]. When compared to the passive lecture model, studies show that the chemistry FC model enhances cognitive load management, lowers failure rates, and boosts student motivation [13]. Without understanding concepts, the meaning of a given representation is frequently not apparent. Furthermore, few studies have shown that pre-class learning reduced the perceived complexity of the coursework while enhancing the instructional clarity and value of the course [14]. With the use of cutting-edge information and communication technology tools, this study was designed, practiced, and then examined from the perspective of solving complex problems by flipped learning. By contrasting the outcomes acquired with the implementation of flipped learning in May 2022 with the results obtained without the implementation of flipped learning in September 2021, its efficacy and impact are examined.

2 Methodology

The need for higher-order thinking abilities and the capacity to relate the three levels of representations—symbolic, microscopic, and macroscopic—present a significant obstacle for students studying electrochemistry [15, 16]. It is crucial to remember that becoming a successful problem solver in the sciences necessitates both conceptual knowledge and know-how procedures [17, 18]. Instead of memorizing the procedures and applying them to a different set of values, our students should be challenged with problem-solving skills that require them to access their knowledge.

Flipped learning fascinates students in the process of learning through activities and representations in solving electrochemistry complex reaction problems in Physical Chemistry [19, 20]. Concerning the flipped classroom module approach, a case study was carried out at the university with a student strength of 68. To equip the flipped learning approach implemented in this coursework the percentage distribution is as follows (learning materials (40%), activities (40%), and assessments (20%). Assessments

Fig.1. Representations and presentations

implemented are discussion, representations, e-portfolios, and think pair share (TPS) to make the class more interactive as shown in Fig. 1. Their grades were analyzed from A to F based on their performance in class and final through formative and summative assessments. Chemistry courses provide a strong emphasis on problem-solving, which can call for students to make decisions to determine the best course of action. Students should be able to use graphical and symbolic representations to combine chemistry and mathematics to better understand the concept of electrochemistry and the reaction mechanism to solve complex problems.

This course was taught by implementing a flipped learning approach that creates an opportunity to interact, share content, and deliver with the help of information communication tools. The learning activities for this course were framed by covering theoretical knowledge, skills, and problem-solving. This is demonstrated through the use of representation by constructing a flow diagram for the process that enables students to enhance their thinking ability and communication skills and room for better improvement of skills facilitated by the teacher.

3 Results and Discussion

The results were compared with those obtained in the previous semester without implementing flipped learning in September 2021. During this semester May 2022 students progressed better by 16.66% in achieving an A grade in formative compared to earlier September 2021 without implementing flipped learning as shown in Figs. 2 & 3. Whereas by implementing flipped learning it is clear that students have performed better and are well distributed between A–C grades in class activities. as shown in Fig. 2 compared to Fig. 3 where students' grades were distributed from A-D with less percentage attainment. This shows that flipped learning has influenced the students to perform better by actively participating in groups and working individually to improve their overall development of skills. The representations, presentations, and TPS activities in class have a higher average because, during the learning process, students look for knowledge on their own to ensure that they comprehend the key ideas for the best answer. Students get better prepared to make and uphold the appropriate results. To help students develop critical thinking, problem-based learning focuses on both issues and understanding pertinent concepts [21, 22]. A person who thinks critically can distinguish, analyze information, and accept responsibility for his actions. The number of pupils who received scores for each facet demonstrates the rise in this indication. The cause of failure of students after implementing the flipped classroom might be that students have no incentive or motivation to complete their work and do not take it seriously while answering tests/quizzes because they recognize that teachers will not and cannot give them a zero. This knowledge makes them unserious during examinations.

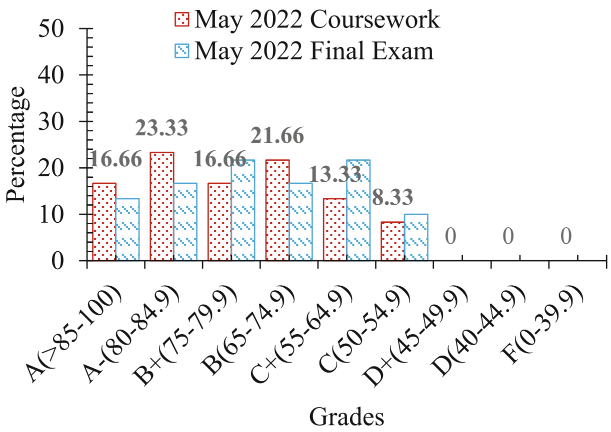

Fig. 2. Percentage attainment with flipped learning

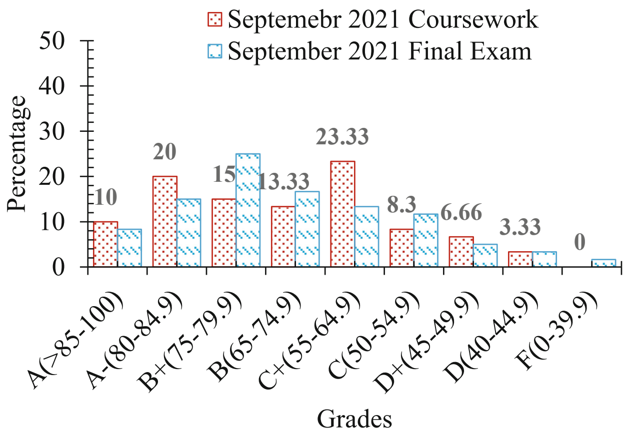

Fig. 3. Percentage attainment without flipped learning

4 Conclusion

The practice of flipped learning in solving complex problems has enhanced students' core competencies and metacognitive capabilities. The primary contribution of this study is the presentation of a flipped learning strategy in solving complex problems is a unique promoting mechanism and its educational advantages. The time gap that was required for everyone to think through ideas was resolved with the flipped learning mechanism. It allowed them to create their original work before bringing them to class for peer discussion and practical application. Additionally, using this process, the study assisted students in appreciating various activities, reflecting on their issues, and coming up with additional ideas. The procedures were utilized to help students organize their ideas and foster creativity. Such a method of learning is anticipated to be able to introduce innovative concepts into the world of STEM education. To continue enhancing teaching techniques for creativity, it can broaden more pertinent applications and gain more experience. Additionally, students developed participation skills and enjoyed online learning sessions. Students understood how to work among their peers. This module helps teachers to provide a more tailored approach to specific students. Overall, it has great potential to promote students' critical creative thinking and transform passive learners into active learners. The result suggests an overall improvement in the student's online learning experience and proves that the transition to online learning was a success despite the emerging circumstances. The suggested future research direction will be of interest to educators, academics, and researchers.

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Enhancing Learning Experiences, Engagement, and Learning Outcomes Through Short-Term Project-Based Learning: A Case Study in the Formation Evaluation Course of Petroleum Engineering

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Abstract. This study investigates the experiences of 58 s-year undergraduate students who participated in a short-term project-based learning (PjBL) Project within the Formation Evaluation course at Universiti Teknologi PETRONAS (UTP). The students' experiences were measured using a survey instrument consisting of 20 items that focused on four constructs: Authentic Learning Experience, Inquiry-based Learning Experience, Collaboration, and Effective Assessment. The survey demonstrated high internal consistency, with Cronbach's alpha coefficients ranging from 0.964 to 0.979. The results indicate that participants had a positive perception and experience with the project-based learning approach, as reflected by a mean survey score of 4.42/5.00. The findings suggest that project-based learning effectively provided an authentic and engaging learning experience, fostering critical thinking, independent inquiry, collaboration, and teamwork. It also prepared students for real-world applications. Furthermore, the study conducted an unequal variance t-test to compare the January 2023 semester batch and the January 2020 semester batch. The results revealed significant differences, providing strong evidence that the implementation of PjBL in the January 2023 semester batch led to significantly enhanced learning outcomes and proficiency compared to the January 2020 semester batch. This further supports the effectiveness of project-based learning as an instructional approach in promoting student success. These findings align with previous research emphasizing the benefits of PjBL in enhancing student engagement, collaboration, and ownership of learning. This study offers valuable insights into the experiences of students involved in a short-term project-based learning project. It demonstrates the effectiveness of the PjBL approach in providing an authentic and engaging learning environment, fostering collaboration, critical thinking, and preparing students for real-world applications.

Keywords: project-based learning · petroleum engineering education · student experiences · survey research

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1 Introduction

In recent years, project-based learning (PjBL) has emerged as an effective teaching methodology for enhancing students' learning outcomes in various fields. PjBL involves a student-centred approach to education that emphasizes active and collaborative learning, problem-solving, and critical thinking. In the field of engineering education, project-based learning has gained popularity as a means of developing students' technical skills, problem-solving abilities, and teamwork capabilities. This teaching technique can be used within an outcome-based education (OBE) system, which is one of the key aspects of Engineering Accreditation Commission (EAC) recognition for engineering programs.

Petroleum engineering is a field that requires a strong theoretical background combined with practical experience. In this context, PjBL can provide students with valuable opportunities to apply their theoretical knowledge in real-world situations and develop their practical skills. Short-term project-based learning experiences can be particularly effective in this regard as they provide students with the chance to work on real-world problems that are relevant to their field of study. Project-based learning is a student-centered approach that involves students working on a project over a period of time [1]. This approach is suitable for petroleum engineering courses because it allows students to engage in authentic assessments that are relevant to the field. Short-term Project-based learning is a good fit for petroleum engineering courses because of these compelling factors.

- Authentic assessments: Project-based learning provides students with authentic assessments that are relevant to the field of petroleum engineering [2–7].
- Real-world experience: Project-based learning allows students to apply the skills and concepts they learn in the classroom to real-world problems [1–7]. This is particularly important in petroleum engineering, where students need to be able to apply their knowledge they gained to solve complex problems in the field.
- Collaboration: Project-based learning often involves collaboration among students, which is an important skill in the field of petroleum engineering [2]. Students need to be able to work effectively in teams to solve complex problems.
- Preparation for the future: Project-based learning helps prepare students for the future by providing them with hands-on experience and real-world skills [1]. This is particularly important in petroleum engineering, where students need to be pre-pared for the challenges they will face in the field.

This study presents a study on a short-term PjBL experience in Formation Evaluation, a petroleum engineering course at the Universiti Teknologi PETRONAS. The objective of the project was to give students the chance to apply their knowledge to a practical real-world problem, which involved accurately estimating the volume of hydrocarbons in a geological formation using well log data analysis. The project was designed to be completed in four weeks, allowing students to hone their problem-solving and decision-making skills while working under time constraints.

The purpose of this work is to describe the design and implementation of the project and to evaluate its effectiveness in terms of student learning outcomes. This study is addressing the following research questions:

- What is the impact of project-based learning (PjBL) on student motivation, engagement, and perceived relevance of their learning experience in a short-term petroleum engineering project?
- How does the implementation of project-based learning (PjBL) enhance student learning outcomes and proficiency in solving real-world problems in a short-term petroleum engineering project?

The findings of this study will contribute to the growing body of research on project-based learning in engineering education and provide insights into the effectiveness of short-term project-based learning experiences in enhancing students' learning outcomes in petroleum engineering courses.

1.1 Project-Based Learning

Project-Based Learning (PjBL) is an innovative approach to teaching and learning that has gained popularity in engineering education. It is designed to help students develop academic knowledge and skills as well as authentic problem-solving experience. Based on constructivist learning theory, PjBL is a student-centred learning method that emphasizes collaboration and active learning. The approach requires students to work on real and complex problems that match their level of study and apply their knowledge and skills to propose and implement solutions [3–7].

PjBL instils higher-order thinking skills such as critical thinking, problem-solving, and communication that are essential for success in the engineering profession [8–12]. The key element of PjBL is the problem or project that serves as the focal point for learning [8, 9, 11, 13, 14]. The project should be designed to be engaging, relevant, and challenging while providing opportunities for collaboration, critical thinking, and problem-solving skills.

Wang & Amiri [15] concluded in their literature review on PjBL in STEM, collaboration is a critical component of PjBL as it promotes teamwork, communication, and problem-solving skills. In PjBL, students work in teams to develop solutions to real-world problems, and collaboration is essential to achieve the desired outcomes. Collaboration in PjBL enables students to leverage each other's strengths, perspectives, and expertise to create better solutions.

Assessment is another crucial element of PjBL [16–20]. The assessment should be aligned with the learning objectives and focus on the process and deliverables of the project. It should provide opportunities for formative and summative feedback and be designed in a way that allows self-assessment and reflection [16]. Xu, Tennyson, and Keller [17], in their article titled "Project-Based Assessment: A New Paradigm for Authentic Assessment of 21st Century Skills," argue that traditional forms of assessment, such as multiple choice tests, do not accurately measure students' abilities to think critically, collaborate, and solve complex problems. Project-based assessment involves designing projects that integrate the curriculum and real-world issues, providing students with opportunities to demonstrate their skills and knowledge through authentic performance tasks. The authors emphasize the importance of rubrics and feedback in assessing student learning. Ward and Rowlett's [18] discussed best practices for assessment in project-based learning (PBL) in higher education. They conducted a review of the literature and identified five key principles for effective PBL assessment: alignment with learning outcomes, clear expectations and criteria, formative assessment throughout the project, peer and self-assessment, and summative assessment at the end.

A systematic review conducted by Mavroudi, Papadakis, and Koutropoulos [21] examined 39 articles published between 2000 and 2020 related to facilitation in PBL. The authors analyzed the literature to identify facilitation practices, competencies, and challenges. The review found that facilitators play a crucial role in PBL by providing guidance and support to students throughout the project. Effective facilitation practices include promoting collaboration and communication, supporting self-regulated learning, and providing timely feedback.

The effectiveness of PjBL in engineering education has been widely studied. The duration of the project is closely related to its scope and level of complexity. Short-term projects typically last for a few weeks, while long-term projects can last up to a full semester or longer. The duration of the project significantly impacts the learning outcomes and students' experiences in petroleum engineering education. Therefore, it is essential to decide the optimal duration of the project to maximize the benefits of PjBL.

1.2 Challenges and Best Practices in Implementing Project-Based Learning in Engineering Education

K.T. Le and colleagues [22] conducted a study on the effectiveness of project-based learning (PjBL) in an engineering course. The study found that PjBL was beneficial for student learning outcomes and engagement, but it also highlighted several challenges in implementing PjBL in engineering education, including difficulties in designing and implementing projects, managing student teams, and assessing student learning. The study suggests that careful attention should be given to project design, student support, and assessment methods to overcome these challenges and maximize the effectiveness of PjBL in engineering education.

Rabbani and Radzi [23] highlighted the challenges in implementing PjBL, such as the need for more time, resources, and support from instructors. The study suggests that PjBL can be an effective approach to enhance learning outcomes in engineering education, but careful attention should be given to the implementation process.

In their article, Gunasekaran, Gao, and Tanniru [24] highlighted the need for a structured and effective approach to project-based learning (PjBL) in engineering education. They argue that PjBL is an effective pedagogical approach to develop critical thinking, problem-solving skills, and technical knowledge, but it can also pose significant challenges for instructors and students if not implemented properly. The authors propose a five-stage PjBL framework consisting of problem identification, problem analysis, solution development, solution implementation, and solution evaluation.

Yeo et al. [25] and Lee & Lee [26] in their studies concluded that PjBL can be an effective approach to teaching engineering, particularly in developing students' problem-solving skills and preparing them for the workforce. However, they also noted that implementing PjBL can be challenging and requires careful planning, support, and assessment.

PjBL can be an effective pedagogical approach in engineering education if implemented properly and assessed appropriately. Instructors should carefully design PjBL projects, provide adequate training and support for both themselves and their students, and use multiple assessment methods to evaluate the effectiveness of PjBL. By doing so, PjBL can enhance students' learning outcomes, engagement, and motivation, and prepare them for real-world engineering challenges.

1.3 Short-Term Project-Based Learning

Short-term PjBL refers to a type of learning experience that is focused on the completion of a project in a relatively short amount of time, typically a few weeks to a few months. The design of short-term PBL involves careful consideration of the project's scope, the learning outcomes that will be achieved, and the resources that will be required [27]. The project should be challenging enough to promote critical thinking, problem-solving, and collaboration, but not so complex that it becomes overwhelming [28].

Several studies have investigated the effectiveness of short-term PjBL in engineering education. Chen & Low [29], Da Silva et al. [30], Lozano & Redondo [31], Sun & Zhang [32], Ingemarsson & Söderholm [33] and Wang & Kao [34] found that PjBL improved students' performance in solving real-world problems and enhanced their teamwork, communication, and critical thinking skills. Similarly, the authors reported that PjBL enhanced students' motivation, engagement, and learning outcomes in engineering related courses. Furthermore, Lee & Choi [33], Froyd et al., [36], Awang & Hassan [37], Akers & Porter [38], Abu-Fraj et al. [39] and Besterfield-Sacre et al. [40] showed that PjBL increased students' confidence in applying their knowledge and skills to practical problems in engineering education.

Wang and Kao [34] discovered that PjBL improved learning outcomes, problem-solving skills, teamwork skills, and self-learning abilities in a digital signal processing course, but also highlighted the need for attention to student support and workload management. Ingemarsson and Söderholm [33] identified some challenges in implementing short-term PBL, including issues related to time management, task distribution, and assessment.

In summary, these studies indicate that PjBL can indeed serve as an effective pedagogical approach to enhance learning outcomes and engagement in engineering education. However, it is essential to emphasize the importance of meticulous consideration in areas such as project design, assessment methods, and student support for optimal results.

2 Short-Term Project-Based Learning Implementation

The implementation process of this short-term project-based learning in petroleum engineering education includes defining the project scope, group formation, project planning, data selection and analysis, solution development, communication and presentation and assessment and feedback.

2.1 Defining the Scope of the Project

The instructor provided the students with a clear and concise project description, including learning objectives scope and timeline. The learning objective for this short-term

PjBL project is to enable students to estimate the volume of hydrocarbons present in a geological formation with accuracy, utilizing well log data analysis. At the end of the project, students will demonstrate their competence in analysing pertinent data, applying suitable models and methods, and presenting their conclusions effectively. The time frame of four weeks allocated to complete this single course project is based on the learning objectives, scope, and complexity of the project, and is considered a short-term project. The duration has been carefully determined to ensure that it allows students enough time to address the complexity and scope of the problem presented.

2.2 Group Formation

The group leaders were selected by the instructor based on their prior academic performance. They were then allowed to choose their own group members based on their preferences. However, certain criteria, such as an even distribution of genders, were imposed to ensure diverse and balanced groups.

2.3 Project Planning

The members within each group collaborated to strategize and coordinate the project, which included establishing project objectives, creating a schedule, determining necessary resources, and delegating tasks and responsibilities.

2.4 Data Selection and Analysis

The students were responsible for carefully selecting appropriate well logs from the provided dataset. They were required to consider several factors, such as the formation depth, the quality and quantity of the logs, and the type of hydrocarbons present in the formation. Once the relevant logs were selected, the students performed a thorough data analysis to estimate the volume of hydrocarbons present in the formation. They utilized various methods and models, including porosity and saturation models, resistivity models, and density models. Additionally, they were required to consider uncertainties and assumptions made during the analysis process and employ sensitivity analysis to evaluate the impact of these factors on the final estimate.

2.5 Problem Solving and Decision Making

The development of problem-solving and decision-making skills was a critical component of this project-based learning experience in petroleum engineering. As the students worked on estimating the volume of hydrocarbons in the geological formation, they encountered various challenges and obstacles that required the application of problem-solving skills. Throughout this stage, the students were expected to develop important skills highly valued in the petroleum engineering industry, including critical thinking, analysis, creativity, and effective communication (Fig. 1).

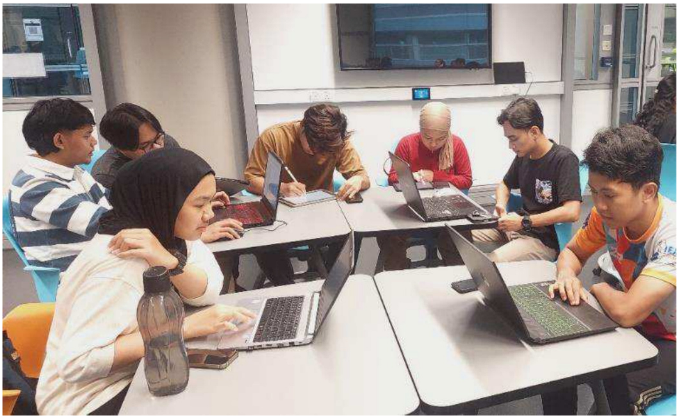

Fig. 1. Students work in group – Facilitator the provided feedback to the groups to help them improve their work.

2.6 Communication and Presentation

Communication and presentation skills were essential aspects of this project-based learning experience in petroleum engineering. The students were required to effectively communicate their findings and conclusions to their peers and instructors through a group presentation. They were encouraged to use a variety of media, such as visual aids and diagrams, to enhance the clarity and impact of their presentation (Fig. 2).

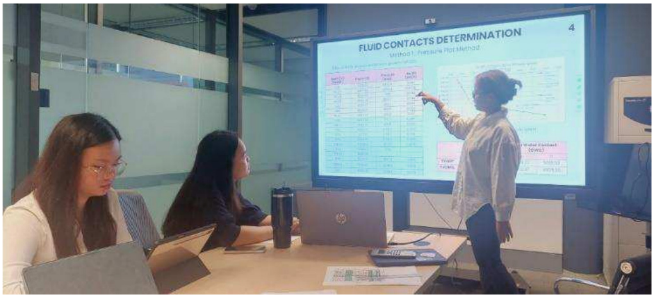

Fig. 2. Group Presentation – Formative Assessment

2.7 Assessment and Feedback

The assessments for this project were aligned with the learning objectives and included both formative and summative assessments. During the project, the instructor provided feedback to the groups to help them improve their work, while the formative assessment was conducted at the end of the project. The overall learning outcomes were evaluated by the instructor using a carefully designed assessment rubric, which was based on the written report and group presentation. This rubric covered specific criteria and expectations for the project and was shared with the students for their reference. Each assessment rubric provided specific expectations for each level of achievement, including descriptors of what each level looked like.

The skills to be assessed are:

- Exploring Pressure Plot and Well Log Analysis: A Comprehensive Understanding
- Assessing the Accuracy of Fluid Contact Determination in Formation Evaluation
- Integrating Pressure Plot and Well Log Data: Unveiling Key Insights
- Interpretating and Analysing Well Log Data: Unravelling Subsurface Secrets
- Calculating Gross Rock Volume: Unveiling Reservoir Potential
- Understanding Reservoir and Fluid Properties: Unravelling the Subsurface Puzzle
- Utilizing the Equivalent Hydrocarbon Column Method for Net-to-Gross Determination: A Comprehensive Approach
- Ensuring Accuracy in Porosity Calculation: Key Considerations in Formation Evaluation
- Estimating Water Saturation: Unlocking Reservoir Fluid Distribution
- Hydrocarbon In-Place Estimation: Determining Resource Potential
- Effective Communication of Findings in Formation Evaluation: Sharing Insights with Stakeholders

3 Method of Evaluation for the Short-Term Project-Based Experience

3.1 Data Collection to Evaluate the Short-Term Project-Based Experience

This study employed a survey research design to investigate the experiences of second-year undergraduate students in the Formation Evaluation course within petroleum engineering education at UTP. Specifically, we aimed to assess the impact of short-term project-based learning on their educational experience.

To gather comprehensive insights, a total of 58 students who had undergone project-based learning participated in this study. They were surveyed using an online questionnaire featuring 20 Likert scale questions/statements. These questions provided five response options, allowing students to express their agreement or disagreement, ranging from “strongly agree” to “strongly disagree”.

To ensure a well-rounded assessment, the questionnaire was strategically designed to map 20 questions to five essential characteristics of project-based learning, covering ten distinct attributes. Each of these essential characteristics was associated with four unique questions/statements, forming a comprehensive framework for evaluation.

The survey questionnaire’s structure and content are detailed in Table 1 for reference.

This research endeavor aims to explore the effectiveness of project-based learning within the context of petroleum engineering education. By delving into students’ perceptions of this approach, we seek to gain valuable insights that can inform and enhance pedagogical practices in the field.The five essential characteristics or distinguishing features of PjBL are:

- Authentic learning experience
- Inquiry-based learning experience

- Collaboration
- Effective Assessment
- Effective Facilitator

3.2 Ethical Consideration and Limitations

Participants were informed about the purpose and nature of the study, and their voluntary participation were sought. The anonymity and confidentiality of the participants will be maintained, and their personal information will not be disclosed.

This study has several limitations, including the use of a convenience sample from a single course at a university, which limits the generalizability of the findings. Additionally, self-reported data collected through the survey questionnaire may be subject to response bias.

3.3 Data Analysis

The data analysis for the study is primarily descriptive, providing percentages, mean scores, and Cronbach's alpha coefficients for each section of the survey. The study used a survey instrument with 20-items, and the Cronbach's alpha coefficient for the entire instrument was 0.997, indicating high internal consistency and reliability.

3.4 Evaluate the Enhancement of Student Learning Outcomes and Proficiency in Solving Real-World Problems Through the Implementation of Project-Based Learning

To assess the impact of short-term project-based learning (PjBL) on student learning outcomes and proficiency in solving real-world problems, a comparison was conducted between two batches of students: the January 2023 semester batch, which received the intervention, and the January 2020 semester batch, which served as the control group. Both batches were evaluated based on similar learning outcomes, ensuring a valid comparison between them.

Prior to performing statistical analysis, the assumption of normality for the data was examined. The Shapiro-Wilk test for normality and a Q-Q plot were employed to assess the distribution of the data for both the January 2023 semester batch and the January 2020 semester batch. These tests are essential to verify whether the data adheres to the assumption of normality, a prerequisite for many statistical analyses. The results of these tests demonstrated that both sets of data followed a normal distribution, satisfying the assumption of normality and ensuring the validity of further statistical analysis.

A box plot (Fig. 3) illustrates the distribution of scores for both the January 2023 semester batch and the January 2020 semester batch, providing a visual representation of their respective score distributions. The box plot allows for a quick comparison of the central tendency, spread, and identification of potential outliers within the two batches. Notably, the January 2023 semester batch is the group that received the intervention, showcasing the impact of PjBL on their learning outcomes and proficiency in solving real-world problems.

By considering the normality of the data and utilizing the box plot, this study ensures the validity of the subsequent statistical analysis and provides a comprehensive understanding of the comparative performance between the January 2023 semester batch and the January 2020 semester batch, explaining the impact of the PjBL intervention on student learning outcomes and proficiency in solving real-world problems.

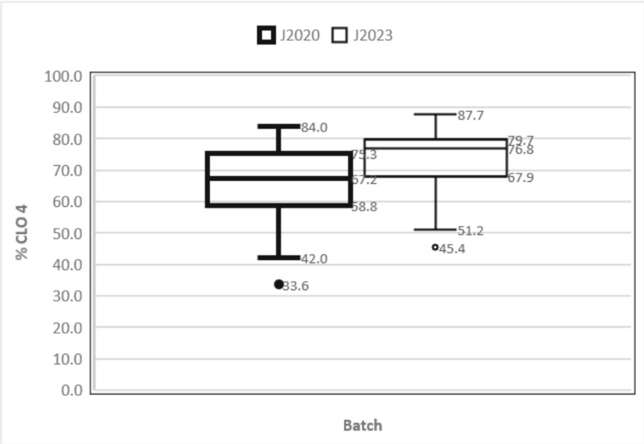

Fig. 3. The distribution of scores for the January 2023 semester batch and the January 2020 semester batch

4 Results and Discussion

The results and discussion sections are divided into two subsections, each focusing on addressing one of the two research questions, as outlined below:

- Impact of Project-Based Learning (PjBL) on Student Motivation, Engagement, and Perceived Relevance:

This subsection examines the impact of project-based learning (PjBL) on student motivation, engagement, and perceived relevance of their learning experience. It explores how PjBL influences students' levels of motivation and engagement in the learning process, as well as their perception of the relevance of their learning to real-world applications. The findings shed light on the effectiveness of PjBL in enhancing student motivation, engagement, and the perceived value of their learning experience.

- Enhancement of Student Learning Outcomes and Proficiency in Solving Real-World Problems through the Implementation of Project-Based Learning (PjBL):

This subsection thoroughly examines the impact of project-based learning (PjBL) on enhancing student learning outcomes and proficiency in real-world problem-solving. It investigates the role of PjBL in fostering critical thinking, collaboration, and ownership among students, and evaluates how these skills contribute to their preparedness for future real-world applications. Additionally, this analysis includes a comparison between two batches to further understand the differences in outcomes achieved through PjBL implementation.

By structuring the results and discussion sections into these two subsections, the study allows for a comprehensive exploration of the impact of PjBL on student motivation, engagement, relevance, learning outcomes, and proficiency in solving real-world problems.

4.1 The Impact of Project-Based Learning (PjBL) on Student Motivation, Engagement, and Perceived Relevance of Their Learning Experience in a Short-Term Petroleum Engineering Project

Table 1 shows the summary of questionnaire responses from 58 respondents.

Table 1. Questionnaire Responses from 58 Respondents

No	Items	% of Respondents						
		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	Cronbach's α
A1	This project is related to a current and relevant and real-world problem and issue	1.7%	1.7%	6.9%	34.5%	55.2%	4.397	0.964
A2	This project is closely connected to the real situation and context that I may encounter in my future professional life	1.7%	0.0%	6.9%	34.5%	56.9%	4.448	
A3	This project required me to apply the real-world problem-solving skills and knowledge to address the real-world problem or issue	1.7%	0.0%	6.9%	36.2%	55.2%	4.431	

(*continued*)

Table 1. (*continued*)

No	Items	% of Respondents						
		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	Cronbach's α
A4	I found that the project is an authentic real-world project and is engaging enough to make me feel like I was working on a real-world problem or issue	1.7%	0.0%	6.9%	34.5%	56.9%	4.448	
B1	I felt that this project-based approach allowed me to pursue my interests and passions within the course	1.7%	1.7%	6.9%	34.5%	55.2%	4.397	0.968
B2	I felt that this project-based approach allowed me to think critically and independently	1.7%	1.7%	6.9%	34.5%	55.2%	4.397	
B3	The facilitator provided guidance and support when necessary. I take the ownership of this project	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
B4	This project was effective in developing my research and inquiry skills	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
C1	I felt that the project-based learning approach provided me with opportunities to collaborate and work with peers	1.7%	0.0%	6.9%	36.2%	55.2%	4.431	0.979
C2	Working in group in this project is helpful in achieving the project goals	1.7%	0.0%	6.9%	36.2%	55.2%	4.431	

(*continued*)

Table 1. *(continued)*

No	Items	% of Respondents						
		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	Cronbach's α
C3	I felt that I had clear roles and responsibilities within my team in completing this project	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
C4	I felt that the collaboration with my team members in this project helped me learn and grow as a team member	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
D1	I found that the assessment used in this project accurately reflected my understanding of the subject matter	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	0.975
D2	I found that the assessment used in this project was more meaningful than traditional assessments, such as examination and quizzes	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
D3	I found that the assessment used in this project motivated me to engage more deeply with the subject matter	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	
D4	I felt that the assessment used in this project prepared me better for future real-world applications of the subject matter	1.7%	0.0%	8.6%	34.5%	55.2%	4.414	

(continued)

Table 1. (*continued*)

No	Items	% of Respondents						
		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	Cronbach's α
E1	The instructor provided appropriate guidance and support throughout the project	1.7%	0.0%	6.9%	36.2%	55.2%	4.431	0.980
E2	The instructor encouraged critical thinking, problem-solving, and creativity throughout the project	1.7%	0.0%	6.9%	36.2%	55.2%	4.431	
E3	The instructor's implementation of the project-based learning approach was effective and impactful for my learning	1.7%	0.0%	5.2%	37.9%	55.2%	4.448	
E4	The instructor allocated adequate guidance and support to help me manage my time during this project	1.7%	0.0%	5.2%	37.9%	55.2%	4.448	

The Cronbach's alpha coefficient for the 20-items survey instrument was 0.997, indicating a high level of internal consistency. The results suggest that the survey instrument is reliable for measuring the students' experience in this short-term PjBL project. In addition, the mean score for the survey was 4.42/5.00, indicating that participants had a good experience and/or positive perceptions towards this short-term PjBL project.

1) Responses for the Questions Related to Authentic Learning Experience

The questions related to the Authentic Learning Experience received a high percentage of strongly agree responses ranging from 55.2% to 56.9%, indicating that the students found the project to be relevant and closely connected to real-world problems and issues. The average scores for the questions were also high, ranging from 4.397 to 4.448, which further supports the notion that the students perceived the project to be authentic and engaging. The value of Cronbach's alpha was 0.964, which indicates a high level of internal consistency and reliability in the questionnaire responses. This suggests that the questions were measuring the same construct and were consistent in their measurement.

The high percentage of strongly agree responses and average scores for the questions related to the authenticity and relevance of the project-based learning approach is a positive sign. It suggests that the students perceived the project to be closely connected to real-world problems and issues, which can enhance their learning and motivation to engage with the subject matter. The high value of Cronbach's alpha indicates that the questionnaire was reliable in measuring the construct of authenticity and relevance of the project-based learning approach. This indicates that the questions were measuring the same construct and were consistent in their measurement, suggesting that the results are valid and can be used to inform future project-based learning approaches.

In a comprehensive analysis, the findings strongly indicate that the project-based learning approach employed in this study effectively delivered an authentic and engaging learning experience closely aligned with real-world problems and issues for the students.

2) Responses for the Questions Related to Inquiry-Based Learning Experiences

Based on the results, it appears that a majority of the respondents strongly agreed that the project-based approach allowed them to pursue their interests and passions within the course and think critically and independently. Additionally, a majority of respondents also agreed that the facilitator provided guidance and support when necessary and that they took ownership of the project. Furthermore, the respondents also felt that the project was effective in developing their research and inquiry skills.

The high Cronbach's alpha value of 0.968 indicates that the questions in the survey were highly reliable and consistent in measuring the construct being assessed. Therefore, we can conclude that the respondents' perceptions about the project-based approach were highly consistent.

In the discussion, we can further highlight the importance of project-based approaches in promoting student engagement, ownership, and critical thinking. We can also discuss the facilitator's role in providing guidance and support to students and the significance of developing research and inquiry skills in real-world problem-solving. Furthermore, we can suggest that future studies can explore the effectiveness of different project-based approaches in enhancing student learning outcomes.

3) Responses for the Questions Related to Collaboration

The responses to the four questions related to collaboration were consistently positive, with all of them receiving the same percentage of strongly agree responses. Additionally, the average scores for the items were relatively high, indicating that participants found the project-based learning approach effective in promoting collaboration, teamwork, and individual growth. Moreover, the Cronbach's alpha coefficient of 0.979 suggests a high degree of internal consistency and reliability among the four questions. This indicates that the questions are measuring a similar construct, which is the effectiveness of project-based learning in promoting collaboration and teamwork. The high level of internal consistency and reliability enhances the validity of the results and provides greater confidence in the findings.

The results suggest that this short-term project-based learning approach was successful in providing opportunities for collaboration and teamwork among participants. This is important because collaboration and teamwork are important skills that are highly valued in many professional settings. Additionally, the positive experience of working in a group to achieve project goals may also help to foster a sense of community and connectedness among participants.

The finding that participants felt they had clear roles and responsibilities within their teams is also significant, as it indicates that the project-based approach was successful in facilitating effective communication and organization within groups. This is essential for successful teamwork, and the development of these skills is highly beneficial for future professional endeavours.

The results suggest that the project-based learning approach was effective in promoting collaboration, teamwork, and individual growth among participants, and that the participants found the experience to be positive and meaningful. The high level of internal consistency and reliability among the questions adds further support to the validity of these findings.

4) Responses for the Questions Related to Effective Assessment

The four questions listed have the same percentage of strongly agree responses, indicating that the participants had a consistent positive experience across all items. The average score for each item is also the same, with an average score of 4.414 for all four items. This suggests that participants found the assessment used in the project to be effective in accurately reflecting their understanding of the subject matter, being more meaningful than traditional assessments, motivating deeper engagement with the subject matter, and preparing them for future real-world applications.

The Cronbach's alpha coefficient of 0.975 indicates a high level of internal consistency and reliability among the four questions. This means that the questions are measuring a similar construct, which in this case is the effectiveness of the assessment used in the project in promoting learning and preparation for real-world applications among participants. Overall, the results suggest that the assessment used in the project was successful in promoting meaningful and effective learning outcomes.

5) Responses for the Questions Related to Effective Facilitator

The results of the study suggest that the instructor played a critical role in the success of the short-term project-based learning approach. The high percentage of strongly agree responses and high average scores across all four items indicate that the instructor provided appropriate guidance and support throughout the project and encouraged critical thinking, problem-solving, and creativity among the participants.

The participants also found the instructor's implementation of the project-based learning approach to be effective and impactful for their learning. The high Cronbach's alpha coefficient indicates that the questions were measuring a similar construct, which in this case is the effectiveness of the instructor in implementing the project-based learning approach.

Furthermore, participants felt that the instructor allocated adequate guidance and support to help them manage their time during the short-term project. This is an important aspect of project-based learning as time management skills are critical for success.

This study also suggests that the instructor's role in implementing the project-based learning approach is critical for its success. The findings of this study can be used to inform the development and implementation of project-based learning approaches in other contexts.

In this study, it is notable that less than 4% of the total respondents reported disagreement or strong disagreement on all the questions. This indicates that the majority of the participants had a positive experience with the project-based learning approach and the instructor's implementation of it. This is an encouraging finding that suggests that the project-based learning approach was effective in promoting learning outcomes among the participants. It is important to note, however, that the small percentage of respondents who disagreed or strongly disagreed may still provide valuable feedback on areas for improvement in future implementations of the approach. Overall, the results of this study suggest that project-based learning, when implemented effectively by an engaged instructor, can be a valuable and effective approach for promoting learning outcomes in short-term projects.

4.2 Enhancement of Student Learning Outcomes and Proficiency in Solving Real-World Problems Through the Implementation of Project-Based Learning (PjBL)

To compare the learning outcomes and proficiency in solving real-world problems between the January 2023 semester batch and the January 2020 semester batch, an unequal variance t-test was conducted. The purpose of this test was to determine if there were statistically significant differences in the means of the two groups.

- The null hypothesis, H_0: stated that there would be no significant difference in the learning outcomes and proficiency in solving real-world problems between the two batches,
- The alternative hypothesis, H_1: proposed that there would be a significant difference.

In this particular analysis, the unequal variance t-test was appropriate due to the different standard deviations observed in the January 2023 semester batch and the January 2020 semester batch. By accounting for these distinct variabilities, the test provided a more accurate assessment of the significance of the observed differences.

The obtained p-value from the t-test was determined to be 0.000488, assuming a significance level (alpha) of 0.025. Since the p-value is lower than the chosen significance level, we can reject the null hypothesis. These results indicate that the implementation of project-based learning (PjBL) in the January 2023 semester batch led to significantly enhanced learning outcomes and proficiency in solving real-world problems compared to the January 2020 semester batch.

The obtained p-value of 0.000488 provides robust evidence in support of the alternative hypothesis, demonstrating a substantial improvement in the learning outcomes and proficiency of students in the January 2023 semester batch who underwent project-based learning (PjBL) compared to their counterparts in the January 2020 semester batch.

The findings of this study indicate that PjBL had a significant positive impact on student motivation, engagement, and perceived relevance. The survey results demonstrated that students had a positive perception of the PjBL approach, with a high mean score indicating their enjoyment and satisfaction with the learning experience. This suggests that PjBL successfully fostered a sense of motivation and engagement among students, making the learning process more meaningful and relevant to their lives.

Furthermore, the implementation of PjBL was found to enhance student learning outcomes and proficiency in solving real-world problems. The study's findings revealed that PjBL provided an authentic and engaging learning experience that closely aligned with real-world challenges and issues. This approach promoted critical thinking, collaboration, and ownership among students, enabling them to develop the necessary skills and competencies to tackle real-world problems effectively.

5 Conclusions

In conclusion, this study explored the effectiveness of short-term project-based learning (PjBL) in enhancing student learning outcomes and motivation within a short-term project. The survey instrument used demonstrated high reliability, indicating that students had a positive perception and enjoyable experience with the PjBL approach, as evidenced by the mean score of 4.42/5.00. The findings revealed that PjBL provided an authentic and engaging learning experience that closely aligned with real-world problems, fostering critical thinking, collaboration, and ownership among students.

The assessment employed in the project effectively promoted desirable learning outcomes and prepared students for future real-world applications. The study recommends that educators prioritize the design of projects that are relevant to real-world problems, encourage student inquiry and exploration, promote collaboration and communication, utilize meaningful and effective assessments, and provide guidance and support from skilled facilitators.

These findings contribute to the expanding body of research on the benefits of PjBL for student engagement and learning outcomes. They highlight the potential of short-term PjBL to cultivate critical thinking, creativity, and problem-solving skills necessary for success in the 21st-century workforce. Moreover, the significant differences revealed by the unequal variance t-test between the January 2023 semester batch and the January 2020 semester batch provide strong evidence to reject the null hypothesis. This suggests that the implementation of short-term PjBL in the January 2023 semester batch led to significantly enhanced learning outcomes and proficiency compared to the January 2020 semester batch.

The calculated p-value of 0.000488, with a chosen significance level (α) of 0.025, further supports the rejection of the null hypothesis, indicating that the observed improvements are not due to random chance but rather reflect a notable enhancement associated with the adoption of short-term PjBL. These findings underscore the effectiveness of project-based learning as an instructional approach in promoting student success, aligning with prior research emphasizing the benefits of short-term PjBL in enhancing student engagement, collaboration, and ownership of learning.

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Appendices

Normality Test: January 2020 Semester Batch Learning Outcome Attainment

In this analysis, we assess the normality of the marks for the learning outcome of the January 2020 semester batch. To determine if the data follows a normal distribution, we employed the Shapiro-Wilk normality test due to the smaller sample size of less than 50.

The descriptive statistics of the January 2020 semester batch learning outcome attainment are as follows:

- Average = 64.8%
- Standard Deviation = 11.920
- Median = 67.2%
- Upper Extreme = 84%
- Lower Extreme = 42%
- Upper Quartile = 75.3%
- Lower Quartile = 68.8%
- Number of Students = 45.

1) Hypotheses:

The null and alternative hypotheses for the Shapiro-Wilk normality test are defined as follows:

- H_0: The sample belongs to a normal distribution
- H_1: The sample does not belong to a normal distribution

The Shapiro-Wilk test is used to determine whether the sample data deviates significantly from a normal distribution. The test statistic (W) is calculated using the formula:

$$W = \frac{\left(\sum_i^n a_i x_i\right)^2}{\sum_{i=1}^n (x_i - \overline{x})^2} = \frac{5917.028}{6251.700} = 0.946$$

where:

- a_i are the coefficients derived from the sample size and distribution parameters.
- x_i are the sorted sample values.
- $\overline{x}$ is the sample mean.

The critical value from the table for $\alpha = 0.05$ is 0.945.

Since the test statistic (0.946) is greater than the critical value (0.945) and the p-value is greater than the chosen significance level ($\alpha = 0.05$), we fail to reject the null hypothesis. This suggests that we do not have sufficient evidence to conclude that the marks for the learning outcome of the January 2020 semester batch deviate significantly from a normal distribution.

Normality Test: January 2023 Semester Batch Learning Outcome Attainment

In this analysis, we examine the normality of the marks for the learning outcome of the January 2023 semester batch. To assess the normality of the data, we employed the Quantile-Quantile (Q-Q) plot due to the larger sample size exceeding 50.

1) Data:

The descriptive statistics of the January 2023 semester batch learning outcome attainment are as follows:

- Average: 72.8%
- Standard Deviation: 9.8530
- Median: 76.8%
- Upper Extreme: 87.7%
- Lower Extreme: 51.2%
- Upper Quartile: 79.7%
- Lower Quartile: 67.9%
- Number of Students: 58

2) Methodology:

The Q-Q plot is a graphical tool used to visually assess the normality of a dataset. It compares the observed data quantiles with the expected quantiles of a normal distribution. Based on the Q-Q plot, the points align fairly closely to the straight line, indicating that the observed data quantiles closely follow the expected quantiles of a normal distribution. This suggests that the data is well approximated by a normal distribution.
However, it is important to note that the Q-Q plot provides an informal visual assessment of normality and does not provide formal statistical evidence.

Comparing Two Normal Distributions with Unequal Variances: An Unequal Variance t-test

This test aims to compare the marks obtained by two different semester batches: January 2020 and January 2023. The analysis will be conducted using an unequal variance t-test to determine if there is a significant difference in the mean marks between the two batches.

1) Data:

The marks data for both batches is as follows:
a) January 2020 Semester Batch:

- Average: 64.8%
- Standard Deviation: 11.920
- Median: 67.2%
- Upper Extreme: 84%
- Lower Extreme: 42%
- Upper Quartile: 75.3%
- Lower Quartile: 68.8%
- Number of Students: 45

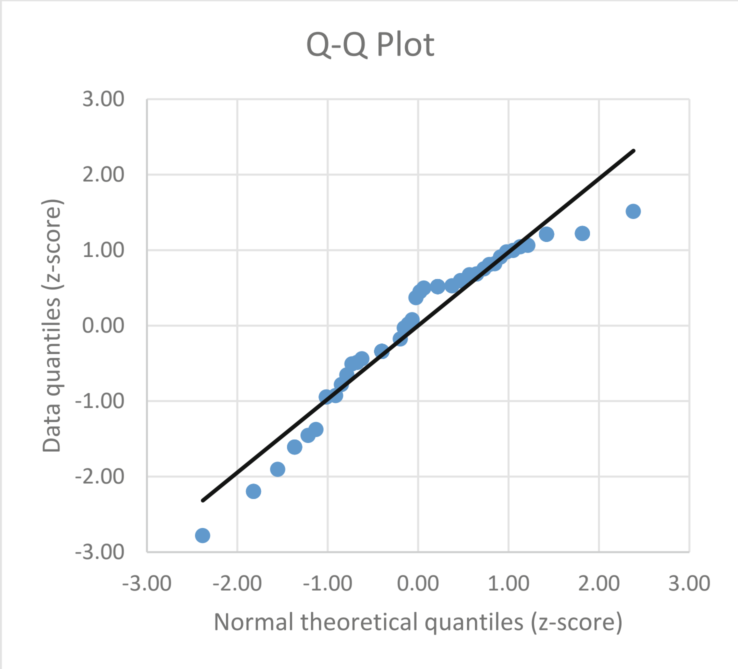

Fig. 4. The Q-Q plot for normality test

b) January 2023 Semester Batch:

- Average: 72.8%
- Standard Deviation: 9.8530
- Median: 76.8%
- Upper Extreme: 87.7%
- Lower Extreme: 51.2%
- Upper Quartile: 79.7%
- Lower Quartile: 67.9%
- Number of Students: 58

2) Hypotheses:

The null and alternative hypotheses for the unequal variance t-test are defined as follows:

- H_0: The mean marks of the January 2020 and January 2023 semester batches are equal.
- H_1: The mean marks of the January 2020 and January 2023 semester batches are not equal.

3) Methodology:

To compare the means of the two batches with unequal variances, we will conduct an unequal variance t-test. This test allows us to account for the difference in variability between the two datasets.

4) Analysis:

Using the provided data, we will calculate the test statistic and p-value associated with the unequal variance t-test.
5) Test Statistic:

The test statistic for the unequal variance t-test is given by:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

where,

- $\overline{X}_1$ and $\overline{X}_2$ are the sample means of the January 2020 and January 2023 batches, respectively.
- s_1 and s_2 are the sample standard deviations of the January 2020 and January 2023 batches, respectively.
- N_1 and N_2 are the sample sizes of the January 2020 and January 2023 batches, respectively.

6) Calculation:

Using the provided data, we can calculate the test statistic as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}} = \frac{64.8 - 87.7}{\sqrt{\frac{11.920^2}{45} + \frac{98530^2}{58}}} = -3.628$$

7) p-value:

Using the calculated test statistic and degrees of freedom, we can find the corresponding p-value associated with the test. p-value = 0.000488.
Given that the p-value is less than the critical value, we should reject the null hypothesis. This provides substantial evidence indicating that the means of the two populations are indeed different from each other.
8) Conclusion:

Considering the calculated test statistic and p-value, we can confidently conclude that a significant difference exists in the mean marks between the January 2020 and January 2023 semester batches.

Project-Based Learning Assessment Rubric for This Work

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Understanding of pressure plot and well log analysis	Limited understanding of pressure plot and well log analysis and their relevance to fluid contact estimation	Developing understanding of pressure plot and well log analysis and their relevance to fluid contact estimation	Adequate understanding of pressure plot and well log analysis and their relevance to fluid contact estimation	Comprehensive understanding of pressure plot and well log analysis and their relevance to fluid contact estimation	1	
Accuracy of fluid contact determination	Significant discrepancies between estimated fluid contact and actual fluid contact	Estimated fluid contact is noticeably far to the actual fluid contact, correct method	Estimated fluid contact is reasonably close to the actual fluid contact	Estimated fluid contact is very close to the actual fluid contact, with minimal error	1	
Integration of pressure plot and well log data	Limited ability to integrate pressure plot and well log data to improve fluid contact estimation	Developing ability to integrate pressure plot and well log data to improve fluid contact estimation	Adequate ability to integrate pressure plot and well log data to improve fluid contact estimation	Advanced ability to integrate pressure plot and well log data to improve fluid contact estimation, and to identify other relevant information from the data	1	

(*continued*)

(*continued*)

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Interpretation and analysis of well log data	Limited ability to interpret and analyse well log data to determine fluid properties	Developing ability to interpret and analyse well log data to determine fluid properties	Adequate ability to interpret and analyse well log data to determine fluid properties	Advanced ability to interpret and analyse well log data to determine fluid properties, and to identify other relevant information from the data	2	
Calculation of gross rock volume	Limited ability to calculate gross rock volume from structural map data	Developing ability to calculate gross rock volume from structural map data	Adequate ability to calculate gross rock volume from structural map data	Advanced ability to calculate gross rock volume from structural map data, using advanced techniques and software	3	
Understanding of reservoir properties and fluid properties	Limited understanding of reservoir properties and fluid properties and their relevance to gross rock volume determination	Developing ability to interpret and analyse well log data to determine fluid properties	Adequate understanding of reservoir properties and fluid properties and their relevance to gross rock volume determination	Comprehensive understanding of reservoir properties and fluid properties and their relevance to gross rock volume determination, and ability to apply them effectively	1	

(*continued*)

(*continued*)

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Understanding of equivalent hydrocarbon column method for net-to-gross determination	Demonstrates a limited understanding of the equivalent hydrocarbon column method, struggles to interpret well log data, shows a low level of accuracy in estimating net sand thickness and equivalent hydrocarbon column height	Developing understanding of the equivalent hydrocarbon column method, accurately interprets well log data, shows a reasonable level of accuracy in estimating net sand thickness and equivalent hydrocarbon column height	Demonstrates a solid understanding of the equivalent hydrocarbon column method, accurately interprets well log data, shows a reasonable level of accuracy in estimating net sand thickness and equivalent hydrocarbon column height	Demonstrates a thorough understanding of the equivalent hydrocarbon column method, accurately interprets well log data, shows a high level of accuracy in estimating net sand thickness and equivalent hydrocarbon column height	2	

(*continued*)

(*continued*)

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Accuracy of porosity calculation	Demonstrates a limited understanding of porosity and log responses, struggles to identify the appropriate log for porosity estimation, shows a low level of accuracy in porosity calculation, has difficulty identifying and correcting errors in log data, and demonstrates a basic knowledge of rock and fluid properties affecting porosity estimation	Developing understanding of porosity and log responses, identifies the appropriate log for porosity estimation, shows a reasonable level of accuracy in porosity calculation, identifies and corrects some errors in log data, and demonstrates a good knowledge of rock and fluid properties affecting porosity estimation	Demonstrates a solid understanding of porosity and log responses, identifies the appropriate log for porosity estimation, shows a reasonable level of accuracy in porosity calculation, identifies and corrects some errors in log data, and demonstrates a good knowledge of rock and fluid properties affecting porosity estimation	Demonstrates a thorough understanding of porosity and log responses, accurately identifies the appropriate log for porosity estimation, shows a high level of accuracy in porosity calculation, effectively identifies and corrects errors in log data, and demonstrates advanced knowledge of rock and fluid properties affecting porosity estimation	1	

(*continued*)

(*continued*)

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Estimation of water saturation	Demonstrates a limited understanding of log data and petrophysical principles, struggles to select appropriate water saturation model based on rock and fluid properties, inputs data inaccurately or without attention to detail, produces inaccurate interpretations, and has trouble making informed decisions based on interpretation results	Developing understanding of log data and petrophysical principles, selects appropriate water saturation model based on rock and fluid properties, inputs data with reasonable accuracy and attention to detail, delivers reasonably accurate interpretations, and uses interpretation results to make informed decisions	Demonstrates a solid understanding of log data and petrophysical principles, selects appropriate water saturation model based on rock and fluid properties, inputs data with reasonable accuracy and attention to detail, delivers reasonably accurate interpretations, and uses interpretation results to make informed decisions	Demonstrates a deep understanding of log data and petrophysical principles, selects appropriate water saturation model based on rock and fluid properties, inputs data accurately and with attention to detail, delivers high-quality and accurate interpretations, and effectively uses interpretation results to make informed decisions	1	

(*continued*)

(*continued*)

Criteria	Needs improvement ($0 \leq x < 2.00$)	Partially meets expectation. ($2.00 \leq x < 3.00$)	Meets expectations ($3.00 \leq x < 4.00$)	Exceeds expectations ($4.00 \leq x \leq 5.00$)	Multiplier	Marks attained
Hydrocarbon In-Place estimation	Demonstrates a limited understanding of geological and petrophysical principles, inputs data inaccurately or without attention to detail, struggles to select and apply appropriate fluid and rock properties, produces inaccurate or imprecise calculations, and has difficulty communicating results effectively	Developing understanding of geological and petrophysical principles, inputs data with reasonable accuracy and attention to detail, selects and applies appropriate fluid and rock properties appropriately, accurately calculates hydrocarbon in place with reasonable precision, and communicates results with clear language	Demonstrates a solid understanding of geological and petrophysical principles, inputs data with reasonable accuracy and attention to detail, selects and applies appropriate fluid and rock properties appropriately, accurately calculates hydrocarbon in place with reasonable precision, and communicates results with clear language	Demonstrates a deep understanding of geological and petrophysical principles, inputs data accurately and with attention to detail, selects and applies appropriate fluid and rock properties with precision, accurately calculates hydrocarbon in place, and effectively communicates results with clear and concise language	5	
Communication of findings	Limited ability to communicate findings clearly and effectively	Developing ability to communicate findings clearly and effectively	Adequate ability to communicate findings clearly and effectively	Advanced ability to communicate findings clearly and effectively, and to tailor communication to different audiences	2	

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EZ Arabic: Mobile Application to Learn Arabic

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Abstract. EZ Arabic is an innovative language learning mobile application that is meant to help people of all abilities quickly and effortlessly learn and master the Arabic language. EZ Arabic provides a convenient and engaging learning experience by utilising a user-friendly design and a wide range of interactive features. To improve their Arabic language skills, users can access a large library of vocabulary exercises, grammar tutorials, pronunciation guidelines, and interactive quizzes. EZ Arabic is constantly improving based on user feedback, allowing for a personalised and effective learning experience. EZ Arabic enables individuals to uncover their language potential and confidently communicate in Arabic, whether they are beginners or advanced learners.

Keywords: mobile application · Arabic · learning

1 Introduction

With EZ Arabic, language learning becomes a breeze. Our app features interactive quizzes designed to help you master the basics of Arabic. Answer engaging questions and enhance your vocabulary, grammar, and pronunciation skills in a fun and interactive way. But that's not all, EZ Arabic also includes a monitoring level system for parents. Keep track of your child's progress and identify areas where they may need extra support. It's a comprehensive tool that ensures a nurturing learning environment for young language learners. The main goals of EZ Arabic are as follows are to create an engaging and interactive platform that promotes effective language acquisition for children in Malaysia, to develop age-appropriate content that aligns with the needs and learning styles of young learners and to incorporate interactive exercises, engaging visuals, and gamification elements to make the learning process enjoyable and motivating.

The development of EZ Arabic are to close the gap and solve some of the problems such as follows: (i) to make learning Arabic to be fun and interactive, (ii) flexible classes that can be conducted anywhere, and (iii) as a tool to assist parents in monitoring their children's progress.

Students would want to learn in a fun environment. However, with traditional teaching methods, classes can be mundane, and students are less likely to fully under-stand the

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knowledge given in class. This leads to a decrease in the student's performance which is an undesirable effect. But, with the multimedia approach of this application, it has 15 been proven many times to create the best environment for students to learn Arabic language in a fun and interactive way.

Students want the freedom of learning anywhere they want to. But, to apply for language classes, in this case: Arabic language, it is not available everywhere. This leads to them losing interest in learning the language due to the work involved in finding classes near them. This application is accessible from their phone, so it is available anytime and everywhere.

Parents would want to be able to monitor their children's performance in classes anytime they want to. However, with other responsibilities, it is quite a hassle to check up on them periodically. So, parents would sometimes feel left out in their children's school life. With this application, parents can use it as a platform to be engaged in their children's performance in their Arabic language lessons through the application..

2 Related Work

2.1 Effects on Learning Arabic Language

Based on the literature review, the effects of learning the Arabic language would likely cover a variety of topics, including the cognitive and linguistic benefits of studying a foreign language, the challenges and difficulties associated with learning Arabic specifically, and the impact of various teaching methods and language-learning tools on student proficiency. Research has shown that studying a foreign language can have a positive impact on cognitive development, including increased creativity, problem-solving ability, and memory. For example, a study by Bialystok, Craik, Klein, & Viswanathan (2004) found that bilingualism can lead to improved executive function and attentional control. Additionally, learning a foreign language can also enhance a person's cultural understanding and empathy. A study by Byram, Gribkova & Starkey (2002) [1] found that language learning can lead to intercultural competence and promote positive attitudes towards other cultures. Learning Arabic as a foreign language can pose certain challenges, such as the complexity of its grammar and script, and the fact that it is written from right to left. Additionally, the language has different dialects spoken in different countries, this can make it difficult for learners to understand spoken Arabic. A study by Al-Fityani (2016) [2] found that Arabic learners face difficulties in understanding and producing colloquial Arabic. Several studies have found that immersion-based teaching methods, such as study abroad programs or immersion classrooms, can be effective in helping students improve their Arabic language proficiency. For example, a study by Al-Issa (2008) found that study abroad programs can lead to a significant improvement in the speaking and listening skills of Arabic learners. Furthermore, using authentic materials, such as Arabic media and literature, can also enhance language learning. A study by Al-Seghayer (2001) [3] found that using authentic materials in the classroom can lead to a significant improvement in the reading comprehension skills of Arabic learners.

2.2 Usability Factors in Mobile Application

The usability factors in mobile applications would likely cover various aspects of the design and functionality of mobile apps that can impact their ease of use and effectiveness for users. Usability in mobile apps can be influenced by factors such as the layout and organization of the user interface, the accessibility and discoverability of features, and the ease of completing tasks. A study by Hassenzahl, Burmester, Koller, & Lehner (2010) [4] found that the perceived usability of a mobile app is positively associated with user satisfaction and perceived usefulness. The design of the user interface can also have a significant impact on usability. Factors such as the use of appropriate visual design elements, clear labelling, and intuitive navigation can help to make an app more usable for users. A study by Hassenzahl, Burmester, Koller, & Lehner (2010) [4] found that the perceived usability of a mobile app is positively associated with user satisfaction and perceived usefulness. The accessibility and discoverability of features is another important usability factor in mobile applications.

A study by [5] proposed Mobile Application Usability Evaluation Metrics (MAUEM) model to provide guidance for mobile application that ist the items to measure each usability attribute.

The steep learning in Arabic, especially among non-native speakers has contributed to a simpler user interface and user experience in application development. This is to ensure for users to operate and utilise the application, receive feedback from interactions, and understand user demands [6]. Another similar study for mobile apps targeted to migrants learning Arabic found through their focus group discussions found that apps that may be used entirely or in part offline, without requiring registration, could be very helpful for migrants who are on the road, living in refugee camps or other facilities for asylum seekers where wifi is scarce [7].

3 Materials and Method

Methodology Model that being used in EZ Arabic application is Rapid Application Development (RAD). It is a software development approach focused on fast delivery. It involves iterative development cycles, user involvement, prototyping, reusing com-ponents, and teamwork. RAD emphasizes quick iterations, user feedback, and collab-oration to build applications efficiently. It is best suited for projects with evolving requirements and emphasizes speed and flexibility.

3.1 Planning and Quick Design

Begin by identifying the key features and functionalities of EZ Arabic, such as vocabulary exercises, grammar lessons, pronunciation guides, and interactive quizzes. Create a rough design or wireframe of the app's user interface to visualize the layout and structure. Define the target audience and their specific needs to guide the devel-opment process.

3.2 Demonstrate

Develop a basic prototype or minimum viable product that showcases the core functionalities of EZ Arabic. Use simple, placeholder content to demonstrate the app's features and flow. Gather feedback from potential users, language experts, or Arabic learners to identify areas for improvement.

3.3 Refine

Continuously iterate and improve EZ Arabic based on user feedback and testing results. Address usability issues, bugs, or performance bottlenecks that arise during the development process. Incorporate user suggestions and refine the user interface for a more intuitive experience.

3.4 Testing

Conduct comprehensive testing of EZ Arabic's functionality, performance, and usability. Perform unit testing to ensure individual components work correctly and integration testing to verify the interaction between different modules. Conduct user acceptance testing (UAT) to gather feedback from real users and identify any additional improvements.

3.5 Deployment

Prepare EZ Arabic for deployment by packaging it for the desired platforms as for this project it is android. Submit the app to relevant app stores or make it available for download and installation. Continuously monitor the app's performance and collect user feedback for future updates.

4 EZ Arabic Prototype Interface

The following shows the user interface for EZ Arabic; which are the Login, Register, Level, Question and interface if the answers are either correct or wrong.

4.1 Login and Register Page

Figure 1 shows the Login Page where the user that already registered an account need to login into the application by entering email and password. Then, the user needs to register an account to use the application. The user must fill their email and password as shown in Fig. 2.

The learning journey starts when as shown in Fig. 3. The user needs to choose level given. The user can choose between level 1, level 2, level 3, and level 4. The higher the level the trickier the questions. Figure 4 shows an example of the Question Page. The user must answer all the questions given by clicking on the answers. There are four multiple-choice questions that the user can choose.

Figure 5 shows the answer page where the answer will be green if the user clicked on the right answer. However, if the answer is wrong, the red color will be displayed as show in Fig. 6.

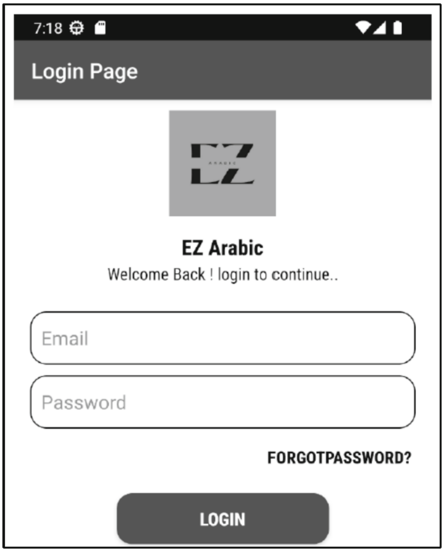

Fig. 1. Login Page

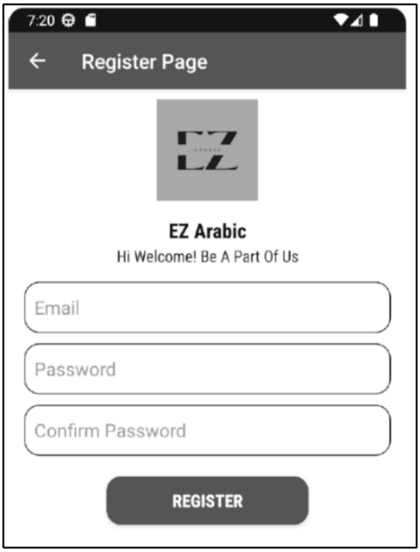

Fig. 2. Register Page

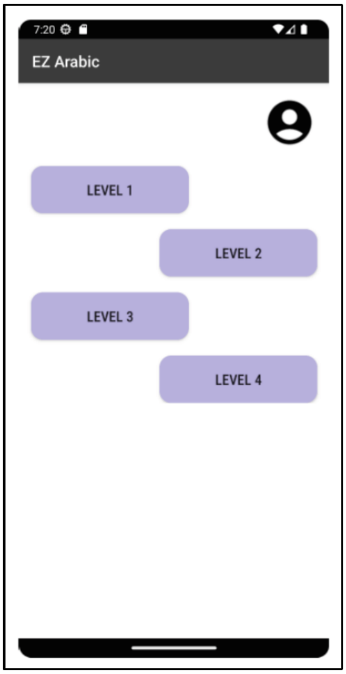

Fig. 3. Level Page

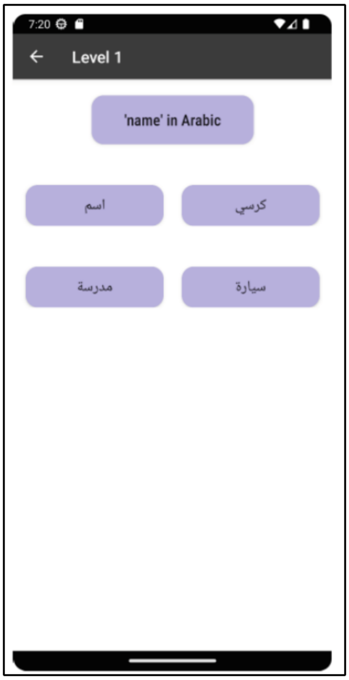

Fig. 4. Question Page

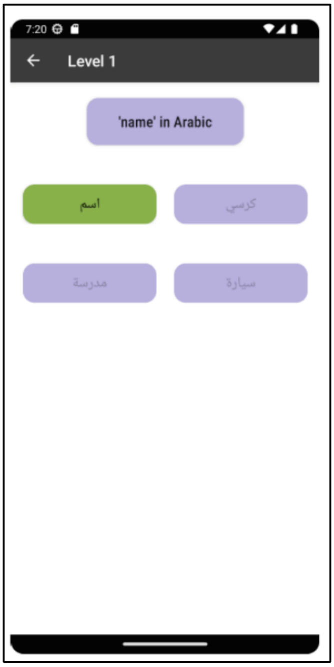

Fig. 5. Correct answer

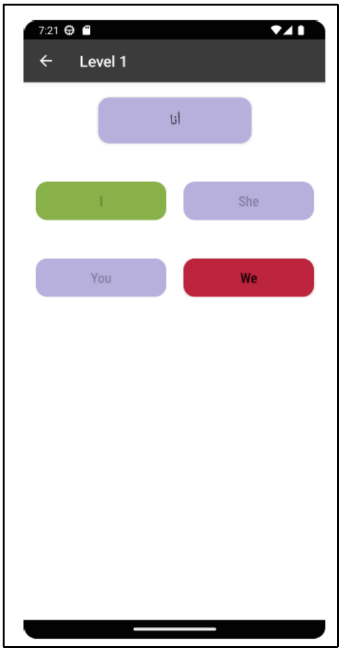

Fig. 6. Wrong answer

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Educating Generation Z: Adapting Humanistic Teaching in Blended Learning Environment

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Abstract. This study explores the adaptation of humanistic teaching principles in a blended learning environment to cater to the needs and preferences of Generation Z students. Generation Z, the cohort born between the mid-1990s and early 2010s, has grown up in a technologically advanced world and possesses unique characteristics and learning preferences. Blended learning, which combines face-to-face instruction with online learning, offers opportunities to incorporate humanistic teaching approaches and leverage technological tools to enhance the learning experience. The research objectives include identifying effective ways to integrate technology in supporting humanistic teaching for Generation Z students and examining students' perceptions of their experiences in such an environment. A qualitative research design is employed, incorporating interviews and video reflections to gather data from randomly selected students. The findings reveal that integrating technology in the classroom can foster meaningful connections between educators and students, promote active learning, facilitate collaboration, and cater to individual students' learning abilities. Students' perspectives indicate a positive reception to the integration of humanistic teaching principles in a blended learning environment, emphasizing the importance of autonomy, self-reflection, and personal growth. This study highlights the potential of adapting humanistic teaching approaches in blended learning to effectively educate Generation Z students and provides insights for educators seeking to enhance student-centeredness and engagement in the digital age.

Keywords: Humanistic Education · Blended Learning · Technological Tools
Introduction

This Over the last decades, the world has witnessed the booming of new technology. Artificial Intelligence, the Internet of Things, data processing, and other tools have been embedded in our lives. It is clear that technological revolution is rapidly taking place in our society [1] that scholars have predicted that emergence of technological singularity that is a point in time where technological growth may result to unforeseeable changes to humankind. These advances in technology have also impacted the education field which evidently dehumanised education because technology has caused human interactions between learners to be at a minimum and it has created a shift in decision-making from people to technology. These days, technology is even used to learn basic skills such as reading, writing and arithmetic that the relevance of educators is questioned.

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In addition, the unexpected arrival of the COVID-19 pandemic transformed the education sector to become more digital. Online classes and distance learning were no longer trends, but a reality prompting educators to embrace the digital transformation of teaching and learning. Nonetheless, during the pandemic, these technological tools are the only option for educators to communicate and interact with their learners in synchronous and asynchronous teaching and learning process [2].

Understanding the impact of technology on society and human relationship, scholars have proposed concepts such as Society 5.0 – a human-centred society that balances between economic advancement and societal problems by integrating the cyber-space and the physical space and Life 3.0 – human life in the age of artificial intelligence [1]. In line with these developing concepts, the education sector should evolve towards Education 5.0 to ensure the version of education that is more caring and inclusive inspired by the Sustainable Development Goals. Education 5.0 focuses on relationship and interaction between learners and with their educators. It is a chain that links digital and technological knowledge to social and emotional skills which prepares learners for life-long learning and lays the foundation for a wide range of skills that go far beyond the digital. Moreover, in Education 5.0 more attention is paid to aspects such as privacy, ethics, security and technological mindfulness. Therefore, Education 5.0 adds a more humane perspective to teaching and learning.

Nonetheless, in an era of emerging smart robots like Sophia or the AI generated technology like ChatGPT which could readily replace humans, Education 5.0 promotes the irreplaceable human qualities of educators because educators' roles in the classroom are still relevant and needed by learners to build into their characters and value while fostering imagination and creativity [3, 4]. However, this do not mean that educators can be complacent but rather they need to be highly competent in integrating various technological tools and platforms by up-grading their teaching methods to meet with the changes in the education system thus fulfilling the fourth Sustainable Development Goals by UNESCO [5]) that accentuate the need to develop quality education through transformative pedagogy while retaining the humanistic elements in teaching and learning.

1 Literature Review

1.1 Humanistic Education in a Blended Learning Environment

Nowadays, educators must adapt to a student-oriented approach that promotes well-rounded growth and impactfully engages students. Through combining online and in-person education, blended learning enables tailored experiences that encourage learner interaction [6]. Simultaneously, education that values humanism fosters development via personal guidance. By integrating the fundamental tenets of humanistic teaching methods with the principles of blended learning, an innovative educational model can be created that boosts student involvement, encourages self-directed learning, and promotes in-depth topic mastery [7]. By blending the best of both worlds, educators can create a transformative learning environment that empowers learners to become active participants in their own education, cultivates their intellectual and emotional growth, and prepares them to thrive in an ever-evolving world.

In addition, by integrating Bransford's ideas on how people learn in blended learning with the principles of humanistic education, educators can create a blended learning environment that is engaging, personalized, socially interactive, and promotes holistic learner development [8]. This integration enhances the effectiveness of the learning process by aligning with the humanistic values of learner-centeredness, personal growth, and the cultivation of a love for learning. It empowers learners to become active participants in their own education, encourages critical thinking, and prepares them for success in a rapidly changing world [7].

Integration of technology in blended learning has pros but according to educators, it does not foster ideal conditions for humanized education. Limited personal connections between students and educators pose a significant challenge in education settings. According to [9], technology's incorporation into the classroom hinders educator's ability to create meaningful connections. The richness and depth of face-to-face communication are lost when relying solely on technological means to communicate. Non-verbal cues can become lost in translation during digital communication, which includes facial expressions and body language. Without adequate emotional connections, educator/learner dynamics might falter.

Moreover, Technology-mediated communication can sometimes feel impersonal, particularly in large online classes or when communication is primarily text-based [10]. The absence of physical presence and direct human interaction may make it challenging for learners to establish a personal connection with their educators. This can lead to feelings of isolation or a perception that the educator is distant or inaccessible. In some cases, the integration of technology may result in less individualized attention from educators. Large class sizes, automated assessments, or pre-recorded lectures can limit opportunities for personalized interactions and make it challenging for educators to address the unique needs and concerns of each [11]. This can impact the depth and quality of connections between educators and learners [12]. Therefore, this creates a virtual gap separating the educator and the learners which is caused by the of lack educators' presence and more of technological mediated instruction [12]. Over time, the learners begin to feel that their virtual class sessions are bland and uninspiring experience resulting to learners to become withdrawn and disinterested to participate in the virtual class sessions.

Another important barrier to the integration of technology in blended learning approach is access and infrastructure. The integration of technology may burden learners from the lower end of the socio-economic background. Learners from disadvantaged backgrounds or underserved areas may lack the necessary devices, software, or internet access required for meaningful participation in blended learning activities. In a study conducted by [13] reported that learners from the low income and working-class background experience more obstacle in their adjustment to virtual learning compared to learners from middle/upper-class backgrounds. The study reports that almost one-third of undergraduate learners from low-income family lack access to technology compared to only 11% of learners from upper middle class and wealthy families. The study also reports 66% of learners from the low-income group claim that learning virtually is a challenge due to the non-conducive home environment such as distraction to noises, family responsibilities and lack of access to appropriate study space. Hence, when these basic conditions required for virtual learning environment [14] are not meet, it amplifies the gap in learning between different socio-economic group of learners.

Taking into consideration of these barriers, applying humanistic education into blended learning educators can create a learner-centred, engaging, and holistic learning environment. The humanistic education focuses on building learners' individuality and self-actualization by integrating the affective and cognitive domains in class activities. The integration of technology can enhance personalization, collaboration, and authentic learning experiences, aligning with the values of humanistic education. This combination fosters the development of well-rounded individuals who are self-directed, reflective, empathetic, and motivated learners.

This paper explores the adaptation of humanistic teaching in a blended learning environment, highlighting the ways in which these approaches synergistically contribute to learner growth and success. By combining the strengths of humanistic teaching with the opportunities afforded by blended learning, educators can create a transformative learning environment that empowers learners to take ownership of their education, fosters their intellectual and emotional growth, and prepares them to thrive in a rapidly changing world.

2 Aims of the Study

This paper explores the integration of blended learning and humanistic education through the use of technological learning tools that empowers learners to become active participants in their own education. Accordingly, the following aims are developed.

1. To identify the ways technology can be effectively utilized to support the adaptation of humanistic teaching for Generation Z learners in a blended learning environment.
2. To identify Generation Z learners' perceptions in regards to their experiences to the integration of humanistic teaching principles in a blended learning setting.

3 Methodology of the Study

3.1 Research Design

The research design for investigating the adaptation of humanistic teaching in a blended learning environment, with a focus on qualitative methods, randomly selected learners for interview sessions, and the creation of video reflections. Qualitative research methods will be employed to gather in-depth insights and rich descriptions of learners' experiences. This approach allows for a nuanced understanding of individual experiences, motivations, and perspectives related to humanistic teaching in a blended learning context. Potential limitations of the research design may include the relatively small sample size due to random sampling and the inherent subjectivity in qualitative research, which relies on individual perspectives and interpretations. Generalizability of findings may be limited to the specific context and population under study.

Ethical guidelines, such as informed consent, anonymity, and confidentiality, will be strictly followed throughout the research process. Participants' privacy and rights will be respected, and their voluntary participation will be ensured.

3.2 Participants

This study is a pilot study conducted on 100 s semester foundation learners from Universiti Tenaga Nasional to evaluate the effectiveness of blended learning and humanistic education through the use of technological learning tools. A random sampling technique will be used to select participants for interview sessions. From the target population of learners enrolled in the blended learning course, a subset of participants will be randomly selected to ensure representation from various backgrounds, learning styles, and academic performances. This approach aims to capture a diverse range of perspectives.

3.3 Data Collection

a) Semi-Structured Interviews: Individual semi-structured interviews will be conducted with the randomly selected learners. The interviews will provide an opportunity for participants to share their experiences, thoughts, and perceptions regarding the adaptation of humanistic teaching in the blended learning environment. Probing questions will be used to explore specific aspects of their learning experiences, engagement, and overall perceptions.
b) Video Reflections: At the end of the semester, learners will be requested to create video reflections that capture their learning journey and experiences throughout the course. They will be encouraged to reflect on the application of humanistic teaching principles, their growth as learners, and the impact of blended learning on their academic and personal development.

3.4 Data Analysis

Interview Transcriptions: The interviews will be audio-recorded and transcribed verbatim. Thematic analysis will be used to identify recurring themes, patterns, and key findings across participants' responses. Codes will be generated, and themes will be refined through an iterative process.

b) Video Reflection Analysis: The video reflections will be analysed qualitatively, employing a similar thematic analysis approach. Key themes and patterns related to the learners' reflections on their learning journey, the application of humanistic teaching, and their perceptions of blended learning will be identified.

4 Results and Discussion

The results of this study shed light on the experiences and perceptions of learners regarding the adaptation of humanistic teaching in a blended learning environment. Through qualitative analysis of semi-structured interviews and video reflections, key themes and patterns emerged, providing valuable insights into the impact of humanistic teaching principles and blended learning on learner engagement, learning outcomes, and holistic development. This discussion highlights the main findings and their implications for instructional practices, learner-centered learning, and the effective integration of technology in educational settings.

4.1 Research Objective 1

To identify the ways technology can be effectively utilized to support the adaptation of humanistic teaching for Generation Z learners in a blended learning environment.

The integration of technology in a blended learning environment has the potential to greatly enhance the adaptation of humanistic teaching practices for Generation Z learners. Through the analysis of interview data and video reflections, several key findings emerged regarding the effective utilization of technology in supporting the application of humanistic teaching principles. This discussion explores these findings, highlighting the ways in which technology can be leveraged to create a learner-centered and engaging learning environment that aligns with the needs and preferences of Generation Z learners. Furthermore, it delves into the implications of these findings for educators seeking to effectively integrate technology in their instructional strategies to support the adaptation of humanistic teaching for this digitally native generation.

The researcher implemented the bookshelf method, consisting of the beginning (pre-class), middle (during class), and end (post-class) stages, to effectively utilize technology in supporting the adaptation of humanistic teaching practices for Genera-tion Z learners. Prior to joining the class, learners were required to log into the UNITEN Learning Management System (LMS) known as Brighten, where they could access recorded video lectures and infographic notes. This allowed learners to engage with the course material before attending the class session.

Technological tools such as Padlet and Google Jamboard were utilized for class activities, fostering collaboration and cooperative learning in an active learning classroom environment. These platforms allowed learners to actively discuss and search for information to complete tasks, thereby creating an active learning environment that minimized feelings of isolation instead allow for learners to communicate, collaborate, and network with each other. Thus, provides platform for the integration of technology facilitated transformative interactions among peers and educators [15, 16]. Active learning techniques, combined with the integration of technological tools, allowed educators to create meaningful connections with their learners and achieve higher levels of learner engagement [17]. This engagement facilitated a more integrated understanding of lesson concepts and their applicability, ultimately leading to better retention of knowledge and improved academic performance.

The incorporation of active learning approaches, including cooperative learning groups, promoted social interaction among learners. Learners actively discussed and sought information to complete tasks, thereby avoiding feelings of isolation. This collaborative environment provided a platform for learners to communicate, collaborate, and network with each other, enhancing their social and communication skills [18–20].

Within the classroom, the educator assumed the role of a facilitator and guide providing scaffolding, a teaching strategy rooted in Vygotsky's Zone of Proximal Development. Scaffolding involved breaking complex lessons into smaller, manageable parts and providing support and guidance through various techniques such as activation of background knowledge, think aloud, questioning, coaching, and modeling [21–24]. These facilitative methods were individually tailored to match the needs of each learner, ensuring that progressive support was provided based on the learners' abilities and competence.

These results demonstrate the effective the integration of various technological tools and platforms facilitated active engagement, collaboration, and communication, aligning with the preferences and learning styles of Generation Z learners. The role of the educator as a facilitator and guide was instrumental in creating a learner-centered and interactive learning experience. These findings have implications for educators seeking to leverage technology to enhance humanistic teaching approaches and create a meaningful and engaging learning environment for Generation Z learners.

In the context of the assignment, the educator employed mediated learning to facilitate the completion of assignments and promote higher-order cognitive processes among learners. Mediation, as emphasized by Vygotsky, involves the use of mediators in formal education to prevent the acquisition of immature concepts and neglect of important learning skills [25]. In this study, the educator acted as the mediating agency by providing instructions and materials for the assignment through Ms Teams. Rather than leaving learners to complete the assignments independently, the educator guided them through the process.

The educator employed a step-by-step approach to assist learners with the assignment. Firstly, examples and demonstrations were provided using platforms like YouTube and TED Talks. This helped learners understand the requirements and expectations of the assignment. Additionally, the educator divided the learners into groups and created collaborative discussions using Google Jamboard. Through mind maps and collaborative filling of Google Sheets, learners were guided in completing the assignment accurately.

In situations where learners faced challenges such as limited internet access or non-conducive learning environments, the educator mitigated the issues by allowing learners to submit assignments through Telegram. This platform also served as a means for learners to seek assistance and ask questions outside of class time. The educator played a vital role in mitigating the negative consequences of virtual learning by harnessing their caregiving qualities. Research suggests that educators' caregiving qualities can help learners decrease the likelihood of negative outcomes and in-crease academic resilience [26–28]. By empathizing with learners, providing scaffolded assistance, and selecting appropriate technological tools that work in low-bandwidth connections like the Telegram application, educators ensure that learning remains possible despite the challenges.

Educators also provided appropriate feedback, modeling, and contingency management (praise and critique), which contributed to learners' comprehension and understanding of specific topics [29, as cited in 25].

The timely support provided by the educator played a crucial role in effective scaffolding, ensuring that learners received the necessary guidance and assistance to enhance their learning experience thus suggest the thoughtfully and purposefully integration of technology support the adaptation of humanistic teaching for Generation Z learners in a blended learning environment.

At the end of each lesson, the educator uses Mentimeter as a tool for reflection on the day's lesson. In Mentimeter, the educator provided a simple prompt to guide learners in reflecting on what they had learned. Reflection plays a crucial role in learning as it allows learners to revisit their learning experiences for improvement and deeper understanding [30]. By engaging in reflection, learners are able to integrate and generalize arguments, recapitulate actions, draw lessons from their experiences, and arrive at meaningful conclusions [31].

Moreover, reflection humanizes the learning process by providing learners with an avenue to assess their understanding and provide feedback on their learning journey. Humanistic education emphasizes self-reflection encouraging learners to think critically about their learning process and monitor their own thinking. It empowers learners to identify their strengths and areas for improvement, allowing them to take an active role in shaping their educational experiences. Through reflection, educators can identify learners' needs and adjust their teaching methods accordingly, positioning themselves as partners in their learners' educational journeys. By fostering reflection, educators promote a learner-centred approach that nurtures deeper understanding, self-directed learning, and continuous improvement.

In the post-class session, beyond the classroom time, the educator provided additional practice opportunities through the Brighten platform. The practice activities were designed to be individualized and personalized, incorporating differentiation practices to promote independent learning. This approach aligns with the values of humanistic education, which recognizes and appreciates the individual differences among learners and aims to personalize the learning experience.

In a diverse classroom, learners may vary in their learning abilities. Some learners may struggle with challenging tasks, while others, with higher abilities, may need opportunities to practice skills they have already mastered [32]. Therefore, it becomes crucial to provide personalized and effective practice that caters to the different levels of learners within the class. The educator in this study adapted the differentiation practice based on the learners' learning abilities, ensuring that all learners could better grasp the lesson concepts [33] By individualizing the learning trajectories while maintaining the same learning goals, the instruction is tailored to meet the specific needs of each learner.

In addition, Generation Z learners' value personalized and independent learning experiences because they are accustomed to learning independently, and they typically prefer engaging in individual settings where they can focus, set their own pace, and derive meaning from their learning before sharing it with others [34, 35].

Research suggests that differentiation practices that cater to individual learners' learning abilities can have a positive influence on learner achievement, particularly when grouping is flexible and teachers adapt their instruction to the needs of different groups [31, 34]. By implementing individualized instruction and personalizing the learning experience, educators can create a supportive and inclusive learning environment that promotes learner success and fosters a sense of belonging for all learners which suggest the adaptation of humanistic education.

4.2 Research Question 2

To identify Generation Z learners' perceptions in regards to their experiences to the integration of humanistic teaching principles in a blended learning setting.

The second Research Objective is aimed to explore Generation Z learners' perceptions of their experiences integrating humanistic teaching principles in a blended learning setting. The findings from learners' interviews and video reflections shed light on their perspectives and provide valuable insights into the effectiveness and impact of hu-manistic teaching in the context of blended learning.

The interviews provided valuable insights into the learners' experiences and perspectives. Several themes emerged from the interviews, highlighting the positive impact of integrating humanistic teaching principles in the blended learning environment. Learners expressed appreciation for the personalized and individualized approach to instruction, which allowed them to learn at their own pace and catered to their unique needs and learning styles. One learner commented, "I really liked how the lessons were tailored to my own abilities. It made me feel like the teacher truly cared about my progress."

During the interviews, learners expressed how the integration of humanistic teaching principles positively influenced their learning experiences. They acknowledged the personalized and inclusive nature of the instructional strategies used, which allowed them to engage in meaningful ways. One learner shared, "The activities and discussions encouraged collaboration and active participation. It felt like our voices were heard, and we had the freedom to express our thoughts and opinions." This feedback aligns with the learner-centered approach of humanistic teaching, which empowers learners to take ownership of their learning and actively participate in the educational process.

In addition, learners emphasized the importance of the supportive and inclusive classroom environment created through humanistic teaching principles. They felt that their voices were heard and valued, and they appreciated the opportunities for collaboration and discussion. One learner stated, "I felt included and supported in the class. The teacher encouraged us to share our thoughts and ideas, and it made me feel more engaged in the learning process."

The video reflections provided further insights into the learners' experiences. In their video reflections, learners expressed their appreciation for the humanistic approach employed by the educator. They highlighted the significance of feeling valued and respected as individuals in the learning process. One learner mentioned, "I felt like the educator really cared about my learning and understood my unique needs. It made me more motivated to engage and participate actively in the class." This sentiment reflects the central tenets of humanistic education, which emphasizes the importance of recognizing and catering to individual differences and fostering a positive and supportive learning environment.

Furthermore, learners appreciated the use of technology to support their learning because the tools used facilitated their learning and engagement, communication, collaboration, and reflection. One learner reflected, "Using tools like Padlet and Google Jamboard made learning more interactive and fun. I enjoyed working with my classmates and learning from their perspectives." While another learner mentioned, "The online platforms made it convenient for us to access resources and engage with the class, even outside the scheduled sessions. It allowed for flexibility and catered to our diverse learning styles." This feedback indicates that the integration of technology in the blended learning environment can complement and enhance the humanistic teaching approach by providing additional avenues for interaction and self-reflection.

The learners' interviews and video reflections also highlighted the impact of humanistic teaching on their personal and social development. They emphasized how the supportive and nurturing learning environment created by the educator fostered their confidence, encouraged risk-taking, and promoted a sense of belonging. One learner expressed, “I felt comfortable expressing my ideas and learning from my peers. The collaborative activities helped me develop my communication and team-work skills.” These reflections align with the holistic nature of humanistic education, which values the growth and well-being of the whole individual, not just academic achievement.

Scholars also support the positive outcomes of integrating humanistic teaching principles in a blended learning setting for Generation Z learners. Personalized learning experiences can enhance learner motivation and engagement. Furthermore, researchers such as [37] emphasize the importance of creating a supportive and inclusive classroom environment to foster learner success and well-being.

All in all, the findings from learners’ interviews and video reflections provide valuable insights into Generation Z learners’ perceptions of integrating humanistic teaching principles in a blended learning setting. The learners appreciated the personalized and inclusive nature of the instructional strategies, the use of technology to support their learning, and the positive impact on their personal and social development. These findings emphasize the effectiveness of humanistic teaching principles in fostering a learner-centered and engaging learning environment, where learners feel valued, motivated, and empowered in their educational journey.

5 Conclusion

In conclusion, this study examined the adaptation of humanistic teaching principles in a blended learning environment to educate Generation Z learners. The results indicated that technology can effectively support the adaptation of humanistic teaching in a blended learning environment. The use of tools such as the UNITEN LMS system (Brighten), Quizizz, Mentimeter, Padlet, and Google Jamboard facilitated engagement, collaboration, and active learning. These technological resources promoted inclusivity, personalized instruction, and catered to individual learning abilities. The utilization of mediated learning and scaffolding strategies provided learners with the necessary guidance and support to enhance their understanding and completion of assignments which aligns with the tenets of humanistic education, emphasizing the importance of individual differences, learner autonomy, and personal growth.

Therefore, adapting humanistic teaching in a blended learning environment holds immense potential to meet the needs and preferences of Generation Z learners. By integrating technology tools, fostering collaboration, and providing individualized instruction, educators can create a learner-centred educational experience that promotes motivation, engagement, and meaningful learning outcomes. This study serves as a foundation for further exploration and refinement of humanistic teaching practices in the context of blended learning, ultimately enhancing the educational experiences and achievements of Generation Z learners.

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Efficiency of 3D Geodata Visualization for Teaching and Learning: Case Study of BSc Petroleum Geoscience Course

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Abstract. In recent years, the usage of virtual reality (VR) applications has expanded in the fields of geoscience education, scientific research, and communication. The usage of VR in geoscience has benefited from the democratization of once inaccessible geodata which has been proven as an effective visualization tool in analyzing and learning the earth's geodata. In this study, we impose a teaching and learning activity of subsurface seismic and well data using 3D VR technology which is commonly used in industry standard software such as Paleoscan, Petrel and JewelSuite. Prior to the VR implementation, the respondents (students from BSc Petroleum Geoscience background) were familiar with the software that typically visualized using 2D computer screens. In this work, we examine the efficiency of immersive virtual reality tools for teaching and learning subsurface seismic datasets. The data includes a one post-stacked time migrated mega merge 3D seismic survey tied to wells with an average seismic velocity of 1700 ms^{-1} calculated from base to top of the carbonate. The students can interact with seismic data such as change scales, color sets, and perform preliminary seismic interpretation. It is found that the implementation of virtual reality (VR) has subsequently enhanced the respondents' skills in understanding and performing seismic data analysis that benefits the overall Petroleum Geoscience course.

Keywords: virtual reality · geophysical data · petroleum geoscience

1 Introduction

In the geological sciences, virtual reality (VR) is regarded as a cutting-edge method that offers 3D visualization and geoinformation for data gathering and distribution method that give an immersive user experience [1–3]. Therefore, any geoscience models would benefit greatly from additional data, including geological and geophysical imagery. In the current practice, most visualizations are limited to being seen on flat, two-dimensional displays. Geologists, geophysicists, educators, and students all benefit from real-time visualization and engagement techniques tailored to geospatial data at varying spatial resolutions. The goal of the user is to enhance their ability to make observations and draw conclusions in both two and three dimensions [4].

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In this study, a geophysics course taught in the final year of the BSc Petroleum Geoscience program was chosen to gauge the learners' perception and performance improvement in visualization using virtual reality for geophysics is interdisciplinary learning. Therefore, it is introducing case study teaching as a replacement for the standard lecture format in educational settings.

2 Methodology and Dataset

Seismic data is an important tool for the development of oil and gas fields as well as for monitoring oil or gas production. Graduate students in geoscience require a solid comprehension of seismic data because of the significance of seismic data to the industry. Fresh graduates will have a greater chance of finding employment if they have a solid grasp of the expanding role that seismic technology and industry exploration. This will also enable them to perform more effectively and integrate more quickly into any geoscience team they join [5]. In this approach, we investigate the perceptions of the virtual reality implementation with regards to the geophysical data in their teaching and learning activities. Prior to this, all the respondents have the chance to explore and use geophysical datasets based on conventional approach (2D computer screen) in existing industry-standard software.

The investigation starts with several questionnaire, asking the familiarity of the respondents in dealing with subsurface geodata as well as their prior experience in using VR. Then the each of the respondents was given opportunity to navigate the subsurface data in VR mode for a few sessions ranging 10–15 min per session (Fig. 1), before being asked on their experience of using VR instead of computer screens. The respondents were provided with several data types; seismic cubes, well logs and digital core with interactive engagement between users allowed during the VR session. During this session, they also had the opportunity to alter the sizes of objects, modify the color sets, and do preliminary seismic interpretations.

Fig. 1. Respondents experience the virtual reality via Oculus Lens sets as well as augmented reality via mobile phones.

3 Result

Several examples showed that VR can be used to aid teaching and learning activities as it enables the interactive and immersive exercises that integrated with digitized learning spaces. This study presents the findings from several anonymous questionnaire given to the identified respondents (BSc Petroleum Geoscience students) after they had experienced immersive virtual reality sessions.

Overall, the findings indicate a positive perception and acceptance of VR technology. 50% of the respondents expressed their extreme satisfaction with the visualization of seismic data, perceived VR as a valuable learning and teaching tool, and showed a willingness to repeat the VR experience. These findings suggest that in-vesting in VR technology for geoscience applications could offer potential benefits for education, exploration, and data analysis in the teaching environment. It has been discovered that most respondents would participate in the virtual reality experience again, and, more crucially, that most students who participated in the navigation affirmed the effectiveness of this technique for geo-education. It has been found that 3D seismic was the most familiar type of subsurface data, with 76.9% of the respondents indicating their familiarity with it, while slightly lower percentage indicate their full understanding of dealing with well logs and core data.

From the initial statistic, 38% of the respondents indicated that they did not have prior experience and knowledge on the VR. However, the study shows that 92% of them believe the usage of VR and simulation in the teaching and learning activity has increase the effectiveness in enriching their knowledge (Fig. 2a). It has been reported the incorporation of VR during the teaching and learning activities has significantly increase the students' confidence level in dealing with the subsurface geodata (Fig. 2b). Respondents also asked whether they agree on the VR usage for independent learning which 92% of them indicate their approval of the VR implementation. A large percentage of respondents believe virtual reality to be a highly beneficial medium for teaching (46.2%), as well as learning (53.8%), in the field of geoscience and earth sciences.

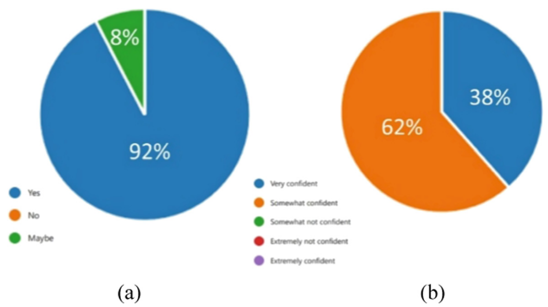

Fig. 2. (a) Respondents were asked whether the implementation of simulation activity has increased the course delivery effectiveness, (b) Respondents were asked on their confidence level dealing with subsurface geodata

4 Conclusion

With a focus on seismic visualization, efforts have been directed at creating a quantitative assessment for petroleum geoscience students at Universiti Teknologi PETRONAS. The study was able to get insight into the possible use of this strategy in geo-education by examining their feedback and experience in virtual reality. While most respondents to the study were enthusiastic about the immersive setting, majority of them appreciated the teaching and learning concept based on the virtual bird's-eye view of the geological and seismic objects on display. They agreed that virtual reality is crucial in improving the learning experience within the earth science discipline. Following the VR simulation exercise, respondents' confidence in geoscience simulation demonstrate the future of geosciences-related learning activity.

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Empowering Learning with Technology: Insights and Way Forward for Universiti Teknologi PETRONAS

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Abstract. Technology Enabled Learning (TEL) has become pivotal in higher education institutions in addressing the rapidly changing educational landscape. This includes the demand for more flexible learning, and innovative learning methods. TEL offers dynamic learning experiences as well as fostering essential skills for the 21st century, such as digital literacy and collaborative problem solving. Higher learning institutions need to critically and continuously assess their existing TEL framework to identify areas for improvement in order to remain competitive on a global stage. This paper highlights the approach adopted by Universiti Teknologi PETRONAS in evaluating its TEL infrastructure, support systems, challenges faced and the way forward for future TEL initiatives.

Keywords: Technology Enabled learning · Blended learning · online learning

1 Introduction

The dynamic landscape of higher education calls for innovative method to transform higher education delivery and pedagogical approaches. The move towards digital transformation means technology plays a distinctive role as the enabler for meaningful learning process. Shift #9 of the Malaysia Higher Education Blueprint 2015–2025 (MHEB) place importance on Globalised Online Learning to harness the power of online learning in providing accessible and affordable high-quality education [1]. This is a long-term strategy to bring Malaysian talent and expertise as the global player of online education, offering online courses such as Massive Open Online Courses (MOOCs) or micro-credential (MC).

Technology enhanced learning (TEL) refers to the use of digital technology to support and mediate educational activities. Quoting Goodyear and Retalis, 2010, "technology

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plays a significant role in making learning more effective, efficient and enjoyable" [2]. The term TEL itself is very broad in nature, encompassing wide range of elements from the infrastructure to the pedagogical aspect of teaching and learning. This includes technology enhanced classrooms, interactive learning approach and instructional methodologies, or learning simulations using artificial or virtual reality. Digital technology can support educational activities through using web-based technology, mobile devices, mobile apps, tablet, computers or any digital device in the learning activities. This includes face-to-face learning, hybrid learning, blended learning, online learning, collaborative learning or self-directed learning, among others. The use of technology in the teaching and learning process also provides better platform for contextual learning, thus providing better learning experience to students.

Learning can be synchronous or asynchronous with the use of technology. For example, the use of screen capture software, podcast, e-learning platform or webinars has made it possible for facilitators to provide alternative method for learning delivery compared to the traditional in-class learning. The competencies of the facilitators in conducting teaching and learning with technologies are also critical. Thus, it is important to understand the factors that contributes to the successful TEL implementation to ensure the learning process is effective, efficient and enjoyable while maintaining the required quality for students to attain the intended learning outcomes.

Many factors affect the successful implementation of TEL at an institutional level. This includes institutional support and staff development [3], institutional policy and organisational culture [4], as well as technology adoption among educators [5]. Analysis of these factors in identifying the gaps within an institution is important to identify the strategies in moving forward towards successful TEL implementation within an institution. For this purpose, this paper will address the following points (i) What are the gaps in TEL at Universiti Teknologi PETRONAS (UTP) against an established benchmark for TEL? (ii) What will be the strategies moving forward for TEL adoption in UTP?

2 Literature Review

Implementation of TEL in a higher education institution requires concerted efforts at all levels, rather than just focusing on the instructional technologies and approaches in creating and sustaining meaningful learning experience for students. Khan's framework on blended learning, for example [6], highlighted the need to have institutional level support in planning, delivering, managing and evaluating blended learning programs, which is also application for any TEL approaches.

UNESCO, in its policy brief for Education 2030 [7] highlighted the eight key dimensions in enhancing the quality of online and blended learning of higher education, which includes (i) institutional vision and philosophy, (ii) curriculum (iii) professional development (iv) learning support (v) infrastructure and support (vi) policy and institutional structure (vii) partnership (viii) research and evaluation. The transformation of a higher learning institution itself towards blended learning practices covers 4 stages, namely (i) building readiness (ii) applying (iii) infusing (iv) transforming.

A similar approach was reported by Graham et. al [8] where the blended learning adoption depends on three factors, namely the strategy, structure and support, while the implementation of blended learning covers three stages as follows:

i. Stage 1: awareness/exploration–no institutional strategy regarding blended learning is available, however, blended learning approach may be implemented on individual basis by faculty members in their classes.
ii. Stage 2: adoption/early implementation–availability of institutional policies and practices to support blended learning strategies and experimentation.
iii. Stage 3: mature implementation/growth–well-established blended learning strategies, support and structure which becomes an integral part of the university operations.

Porter et al [9] conduct a study based on the proposed framework by Graham et.al [8]. The study involved a survey involving 214 faculty members, as well as 39 faculty members who are the early adopters of the blended learning approach. The findings showed that higher learning institution need to adapt to the different needs of early and late adopters in blended learning. For example, the need to publish a standard blended learning guidelines to facilitate uniformity, scaling up of university infrastructure to maintain good internet speed and accessibility to accommodate growing on-campus internet users, as well as on-going professional development to assist the late adopters learning from the early adopters.

Another important aspect of TEL implementation is the individual understanding of their roles and responsibilities towards TEL implementation as well as its interconnections. A survey conducted by the Norwegian Agency for Digital Learning [10] to 235 academic managers and 1072 academic staff. The academic managers consist of deans or head of departments (200), head of studies or head of Sects. (35) showed a mismatch in perception of roles towards the role of supporting TEL implementation. Although the academic managers believe that they are heavily involved in supporting TEL, the academic staff considers the academic managers role towards supporting TEL is limited.

3 Approach

Universiti Teknologi PETRONAS (UTP) participated in the benchmarking on Technology-enabled learning (TEL) with Commonwealth of Learning (COL) in December 2021, together with several public universities in Malaysia. COL promotes the use of TEL in improving access to quality education and training. Several aspects are considered including policy development, improving institutional capacities to develop blended courses, and strengthening the technological infrastructure to leverage on the potentials of TEL. Specifically, TEN (10) domains are considered, which covers (i) policy (ii) strategic plan (iii) IT support (iv) technology applications (v) content development (vi) documentation (vii) organizational culture (viii) leadership (ix) human resource training and (x) technology-enabled champions. Each of these domains contains four to six performance indicators that needs to be evaluated based on the current practice at the institution, with evidence.

The benchmarking exercise follows the TEL Benchmarking Toolkit, which covers FIVE stages as follows: (http://oasis.col.org/handle/11599/3217),

i. Setting-up committee, processes, and documentation
ii. Self-review by internal committee members of the institution
iii. Validation of review by external consultant
iv. Action plan development
v. Closing and reporting of findings to senior management

Upon completion of the benchmarking exercise, UTP has outlined strategies to address the gaps highlighted from the benchmarking exercise, and roll-out the proposed strategies accordingly.

4 Adoption of TEL in UTP

4.1 TEL benchmarking outcome

The benchmarking exercise in UTP using the TEL Toolkit was completed in March 2021. The outcome is shown in Fig. 1, based on the ten dimensions outlined in the TEL Toolkit.

Among the ten domains, the lowest score is on Content Development (3.25), Documentation (3.25) and TEL champion (3.5). The domain with the highest score includes IT support (5.0), Technology Applications (5.0) and Strategic Plan (4.25). The overall average score for UTP is 3.96, indicating there are opportunities for improvement on the TEL approach in UTP.

Fig. 1. UTP score for the ten domains outlined in TEL Toolkit.

The high score for IT support and Technology Application could be attributed to the Covid-19 that has accelerated the need for excellent IT support and technology application in supporting the online delivery for all courses during the pandemic. The technology application in TEL has extended beyond the infrastructures for teaching and learning, e.g., the availability of Technology-Enhanced Active Learning (TEAL) classrooms, to applications and software for teaching and learning, e.g., the use of MS Teams as video-conferencing tools, enhancement of LMS, incorporation of in-house modules for Augmented Reality (AR) and Virtual Reality (VR) for teaching and learning.

The strategic plan developed in 2021 on the academic program and delivery towards sustainability (2025) includes the initiative on Blended and Immersive Learning as one of its pillars. The initiative covers four main domains that is intended to guide the university community towards blended and immersive learning journey. This includes (i) systems and structures (ii) content creation (iii) professional development (iv) enculturation.

4.2 UTP Adoption Strategies

UTP is looking seriously at implementing blended and multimode learning as part of its learning approaches. This requires concerted effort and support at the institutional level. Particular attention was given to the three domains with the lowest score, namely (i) content development (3.25) (ii) Documentation (3.25) (iii) TEL Champion (3.5).

The low score for documentation and content development showed the need to assist the late adopters in implementing TEL for their classes. This includes the need for guidelines, playbook and trainings for lecturers on various aspects related to TEL, for example the use of technology for learning and creating a good self-instructional material for learning.

There is also a need to groom faculty members as TEL champions, especially the early adopters, and provide a platform for experience sharing in assisting all faculty members to adopt TEL approaches for their class. These are done via various initiatives as follows:

i. Establishment of UTP Open Educational Resources (OER) to facilitate sharing of learning materials to expedite content development and improvement.
ii. Enhancing the current training framework for faculty members to groom more champions in the TEL areas.
iii. Development of guidelines related to blended (and multimode learning) to assist faculty members in implementing TEL approaches for their classrooms.
iv. On-going and continuous trainings related to blended learning, including application of related software and applications for learning delivery.
v. Nurturing organizational culture of BL through sharing of practices in Community of Practice as well as Teaching and Learning Festivals.
vi. Enhancing the academic training matrix to include positioning of academic staff to various level of proficiency in teaching and learning according to their level of contributions and achievements (Fig. 2), where Level 1: Developing is for faculty members who is at the start of their teaching career, and Level 4: Exemplary are for faculty members with significant contributions and achievements in teaching and learning. The academic positioning criteria serves as a guide in planning a structured training programs for the faculty members.

Figure 3 showed the overall teaching and learning framework implemented in UTP in providing meaningful learning experience for students. This framework requires all faculty members to use the active learning approach in their class, prior to implementing other approaches under the student-centred learning spectrum. This is to allow the faculty members to develop the required skillsets in supporting students learning, which is very important when implementing cooperative learning or problem-based learning. Similarly, faculty members are exposed to the concept of creating self-instructional

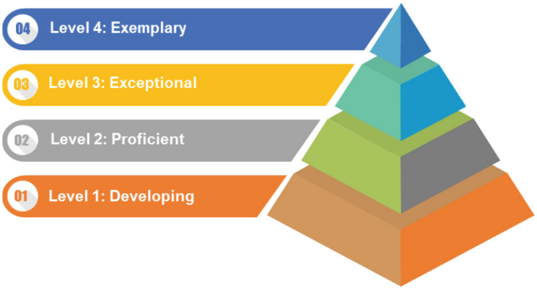

Fig. 2. UTP Academic positioning as the enhancement for academic training matrix

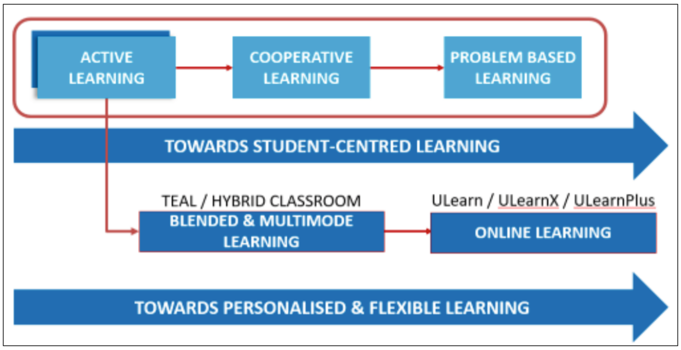

Fig. 3. UTP Teaching and Learning framework in advancing blended and immersive learning for enriching students learning experience.

materials through implementing blended learning for their course, prior to being fully involved in courses delivered via online learning such as online distance learning (ODL), micro-credentials (MC) or Massive Open-Online Course (MOOCs).

5 Conclusion

TEL approaches, in the case of UTP, the blended and multimode delivery, is important in creating an effective and meaningful learning environment for students. Continuous assessment on the progression on yearly basis is pivotal to ensure the successful implementation of TEL approaches for UTP to realize its vision as a leader in technology education and center for creativity and innovation. This transformation requires not only the institutional support in providing the system and structure to manage teaching and learning, but also a structured training approach to position the faculty members as the champion for TEL approaches.

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Enhancing Cooperative Learning in Process Plant Design Course Through Reflection Tool

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Abstract. Cooperative learning is a highly effective instructional approach in engineering education which promotes active participation, collaboration, and shared responsibility among students. In the context of Process Plant Design (PPD) course, the integration of reflection tool such as Teammates can enhance the students' cooperative learning experience, especially in completing their integrated design project (IDP). The Teammates reflection tool provides a structured framework for peer evaluation and self-assessment within teams. By utilizing this tool, students can assess their teammates' contributions based on predefined criteria and provide constructive feedback. Additionally, this tool prompts self-reflection, enabling students to critically analyze their own performance and identify areas for improvement. It was found that integrating Teammates reflection tool in PPD course for project-based learning yielded several positive outcomes, including (1) fostered accountability and equal distribution of workload within teams, (2) facilitated structured feedback for effective communication and collaboration, as well as (3) encouraged metacognition and self-reflection.

Keywords: cooperative learning · reflection tool · teammates · process plant design

1 Introduction

Cooperative learning is widely recognized as an effective pedagogical approach in engineering education, fostering student engagement, critical thinking, and teamwork skills [1]. However, the challenge lies in ensuring equitable contributions and accountability within teams, as well as promoting metacognition among students. To address these challenges, there is a need for a robust and structured tool that facilitates peer evaluation and self-assessment in cooperative learning environments, especially for project-based learning where students work in teams of 4 to 5 members [2]. While various tools and methods exist for peer evaluation, the traditional framework lacked structured assessment mechanisms, which can lead to disparities in workload distribution, unequal participation, and limited opportunities for self-reflection. As a result, students may not recognize their own strengths and areas for improvement, thus hindering their personal growth and development of effective teamwork skills.

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The objectives of this study include (1) explore the significance of incorporating Teammates reflection tool in PPD course specifically IDP, (2) discuss the unique features of the Teammates reflection tool compared to classical reflection questionnaire, (3) provide case studies demonstrating the effectiveness of the Teammates reflection tool, (4) offer practical insights for implementing Teammates reflection tool, and (5) discuss future directions and implications of using the Teammates reflection tool in cooperative learning settings beyond PPD course.

2 Methodology

2.1 Case Study

In PPD course within the bachelor's degree in Department of Chemical Engineering at Universiti Teknologi PETRONAS, students were tasked with completing an open-ended IDP. In this project, students were expected to design complex engineering solutions for chemical processes by integrating the knowledge from several fundamental core subjects such as reaction engineering, separation processes, materials engineering, thermodynamics as well as process safety and loss prevention. For project implementation, students were divided into small heterogeneous groups of 4 or 5 to carry out the project tasks, over 12 weeks of the semester. In previous semesters, peer evaluation and reflection activities were conducted using anonymous questionnaires through Microsoft Forms [4]. However, it has been observed that this method lacks a systematic structure, making it less effective in collecting feedback. Additionally, the feedback received was primarily directed towards the instructors, and team members were unable to provide direct feedback to their peers. Moreover, Microsoft Forms offered limited customization options and lacked the ability to track individual contributions over time. It became evident that while Microsoft Forms could gather individual responses, it did not provide comprehensive insights into team dynamics or facilitate the overall project workflow. As a result, Teammates reflection tool has been adopted to overcome the aforementioned issues and provide a more robust framework for peer evaluation and reflection activities for IDP.

2.2 Implementing Teammates Reflection Tool

During initiation, students were introduced to the Teammates reflection tool, wherein the instructor explained its purpose and how it will be used to facilitate peer evaluation and self-assessment. This is followed by customization of evaluation criteria and scales by instructor to align with the course learning objectives and integrated project requirements. Subsequently, students evaluated their teammates based on the established criteria, considering factors such as contribution, teamwork, communication, problem-solving, and professionalism. This tool allows for both qualitative feedback (formative) and quantitative ratings (summative). Upon completion of the peer evaluation, students were encouraged to engage in self-assessment and reflection, considering the feedback received from their teammates. This will enable them to reflect on their own contributions, strengths and opportunities for improvement [5]. This will lead to the development of action plans by the students to identify steps in which they can enhance their performance for the IDP. Instructors would then facilitate group discussions where students were provided the opportunity to share their reflections and discuss on the feedback received, as well as collectively identify strategies for enhancing team dynamics and individual performance. It is therefore imperative to conduct peer evaluation several times during the execution of a project. This is crucial to provide students with opportunities for improvement [6].

2.3 Teammates Reflection Tool Set-Up

Prior to implementing the Teammates reflection tool, instructors were required to create a course and enroll students. The students can be enrolled into project groups to facilitate providing feedback among smaller groups. In this step, the email of the students should be input, as direct feedback will be sent to the student upon completion of the evaluation. Figure 1 shows an example of interface for students' enrolment in Teammates.

Fig. 1. Example of students enrolment in groups using Teammates

Subsequently, the instructor can create a feedback questionnaire. The questions should be properly designed so that qualitative and quantitative feedback are collected from the feedback session. The questions can be in the form of essay, multiple choice, numerical scale, distribute points, team contribution, rubric, or rank. The instructor can also specify the feedback paths, such as feedback between teams, from instructor to students, or from each student to other students within a team. The set-up also includes visibility control to manage the visibility level of each question, such as giver's team members, recipient's team members, other students, and/or instructors, as well as anonymous or non-anonymous. Upon completion of setting up, instructors were able to preview the session as a student. Each feedback session can be scheduled with deadlines, wherein instructors can specify the opening and closing time. Figure 2 displays an example of feedback session questionnaire and setting in Teammates.

Thereafter, Teammates automatically send emails to students and instructors with instructions to access their feedback session at the time preference specified by the instructor (Fig. 3). Instructors can send manual or automated reminders to the students to complete their responses. After a session has opened, the instructor is able to view the responses, moderate responses, add comments to responses and submit responses for students. After a session closes, the instructor can also publish the results to make it

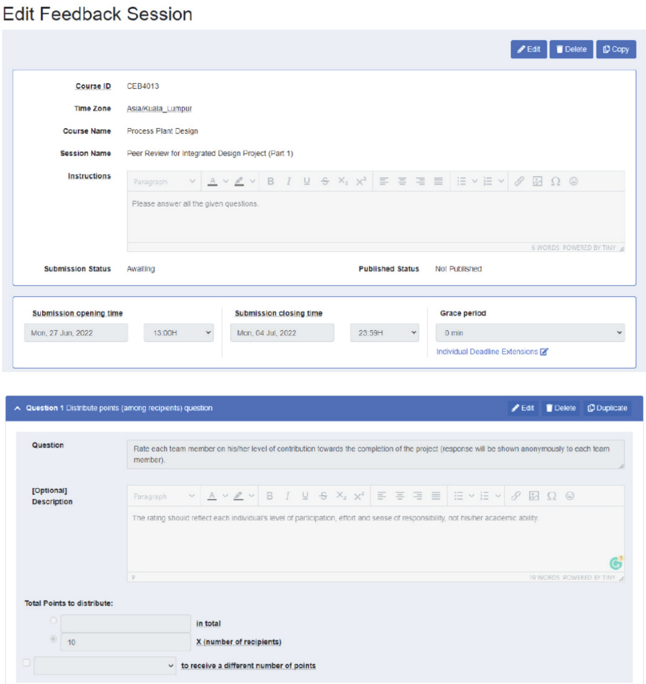

Fig. 2. Example of feedback questionnaire and question for the students

visible to students for areas of improvement, as well as download results of the session in spreadsheet format.

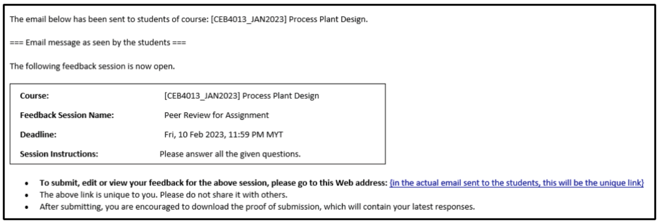

Fig. 3. Example of feedback session automated email

3 Results and Discussion

Through the Teammates reflection tool, it was found that students' accountability towards completing the project was enhanced. It fostered more equal distribution of workload within teams. The comprehensive feedback collected by Teammates allowed for a better understanding of individual and team performance over time. Overall, a majority of teams (92%) expressed their satisfaction with the Teammates reflection tool (Fig. 4). They acknowledged its effectiveness in promoting collaboration, fostering open communication, and encouraging constructive feedback among team members. Moreover, teams reported an improved understanding of their strengths and areas for improvement, enabling them to make necessary and timely adjustments to optimize their performance in a team.

Additionally, the Teammates reflection tool has also facilitated self-reflection among students. Students have been able to evaluate their own progress and behavior during the project implementation. They have been prompted to consider their level of engagement, their contribution to the team dynamics and effectiveness in communicating with team members. This process has allowed students to gain valuable insights into their own work habits, communication styles, and problem-solving approaches. Due to the integration of self-reflection, it has empowered students to take ownership of their learning and personal development. By critically evaluating their own contributions, students have become more self-aware, proactive, and adaptable, thus leading to improved teamwork and more successful project deliverables.

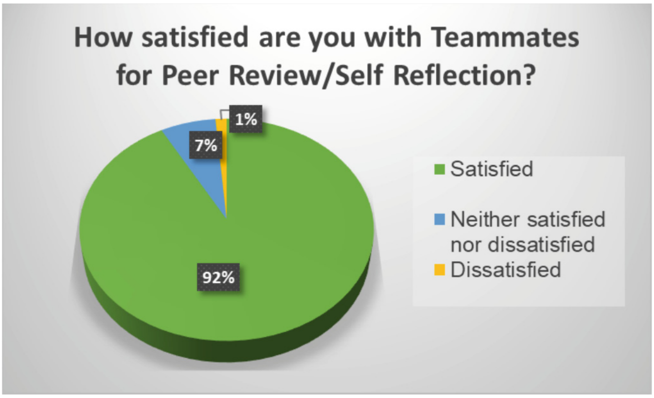

Fig. 4. Students' satisfaction survey

To further improve the utilization of the Teammates reflection tool, it is recommended to complement its usage with personal email announcements or frequent in-class reminders, as these additional communication channels will help ensure that students actively engaged with the tool.

4 Conclusion

In conclusion, the integration of Teammates reflection tool in PPD course for project-based learning has shown significant positive outcome, including fostering accountability, facilitating effective communication, as well as promoting metacognition and self-reflection. Nevertheless, it is important to acknowledge that the efficacy of the tool relies heavily on the course instructor's ability to design a well-crafted set of questions that align with the course learning objectives. By creating purposeful prompts, instructors can maximize the benefits of the reflection tool, ultimately enhancing the overall success of the project-based learning experience.

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Enhancing Engagement and Learning Outcomes in Reservoir Characterization and Geological Modeling Classes Through Gamification

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Abstract. Reservoir characterization and geological modeling are difficult topics in petroleum geoscience that necessitate a thorough understanding of analytical techniques and geological principles. On the other hand, conventional teaching methods sometimes fall short of igniting students' enthusiasm and desire in these specialized fields. Incorporating gamification techniques has emerged as a possible tactic to address this problem and improve effective learning outcomes. This study looks at gamification's possible benefits and doable implementation methods in geological modeling and reservoir characterization courses. Gamification is the process of incorporating game elements—like points, badges, quests, and challenges—into situations that are not related to playing games. By utilizing these game dynamics, instructors may create an interactive and immersive learning environment that capitalizes on students' intrinsic drive for play and competitiveness. Leaderboards and points empower students to compete in a healthy way, which motivates them to participate actively and strive for excellence. Awards and achievements provide them with a sense of achievement and concrete recognition for their accomplishments, which raises their self-esteem. Students get the chance to apply their knowledge and skills in real-world scenarios through challenges and quests, which helps them strengthen their critical thinking and problem-solving abilities. Gamification is implemented in reservoir characterization and geological modeling classes using a structured process. Each of the course's modules focuses on a different subject or group of skills. Badges and awards are also awarded for exceptional performance, acting as visible symbols of knowledge. Teamwork and social interaction are given even more importance during the gamified learning process. Group activities and team-based projects promote cooperation and teamwork, simulating the necessity of effective teamwork in the workplace. Instructors can evaluate the effectiveness of gamification through this iterative approach and make the necessary adjustments to enhance the learning environment. Teachers are equipped to create an exciting and effective learning environment that prepares students for the challenges of the petroleum industry using gamification techniques.

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Keywords: Gamification · reservoir characterization · Geological modeling · Collaboration

1 Introduction

1.1 The Background on Reservoir Characterization and Geological Modeling

In the subject of petroleum geoscience, geological modeling and reservoir characterisation are crucial. In order to comprehend the geological characteristics of reservoirs, such as rock qualities, fluid distribution, and structural aspects, these disciplines include the study and interpretation of subsurface data. Optimizing oil and gas exploration and production methods requires precise reservoir characterisation and geological modeling.

The importance of engagement and learning outcomes in these fields must be emphasized in this setting. These topics have typically been taught utilizing traditional techniques including lectures and textbook-based instruction. However, these strategies frequently fall short of engaging pupils and inspiring them, which leads to passive learning situations and minimal knowledge retention.

1.2 A Significance of Engagement and Learning Outcomes in These Disciplines

To promote efficient learning outcomes in reservoir characterisation and geological modeling, engagement and active participation are crucial. Fully involved pupils are more likely to have a deeper understanding of the material, use critical thinking abilities, and retain information for longer periods of time. Furthermore, participation that is active fosters teamwork and problem-solving skills, both of which are highly valued in the petroleum sector [1, 2].

1.3 An Introduction to Gamification as a Potential Solution

There are a number of advantages to using gamification in reservoir characterization and geological modeling classes. By making learning an entertaining and engaging activity, it increases student engagement [2]. Gamification's competitive elements, such as leaderboards and achievements, provide students with a sense of accomplishment and encourage them to participate fully and pursue excellence. Through quests and challenges that mimic real-world situations, gamification also fosters active learning, critical thinking, and problem-solving abilities (Table 1).

In conclusion, the incorporation of gamification techniques in reservoir characterization and geological modeling classes holds great potential for improving engagement and learning outcomes. By creating an environment that harnesses students' intrinsic motivation and aligns with their preferences for interactive and immersive experiences, educators can enhance their teaching effectiveness and better prepare students for the challenges of the petroleum industry [2, 3].

Table 1. Table showing countries using gamification as an effective learning tool.

Country	Institution/Organization	Gamification Approach
United States	Khan Academy	Badges, points, and progress tracking
	Duolingo	Levels, streaks, and leaderboards
	Classcraft	Role-playing and team-based challenges
	Breakout EDU	Escape room-style challenges
United Kingdom	National Geographic Kids	Quests and virtual expeditions
	Institute of Play	Game-based curriculum and design thinking
	FutureLearn	Achievement badges and social learning
Australia	Questacon	Interactive science exhibitions and quests
	Mathletics	Competitive math challenges and rewards
Canada	Prodigy	Fantasy-themed math game and assessments
	McGill University	Simulation-based learning and virtual labs
	Classcraft	Class management and behavior tracking
Singapore	SMARTGAMES	Interactive educational games and puzzles
	Science Centre Singapore	Augmented reality and gamified exhibits
	Mathletics	Adaptive math learning and competitions
Germany	Serlo	Gamified exercises and learning pathways
	Kahoot!	Quiz-based competition and leaderboards
	TopMaths	Interactive math challenges and progress tracking
South Africa	3D World Creator	Gamified 3D design and virtual reality
	MathsOnline	Gamified math lessons and quizzes
	Funda Wande	Gamified language learning for children

2 Gamification in Reservoir Characterization and Geological Modeling

2.1 Definition and Explanation of Gamification

Gamification is the process of incorporating game concepts and aspects into places that are not gaming-related, such as educational settings. It is an effective strategy that uses the motivating features of games to improve educational experiences. Gamification transforms the typical classroom into an engaging and dynamic environment where students actively participate and become immersed in the subject matter in the context of reservoir characterization and geological modeling [2–4]. Gamification fosters a sense of accomplishment by introducing game features like points, badges, leaderboards, quests, and challenges. Points are given for finishing tasks or displaying knowledge, offering quick feedback on development. Badges honor specific achievements and motivate students to pursue proficiency in many fields. Leaderboards encourage constructive rivalry, which motivates pupils to go up the rankings [1, 3].

2.2 Definition and Explanation of Gamification

To improve learning outcomes, different game mechanics can be used in reservoir characterisation and geological modeling courses. Students are rewarded for their accomplishments and advancement through point-based systems. Students can keep track of their progress and evaluate it against that of their friends by accruing points. By displaying rankings, leaderboards enhance this competitive element by encouraging students to aim for higher ranks and generating a sense of accomplishment [4–6].

Badges serve as tangible indicators of accomplishments and abilities. They serve as a source of inspiration and physical acknowledgment for the achievements of students. By attaining milestones, finishing difficult activities, or showcasing particular talents, students can earn badges [5]. This visible demonstration of improvement fosters a sense of pride and success, fostering engagement and inspiring students to keep going with their education [5, 6].

2.3 Potential Impact on Learning Outcomes and Skill Development

Gamification has the ability to enhance learning outcomes and skill development in reservoir characterisation and geological modeling classes. Students are more likely to actively engage in activities when game mechanics are introduced, which improves knowledge retention and comprehension of difficult ideas [3, 6]. Gamification encourages critical thinking, problem-solving skills, and decision-making, all of which are crucial in the discipline of petroleum geoscience because of its interactive nature. Gamification also gives pupils the chance to put their knowledge to use in real-world situations. Students can learn to solve practical problems and get expertise with the complexity of reservoir characterisation and geological modeling through quests and challenges that mirror real-world circumstances. Instantaneous feedback from the game mechanics allows students to evaluate their performance, spot areas for development, and participate.

3 Case Studies and Examples

3.1 Showcase of Successful Implementation in Educational Settings

To improve student engagement and learning results, many academic and research organizations have effectively utilized gamification tactics. An online learning platform that incorporates gamification components is the Khan Academy, which serves as one famous example. Students are encouraged to advance and reach greater levels of competency by earning points and badges for completing classes and mastering topics [1, 4, 6].

Another successful application is the language study program Duolingo, which uses gamification to keep users interested. It includes gaming aspects like leveling up, streaks, and leaderboards to promote consistent practice and monitor advancement. Around the world, this strategy has been successful in luring and keeping language learners [2–5].

3.2 Highlighting Specific Examples of Gamification in Reservoir Characterization and Geological Modeling

Several examples show how gamification can be used effectively in the context of reservoir characterisation and geological modeling. Utilizing interactive activities and virtual simulations is one strategy. For instance, in a virtual drilling exercise, students could assess geological information and choose where to drill wells (Fig. 1). Students can gain a deeper grasp of the intricate geological structures and develop their decision-making abilities by gamifying the process and giving rapid feedback on the results [2–5]

Another illustration is the inclusion of gamified tasks and quizzes in the curriculum. Students could take part in competitive quizzes that evaluate their understanding of ideas in geological modeling or reservoir characterization methods. Rankings can be shown on leaderboards, encouraging healthy competition and inspiring pupils to achieve academic success. .

3.3 Discussing the Outcomes and Feedback from Students

Students who have participated in gamified learning in geological modeling and reservoir characterisation have provided overwhelmingly positive feedback. They appreciate how the approach is participatory and immersive and find it more pleasant and engaging than conventional training techniques. The game's components, including points, badges, and leaderboards, provide players with a sense of success and inspire them to perform well [2–5].

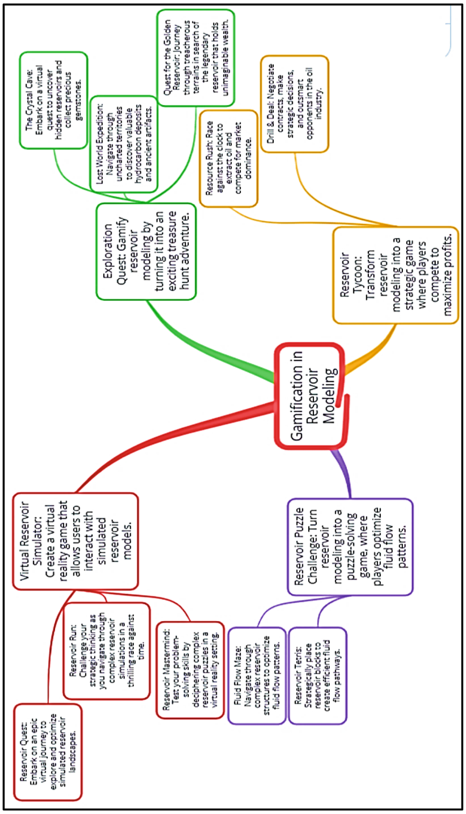

Fig. 1. Gamification Techniques used in the reservoir modeling session.

Additionally, students say that their learning outcomes have improved, including their ability to comprehend difficult ideas, their capacity for critical thought, and their ability to solve problems. The interactive element of gamification enables individuals to apply their understanding in true-to-life situations, preparing them for difficulties in the workplace in the future [1–3].

4 Future Direction

4.1 Exploring Further Research Opportunities in Gamification

There are a lot of potentials for additional research as gamification continues to develop in its use for reservoir characterisation and geological modeling. Future research might explore how particular game mechanisms, like quest-based learning or social collaboration, affect student engagement and knowledge gain. Researching the long-term impacts of gamification on skill retention and transferability would also yield insightful results [2, 4].

4.2 Potential Advancements in the Field

New opportunities for gamification in several fields have been made possible by technological innovation. Students can interact with geological formations in a virtual world through the use of augmented reality (AR) and virtual reality (VR), which can be combined to create immersive experiences. Furthermore, the application of artificial intelligence (AI) algorithms might facilitate adaptive gamification, adapting the learning process to specific student demands and maximizing the efficacy of the strategy [2, 5, 6].

4.3 Summary of the Benefits and Potential of Gamification in Reservoir Characterization and Geological Modeling

Gamification has a lot to offer students studying geological modeling and reservoir characterization. Teachers can design compelling learning environments that encourage active involvement, critical thinking, and problem-solving abilities by utilizing game mechanics and components [2, 5]. Immediate feedback and progress monitoring encourage student motivation and self-evaluation. Additionally, gamification improves student participation by encouraging a sense of belonging and joint learning opportunities. Students can acquire useful skills and abilities that are immediately transferable to their future employment by modeling real-world events and offering opportunities for practical application [4–6].

The dataset below (Table 2) shows potential benefits of gamification in your reservoir characterization and geological modeling classes. Below is a simplified example of such a dataset, showcasing how students' engagement and learning outcomes can improve through the implementation of gamification techniques.

Table 2. Table showing potential benefits of gamification.

Student ID	Module Completion (%)	Points Earned	Badges Awarded	Teamwork Score (out of 10)	Exam Score (out of 100)
001	25	1500	2	8	87
002	50	2100	3	9	92
003	75	2800	4	7	88
004	100	3500	5	10	95
005	30	1700	2	6	84
006	55	2300	3	8	90
007	80	3000	4	9	93
008	100	3500	5	10	96
009	40	1900	2	7	86
010	65	2600	3	8	91

5 *C*onclusion

In conclusion, by delivering a dynamic and immersive learning experience, gamification has the potential to transform the teaching of reservoir characterization and geological modeling. Gamification has been successfully implemented in a number of educational contexts, and examples from these fields specifically show how it may engage students and enhance learning outcomes.

Future study opportunities can examine how particular game mechanics and technological breakthroughs like VR and AI affect gamified learning experiences. These developments have the potential to increase the interactive aspects of learning and offer more individualized and adaptive learning environments.

Gamification is advantageous for instructors who teach reservoir characterisation and geological modeling because it fosters better critical thinking and problem-solving abilities in students as well as a sense of accomplishment. A learning environment that promotes active learning, collaboration, and skill development can be developed by educators by introducing gamification techniques into the curriculum.

The potential of gamification in these subjects must be explored and embraced by educators if they are to adequately prepare students for the difficulties and complexity of the work. The next generation of competent and skilled experts in reservoir characterization and geological modeling can be shaped by educators by incorporating gaming mechanics and components into the curriculum.

In conclusion, gamification has been shown to be an effective method for raising student enthusiasm, engagement, and learning outcomes in classes on reservoir characterization and geological modeling. Education professionals can develop an engaging and productive learning environment by incorporating game components, devising relevant game mechanics, and resolving potential difficulties. As technology develops, further investigation into gamification in these fields will open up new opportunities and influence how petroleum geoscience education is delivered in the future.

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Exploring Special Education Teachers' Attitudes and Behavioural Intentions Towards' Inclusive Open Educational Resources (IOER)

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Abstract. This quantitative study investigates the attitudes and behavioural intentions of special education teachers towards using Integrative Open Educational Resources (IOER) in their teaching. Grounded in the theoretical frameworks of the Technology Acceptance Model (TAM) and the study aims to understand the factors influencing the acceptance and use of IOER among special education teachers. Data were collected through questionnaires administered to 175 special education teachers, who provided insights into their attitudes and intentions related to IOER adoption in teaching. Quantitative analysis of the collected data revealed significant positive effects of all variables on the acceptance and use of IOER in teaching, except for external variables such as age and teaching experience. Notably, the study's hypotheses were tested, leading to the rejection of several null hypotheses. The results indicated that perceived ease of use is a significant predictor of perceived usefulness and attitude, while perceived usefulness significantly predicts attitude and behavioural intention. Moreover, attitude emerges as a significant predictor of behavioural intention. Additionally, the study found that age and teaching experience have a significant negative impact on behavioural intention, perceived ease of use, and perceived usefulness. Considering these findings, the study concludes with important recommendations to enhance the adoption and effective utilization of IOER among special education teachers.

Keywords: Inclusive Open Educational Resources (IOER) · Technology Acceptance Model (TAM) · Special Education Teachers

1 Introduction

The landscape of education has witnessed a significant transformation marked by the emergence of Open Educational Resources (OER) and the evolution towards Inclusive Open Educational Resources (IOER). In recent years, a global network of experts and institutions has collaborated to create and share high-quality, openly accessible educational content. OER, defined as digital resources with educational value that are openly licensed or in the public domain, have played a pivotal role in reshaping traditional educational paradigms (White & Manton, 2011). Open licensing has enabled the unrestricted

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use, adaptation, and sharing of educational resources, fostering collaboration and innovation within the education community. Initially conceived as tools to enhance access to quality content and expand participation in higher education, OER have evolved to encompass a broader spectrum of educational practices. The versatility of OER, ranging from individual resources to comprehensive courses, has led to their integration into formal education settings. These resources offer pedagogical value and a foundation for continuous improvement through collective contribution and adaptation by educators worldwide. This rapid dissemination of innovative teaching and learning approaches has underscored the pivotal role of OER in transforming education. However, despite the global availability of OER, their utilization has not been uniformed. The realization that open access content alone is insufficient to drive widespread participation has given rise to the concept of open educational resources (OER). This emerging paradigm encompasses practices that go beyond mere content dissemination, embracing strategies that embed the use and creation of OER within educational policies and pedagogical models (White & Manton, 2011). OER is rooted in promoting learner agency and the collaborative co-creation of knowledge.

2 What is IOER?

2.1 IOER Concept

First, The concept of inclusive education was initially introduced in the Salamanca Statement by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 1994. This landmark document defined inclusion as the education of all students, including those with disabilities, alongside their peers without disabilities. Despite its adoption in the Convention on the Rights of People with Disabilities by the United Nations in 2006, the translation of this principle into effective classroom practices has encountered challenges. In numerous countries, students with disabilities and special educational needs (SEN) continue to receive instruction primarily within self-contained classrooms, indicating a gap between inclusive education aspirations and actual implementation [15]. Open Educational Resources (OER) can help ensure that everyone has equivalent and equal access to education. Open Educational Resources (OER) are digital resources with potential educational value for educators, students and self-learners which have been published on the web with an open license or are in the public domain [14]. In the Paris OER declaration 2012, [12] highlighted the promotion and use OER to widen access to education at all levels, both formal and non-formal, in a perspective of lifelong learning, thus contributing to social inclusion, gender equity and special needs education [13] argue that without scrutiny, efforts in developing OER can be a mixed blessing, expanding inclusion and equity in some areas, but furthering inequities in others. The inequities include learners who have been marginalised in many educational settings: students from low-income communities and minorities, learners with disabilities, learners who are gifted and talented, learners from diverse cultures and linguistic backgrounds, and learners in rural areas. It is suggested that the design and delivery of OER should provide equitable interaction to all learners including learners with disabilities. Unleashing its full potential is disrupted due to the disregard for the special needs and learning characteristics of certain user groups such as people with disabilities by the mechanisms delivering OER [3]. [9] asserted that to date, there had been no extensive research on how to utilize the great potential of OER for marginalized and disadvantaged groups, what the prerequisites are for doing so, and, in particular, to what extent existing OER platforms are already exploiting it. Open educational resources (OER) have the potential to provide inclusive and equitable learning opportunities for all students, regardless of their economic or social background ([7, 10]). Inclusivity in Open Educational Resources (OER) is important because it helps to ensure that all learners have access to high-quality educational materials, regardless of their background or circumstances. This is especially relevant in today's digital age, where access to technology and the internet can often be a barrier to learning. By using OER, educators can help to bridge the gap and provide equal opportunities for all students. There are several studies that have highlighted the importance of inclusivity in OER. For example, a 2018 article published in the International Review of Research in Open and Distributed Learning found that "OER can be a powerful tool for promoting inclusivity and equity in education" [1]. Another study, published in the Journal of Open Education and Cultural Heritage in 2020, found that OER can be used to "promote social justice and equality in education" [4].

The utilization of Inclusive Open Educational Resources (IOER) by special education teachers in Malaysia represents a transformative shift in the way education is delivered to students with diverse learning needs. IOER embodies the integration of digital resources, open content, and inclusive pedagogical approaches to support the academic and personal development of students with disabilities. Special education teachers in Malaysia are increasingly embracing IOER as a means to provide tailored and flexible learning experiences that cater to the unique requirements of their students. By leveraging IOER, educators can access a wealth of adaptable materials, interactive tools, and multimedia resources that can be customized to accommodate various learning styles and abilities. This innovative approach not only promotes active engagement but also fosters a more inclusive classroom environment where students with special needs can actively participate alongside their peers. As IOER continues to gain traction within the special education landscape of Malaysia, it is anticipated that its adoption will contribute to a more inclusive, accessible, and empowering educational journey for students with disabilities across the nation.

2.2 Inclusive Open Educational Resources Initiatives

The OpenStax Textbook Initiative is an example of an inclusive OER initiative that aims to make high-quality, peer-reviewed textbooks available for free to students worldwide. The initiative was founded in 2012 with the goal of reducing the cost of education for students and increasing access to learning materials. According to a 2020 study published in the International Journal of Educational Technology in Higher Education, the use of OpenStax textbooks has been shown to significantly improve student outcomes and increase access to education for underserved populations [8]. The Global Open Educational Resources (OER) Network is another example of an inclusive OER initiative that aims to promote the use of OER around the world. The network was launched in 2017 and is coordinated by the Commonwealth of Learning, an international organization that promotes the use of open and distance education. The Global OER Network brings together governments, education institutions, and other stakeholders to share knowledge and experiences, and to support the development and use of OER in various contexts. A 2020 study published in the Journal of Open Education and Cultural Heritage found that the Global OER Network has played a significant role in increasing the availability and use of OER in countries around the world, particularly in low- and middle-income countries [5].

In this study, it becomes imperative to investigate the attitudes and behavioural intentions of educators towards utilizing IOER in their teaching practices. Grounded in the Technology Acceptance Model (TAM), this quantitative study seeks to unravel the factors influencing the adoption of IOER among special education teachers in Malaysia. By understanding the interplay of attitudes, perceptions of ease of use, perceived usefulness, and behavioural intentions, this research contributes to the broader discourse on inclusive open educational practices. This study holds significance as it provides insights for various stakeholders including school administrators, teachers, students, and the Ministry of Education, shedding light on the integration of Inclusive Open Educational Resources (IOER) in teaching. By investigating factors affecting teachers' acceptance and utilization of IOER in teaching, the study aims to diversify teaching methods, enhance student engagement, and empower teachers to adapt new techniques. The findings will guide special education teachers in refining their teaching styles and inform schools about necessary infrastructure and support, contributing to improved teaching processes. OER is seen as having the potential to provide inclusive and equitable learning opportunities, there are several challenges that need to be addressed to ensure that they are truly inclusive ([6, 7, 10]). Strategies such as increasing diversity among OER creators, improving accessibility, and providing translation services can help to promote inclusivity in OER and ensure that they are accessible to all learners [6].

3 Research Objectives

The main objectives of this study are to investigate the attitudes and behavioral intentions of special education teachers towards using Integrative Open Educational Resources (IOER) in their teaching practices. Specifically, this research aims to:

1. Examine the attitudes of special education teachers towards the utilization of IOER in their classrooms.
2. Explore the behavioral intentions of special education teachers regarding the incorporation of IOER into their instructional strategies.
3. Investigate the relationship between perceived ease of use and perceived usefulness of IOER among special education teachers.
4. Analyse the influence of attitudes towards IOER on the behavioural intentions of special education teachers.
5. Examine potential demographic factors, such as age and teaching experience, that may affect attitudes and behavioral intentions towards IOER.

The primary aim of this study is to enhance the comprehension of how special education teachers perceive the utilization of IOER and their inclination to incorporate these resources into their instructional methodologies. To fulfil these objectives, the research hypotheses have been formulated as follows:

- *Ho1* Perceived ease of use is not a significant predictor of perceived usefulness.
- *Ho2* Perceived ease of use is not a significant predictor of attitude.
- *Ho3* Perceived usefulness is not a significant predictor of attitude.
- *Ho4* Perceived usefulness is not a significant predictor of behavioral intention.
- Ho5 Attitude is not a significant predictor of behavioral intention.
- Ho6 Age of teachers is not a significant predictor of behavioral intention.
- Ho7 Age of teachers is not a significant predictor of perceived ease of use.
- Ho8 Age of teachers is not a significant predictor of perceived usefulness to use.
- Ho9 Teacher's experience of teaching is not a significant predictor of behavioral intention.
- Ho10 Teacher's experience of teaching is not a significant predictor of perceived ease to use.
- Ho11 Teacher's experience of teaching is not a significant predictor of perceived usefulness.

4 Research Design and Methodology

To achieve the study objectives and address research questions, a quantitative research design and methodology were employed. A survey research design was adopted, utilizing quantitative questionnaires to collect data from respondents. The survey approach was suitable for this study, focusing on respondents' attitudes and behavioural intentions towards the research topic. The advantage of this method is its ability to cover a wide population and gather data on respondents' attitudes and intentions. The research population consists of special education teachers in Malaysia Secondary Schools offering Special Education programs. Random sampling was used, and teachers responded to the survey through Google Form. The study involves dependent and independent variables which dependent variables include perceived ease of use, perceived usefulness, attitude, and behavioural intention. The relationships between these variables were analysed, with some variables serving as dependent variables for others. Independent variables encompass Inclusive Open Educational Resources (IOER) and teacher characteristics. The study utilized a questionnaire adapted from [2] to measure the constructs of perceived usefulness, perceived ease of use, attitude, and behavioural intention. The questionnaire consisted of multiple-choice and Likert scale items, with back-to-back translation ensuring clarity for English and Malay-speaking teachers. The questionnaire collected data on respondents' demographic information, attitudes, and intentions.

4.1 Data Collection

Data collection for this study was conducted over a span of approximately one month. Subsequently, the researcher randomly distributed the questionnaire using Google Form to Special Education teachers in Malaysia. To ensure a diverse and random pool of respondents for the study, a strategic outreach plan was implemented through social media platforms, specifically Facebook and Twitter. Engaging and concise messages were crafted, accompanied by visually appealing graphics and banners that highlighted the study's significance for Special Education teachers. The use of relevant hashtags, posting at peak hours, and sharing engaging content such as teaser posts and visuals were integral to capturing users' attention. In addition, interactions with the audience, collaboration with special education experts, and sharing in pertinent groups further enhanced the study's reach. A dedicated landing page was created to provide comprehensive information about the study and direct participants to the survey. By monitoring and optimization of the use of social media, the researchers were able to get adequate numbers of respondents for this study.

4.2 Data Analysis

Data analysis encompasses the process of summarizing, organizing, synthesizing, and deriving conclusions from the collected data [11]. The quantitative data analysis in this study involved both descriptive statistics and inference techniques. Descriptive statistics were used to assess perceived ease of use and perceived usefulness in relation to factors like age and gender. Inference statistics, on the other hand was used to determine differences in attitudes and behavioural intentions towards using IOER. A significance level of $\alpha = 0.05$ was utilized to assess the significance of the research hypotheses. A significance value lower than 0.05 indicates a statistically significant difference between the tested variables in the hypotheses. The analysis of the difference in attitude and behavioural intention towards IOER usage among special education teachers involved correlation and simple linear regression analyses for each questionnaire item. The relationships between variables were explored through crosstabulation. All statistical analyses were conducted using the Statistical Package for the Social Sciences version 22 (SPSS).

5 Findings

The collected data was analysed and interpreted using the instruments described earlier, along with references to relevant literature. The data obtained from the study were categorized into two sections. The first section presented descriptive data, including percentages and simple statistical descriptions. The second section provided analytical data related to the variables of interest. The findings were organized in alignment with the research questions and hypotheses. The distribution of the respondents based on gender showed that 26.3% were males and 73.7% were females. In terms of age, 44.6% of respondents were aged above 40 years, 24% were aged between 30 and 35 years, 17.1% were aged between 36 and 40 years, and 14.3% were aged below 30 years. Additionally, 86.9% of teachers had a bachelor's degree, while 13.1% had a master's degree.

To address the research hypotheses, correlation analysis and simple linear regression analysis were conducted. The correlation analysis aimed to examine the relationships between variables and to determine whether null hypotheses should be accepted or rejected.

The first hypothesis (Ho1) which suggested that perceived ease of use is not a significant predictor of perceived usefulness. However, the analysis revealed a significant and

Table 1. Sample of Correlation analysis (PEU, PU)

Correlations			
		PEU	*PU*
PEU	Pearson Correlation	1	.650**
	Sig. (2-tailed)		.000
	N	175	175
PU	Pearson Correlation	.650**	1
	Sig. (2-tailed)	.000	
	N	175	175

[a] Correlation is significant at the 0.01 level (2-tailed)

moderate positive correlation between perceived ease of use and perceived usefulness ($r = 0.650$, $p < 0.01$), leading to the rejection of Ho1 (Table 1).

Regression analysis was also performed to explore the predictive ability of certain variables. For example, the regression analysis for Ho1 indicated that perceived ease of use explained 42.3% of the variation in perceived usefulness (R^2 = 0.423). The standardized coefficient (β) for perceived ease of use was 0.648, indicating a positive relationship. Similar procedures were followed for the other hypotheses as well. For instance, the correlation analysis for Ho2 suggested that perceived ease of use is a significant predictor of attitude to use ($r = 0.639$, $p < 0.01$). Regression analysis indicated that perceived ease of use explained 40.8% of the variation in attitude (R^2 = 0.408), with a standardized coefficient (β) of 0.407. The findings related to the remaining hypotheses (Ho3 to Ho10) followed a similar pattern of correlation and regression analysis, where the relationships between variables were examined and the hypotheses were either accepted or rejected based on the analysis outcomes. The results provided insights into the relationships between variables such as perceived usefulness, attitude, behavioural intention, age, and experience in teaching. The summary of the correlation analysis is shown in Table 2 below:

Table 2. Sample of Correlation analysis for all variables

Factor	*PEU*	*PU*	*BI*	*Age*	*TE*	*AU*
TEACHING EXPERIENCE (TE)	−0.211	−0.270	−0.298	–	1	–
AGE	−0.272	−0.317	−0.334	1	–	–
AU	0.639	0.853	0.712	–	–	1
PEU	1	0.650	0.486	−0.272	−0.211	0.639
PU	0.650	1	0.60	−0.317	−0.270	0.853
BI	0.486	0.670	1	−0.334	−0.298	0.712

In summary, the study's findings provided evidence for various relationships between the variables of interest. The results highlighted significant predictors and their impact on factors such as perceived ease of use, perceived usefulness, attitude, and behavioural intention. The statistical analyses and interpretations helped to answer the research questions and test the hypotheses, contributing to a deeper understanding of the factors influencing the utilization of IOER in teaching within the context of the study. Figure 1 below showed the simple linear regression results for this study.

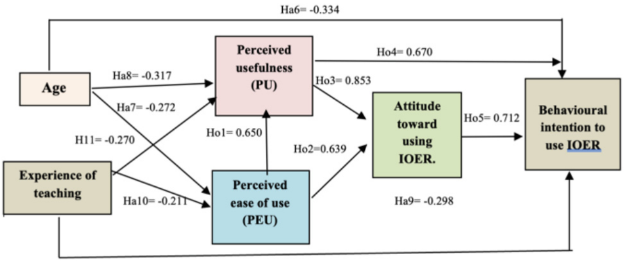

Fig. 1. Linear Regression Results.

6 Discussion

The findings of the study indicate that the perceived ease of use of IOER (Inclusive Open Educational Resources) has a positive influence on the perceived usefulness of these resources. This implies that when users find IOER easy to use, they are more likely to see them as valuable. Special Education teachers expressed that IOER can enhance their work performance when they perceive the resources to be easy to use. This aligns with previous research that suggests perceived ease of use directly affects perceived usefulness. Perceived ease of use refers to the belief that using a system will be effortless, and this perception can impact users' attitudes and intentions. Teachers' willingness to use IOER is influenced by their perception of its ease of use. Similarly, the relationship between perceived ease of use and attitude towards IOER is positive, indicating that teachers are more inclined to have a favourable attitude when they find the resources easy to interact with. Moreover, the study found that perceived usefulness positively influences attitude and behavioural intention towards IOER.

Teachers are more likely to form a positive attitude and intention to use IOER when they see it as a valuable tool that enhances their productivity and effectiveness in teaching. Age and experience were also examined in relation to IOER usage. The findings show that older age and greater teaching experience are associated with decreased behavioural intention, perceived ease of use, and perceived usefulness of IOER. This suggests that younger and less experienced teachers are more open to incorporating IOER into their teaching practices. In terms of implications, the study's conceptual framework based on the Technology Acceptance Model (TAM) offers insights into predicting behavioural intention to use IOER among Special Education teachers. The findings can help inform educational institutions' plans to integrate multimedia technologies like IOER into teaching practices, especially in government school management settings. Overall, the study underscores the importance of considering perceived ease of use and perceived usefulness when introducing IOER to educators. It highlights the need to provide user-friendly IOER and support to enhance their adoption and integration in teaching.

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Enhanced Learning Through Hybrid Research Outputs, Technology, and Practical Applications in Undergraduate Courses

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Abstract. The traditional lecture-based teaching model needs to evolve to meet the demands of contemporary learners and the advancements in educational technology. In this practice we have implemented a hybrid approach with four key strategies 1) Integration of Research Outputs into the teaching and learning ecosystem of undergraduate courses, 2) utilization of Interactive asynchronous lectures, 3) Incorporation of high quality thin sections from producing oil and gas fields, 4) implementation of structured problem-based project to apply the skill sets gained from the teaching and learning activities. Based on visual observation during the face-to-face sessions and online monitoring; the students exhibited heightened engagement with the interactive lecture contents, obtained improved understanding of complex concepts and clearer vision on the practicality of the course contents. It is also shown on their performance indicators that using a combined pedagogical approaches might helped in gaining practical skills and improved knowledge retentions. This may bring new insights into the teaching and learning community practice of the geosciences and related fields.

Keywords: hybrid · practical skill · interactive · problem-based

1 Introduction

In tertiary education, the traditional lecture-based teaching model is evolving to fulfill the demands of present-day learners and to incorporate the advancements in educational technology [1–4]. Educational technology has shown significant progresses over the past few years. For instance, the modernization of the internet and digital technologies has transfigured the way education is delivered and received in a number of ways [5]. From interactive whiteboards in the classrooms to huge number of online courses including the Massive Open Online Courses (MOOCs). Technology has made education more accessible, and personalized [6]. Artificial Intelligence (AI) and Machine Learning (ML) approaches are now being integrated into several educational platforms to provide

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adaptive learning experiences, where the content is tailored to each learner's pace and level of understanding [7, 8] strengthening the delivery of personalized contents. Virtual Reality (VR) and Augmented Reality (AR) are also progressing by offering immersive learning experiences, making complex concepts easier to comprehend [9, 10].

These educational technological advancements have significantly shifted the classical model of teaching and learning to adopt the trends. The traditional model, often criticized for its one-size-fits-all approach, is being replaced by a more learner-centric model [11–13]. Technology enables self-paced learning, where students can learn at their own pace, anytime, anywhere. It also expedites collaborative learning, where students can work together on projects remotely using varieties of communication channels. Moreover, technology provides educators with valuable insights into the progress of each student, helping them identify areas where the student might be struggling to understand; hence adjust their teaching strategies accordingly. Thus, educational technology is not just changing the way education is delivered, but also how it is designed, hence creating a more effective and inclusive teaching and learning ecosystem [14].

The advancement and usage of educational technologies has created a number of impressive progress in delivering equitable and quality educational contents globally. However, combining this progress with other pedagogical approaches might have additional advantage in addressing accessibility, and various learning styles. Hybrid teaching is one of the pedagogical approaches that combines different methods of instruction, such as face-to-face, online, synchronous and asynchronous, to enhance student learning outcomes [15, 16]. Hybrid teaching can offer several benefits, such as increased flexibility, accessibility, engagement and collaboration, as well as reduced costs and environmental impact. However, hybrid teaching also poses some challenges, such as technical issues, communication barriers, workload management and assessment design [17, 18]. Therefore, hybrid practitioners need to carefully plan and implement their courses, taking into account the needs and preferences of their students, the goals and objectives of their curriculum, and the available resources and tools in their higher educational institutions. It is reported that hybrid teaching could have a positive impact on knowledge transmission [19], provided it is conducted effectively and appropriately.

In this article we explore the transformative impact of a hybrid teaching integrated with practical input of research outputs into the learning and teaching ecosystem of undergraduate courses. The approach integrates research outputs, innovative technology, and hands-on practical experiences to enhance student engagement, knowledge retention, and real-world applicability of the subject principles.

2 Methods

In implementing the hybrid approach, four key strategies were employed: 1) Integration of research outputs into the learning objectives of the course, 2) utilization of interactive asynchronous lectures, 3) incorporation of industry standard thin sections from actual producing oil and gas fields, 4) implementation of structured problem-based projects to apply the skill sets gained from the aforementioned teaching approaches.

Research outputs, such as scholarly articles, prepared laboratory samples, and documentary videos were seamlessly integrated into the undergraduate curriculum. Students were exposed to current developments in the field, nurturing critical thinking and encouraging them to explore the real-world applicability of the subject as well as the implication of the theoretical concepts covered in the classrooms.

Leveraging integration of technology into the learning management system (Ulearn), interactive asynchronous lectures were delivered using the H5P application. This approach allowed students to engage with the content at their own pace through the interactive elements, such as quizzes, short answer questions, and simulations embedded into the recorded lectures to enhance both comprehension and engagement of the learners. To bridge the gap between theory and practice, industry standard petrographic thin sections from actual producing oil and gas fields were incorporated into the teaching and learning practice. In addition, a well-structured problem-based exercises were executed throughout the semesters.

The academic performance of students over a period of four years, from 2019 to 2022 was examined to see how the teaching and learning ecosystem has impacted their scores. The data was collected from various sources, such as standardized quizzes, tests, graded laboratory exercise, and presentations. The aim was to identify the trends, patterns, and factors that may have influence in the students' learning outcomes and achievements.

3 Results

The hybrid approach yielded several noteworthy outcomes that could be grouped into the following categories.

1) Enhanced engagement and interactivity

   The students exhibited heightened engagement with the interactive lecture content, as evidenced through increased participation in discussions forums, class activities and asking questions during the face to faces sessions.
2) Improved understanding of complex concepts

   The integration of research outputs provided students with real-world context of the subject they have spent a semester on it. It also helped enhance their understanding of complex theoretical concepts and their implication in the practical world, for this case the oil and gas industry.
3) Strengthened practical application

   Utilization of high quality petrographic thin sections from actual producing fields has enabled students to translate and appreciate the theoretical knowledge into practical skills, fostering a deeper connection between classroom learning and industry applications. In addition, integrating it with adjunct lectures delivered by industry experts creates excitement and enthusiasm for learning more in the subject. As shown in Fig. 1, the students were able to generate publication standard map using open-source application based on the problem-based project assigned to them.

The results showed that the students generally performed well throughout the four years, with an average score of 75% across (Figs. 2 and 3). However, there was a slight decline in performance in 2020 and 2021, which coincided with the outbreak of the COVID-19 pandemic. The performance improved slightly in 2021 and 2022, as the pandemic situation eased and schools resumed regular operations.

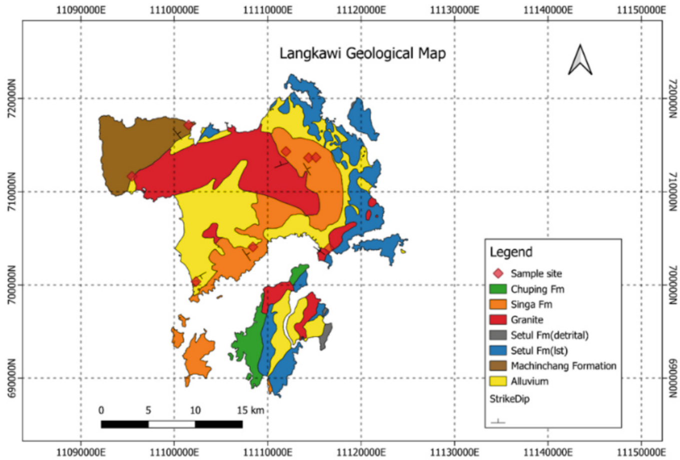

Fig. 1. Professional looking geological map produced by students working as a group using an open-source application

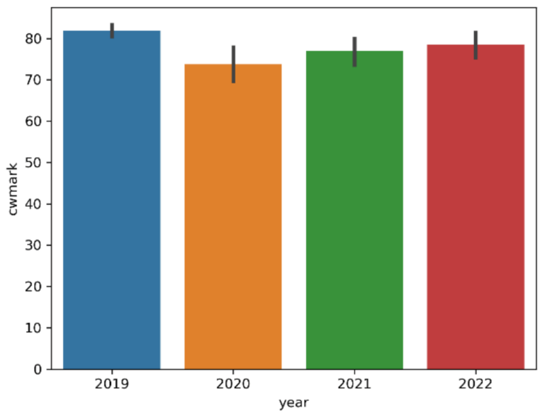

Fig. 2. Student performance based on course work marks for the specified academic years

4 Discussion

These hands-on experiences enabled students to analyze geological datasets, connecting the theoretical knowledge gained during the teaching and learning process to tangible geological phenomena that has an immediate use case in the oil and gas industry. The hybrid approach implemented in the experimented courses underscores the significance of integrating various pedagogical strategies to suite the evolving teaching and learning ecosystem. By combining research outputs, technology-enabled learning facilities, and hands-on experiences, educators could create a dynamic learning environment that caters to diverse learning styles and prepares students for real-world challenges.

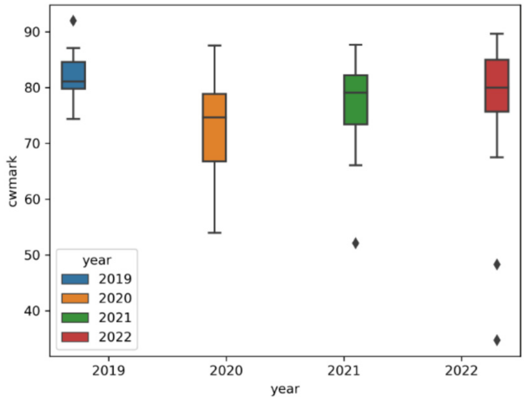

Fig. 3. A boxplot of the students' performance indicator to see the distribution of the course work marks

5 Conclusion

The implementation of a hybrid approach that intertwines research integration, technology, and practical experiences has demonstrated its potential to improve undergraduate teaching and learning practices in higher educational institutions. This innovative approach not only enhances student engagement and comprehension, but also equips students with the skills and knowledge required to excel in their respective field of study beyond the classroom.

6 Recommendation

As education continues to evolve, further research is needed to explore the long-term effects of this approach on students' career trajectories and their ability to apply the learned concepts and skills in professional setting. In addition, investigating the scalability of this approach to other subjects might provide valuable insights into its applicability.

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Exploring Students' Understanding of Mathematical Function Through Desmos

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Abstract. This research paper aims to demonstrate the students' understanding of mathematical function through Desmos. As an educator, the task of finding ideas to convey knowledge effectively to students in this age of technology is challenging. The importance of implementing PBL is essential to maintain interest and interact during the learning process while preparing them for challenges in this modern world. For a larger class size, PBL will help the students for a better leaning process by doing activities that most students can participate in and express their ideas. In this study, a total of 127 foundation students were involved in doing the simulation by using Desmos, a free web-based software as part of their 8-week project assignment. The students were asked to combine and relate the polynomials and piecewise function to design two roller coaster tracks by using Desmos. The results are spectacular. With great teamwork and continuously seeking guidance from the instructors, students were able to show their creativity by presenting the end-product.

Keywords: Mathematics · Desmos · Case Study · Polynomial · Piecewise Function

1 Introduction

Covid-19 has a great impact on the world, not only to our everyday lives but also gave great impact to the education itself. From traditional classes the educators challenged ourselves to conduct fully online classes and until today, the online classes continue intermittently with physical classes. Conducting continuous online classes does have its own challenges. As an educator, to act creatively is a must to encourage students to actively interact and boost their interest in what is being taught and be able to explore so that the learning process is becoming more interesting these days especially for mathematics subject. Thus, a few things should be considered such what are the effective tools to enhance students' understanding of mathematical concepts? And what is the relation of mathematical concepts in real life?

In recent years, there are various ways for teaching and learning. Before the 21st century, traditional learning was used and only focused on the educator as the only source of information for students. A lack of interaction occurred between educator and students

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as well as interaction among their students itself in this learning process. According to [1], traditional teaching and learning is known as the “Five-Step Method”: organizing teaching, revising the old lesson, describing the new lesson, consolidating the new lesson, and assigning homework. [2] stated that it is irrelevant to believe that spoken and written words alone are capable to deliver tons of information or knowledge to students especially in teaching mathematics. In other words, traditional education is unable to enhance critical thinking skills as students do not have the opportunity to discover the concept or topics learned on their own. To overcome this, modern teaching and learning was introduced such as problem-based learning (PBL). The transition from traditional teaching to PBL will create a successful learning environment as more interactive activities are conducted for students throughout the learning process. Furthermore, PBL is viewed as an advanced measure to inspire students to discover and understand how to learn through real-life problems [3].

In PBL, educators assist students in resolving complex, realistic problems by using smartphones, computers as well as other education platforms and software. Engaging students with technology will enhance fun and effective learning. Educators play a vital role in creating a teaching and learning process that fits into the technology as it keeps on evolving and is widely available. According to [4], implementing PBL will develop the students understanding in their own context which helps them to learn effectively. Although the PBL process calls on students to become self-directed learners, instructors guide them by monitoring discussion and intervening when appropriate, asking questions that probe accuracy, relevance, and depth of information and analyses; raising new (or neglected) issues for consideration; and fostering full and even participation [5]. PBL is important in mathematics subjects as integrating it with real life will gain students’ interest towards mathematics. This is because the connections between everyday life and mathematical concepts are often overlooked. [6] mentioned that students are able to visualize mathematical concepts through graph as Desmos represents a powerful visualization that are similar to other representations such as diagrams and images.

Rather than using paper and pen, graphing calculators had the potential to modernize mathematics education, in taught and the content of courses [7]. [8] believed that the graphing calculator enabled students to approach problems from a different perspective, using numerous representations to explore and estimate where students may use graphic forms to visualize problem situations and estimate solutions, then if more precision is needed, explore the problem in more detail symbolic representations and using tabular. Desmos is a graphing calculator widely used for graphing such as transformation of function and it demonstrates how this transformation graph works [9]. Desmos has a strong ability for scientific content as it allows user to sketch the graph of linear and non-linear easily. Making graphs and observing how altering variables affect those graphs in real time are a strength of Desmos activities and its graphing calculator [10]. Students’ able to explore function in detail such as how does the changes of parameters affect the shape of the graphs. In directly, it will enable them to learn on their own and gain more understanding about the domain, range, minimum points, maximum points and end behavior of graphs. Furthermore, students realized the importance of the usage of Desmos software and have a chance to work at their own pace [11].

To minimize the problem while using Desmos, educators should be able to identify the cause of students' errors, since errors might be due to students' inability to understand the technology rather than the mathematical concept [12]. Thus, educators need to be trained before applying technology in teaching and learning. Exploring various functions such as piecewise and polynomial using Desmos helps students able to grasp better understanding about graph and better visualization on mathematical concept. Therefore, educators' guidance and support are important to enhance students' confidence to use the tool. Our main purpose of study is to explore students' understanding of mathematical functions by using Desmos.

2 Methodology

The research sample consisted of 127 foundation students in Engineering and Science who were enrolled in Mathematics I in May 2022. These students were divided into 13 nest groups of 9 to 10 members in a group. The students were given a task of a real-world physical situation that can apply the polynomials and piecewise function topics covered in Mathematics I. Each nest group was required to design two roller coaster track and must be able to show a few peaks of the roller coaster track with the help of Desmos. All function used, must clearly displayed in Desmos. The first roller coaster track must be designed by using piecewise functions and second roller coaster track must be designed using only one polynomial. The students were given 8 weeks to complete the project. After both task completed, students need to compare and choose the best roller coaster design by considering the design, safety, strength and the weakness of the roller coaster. Students were required to submit their work in the form of PowerPoint slides as well as provided the Desmos drawing link for both graphs. Hence, this will make the checking process easier as it is important to ensure the students are on the right track based on the drawing using Desmos and all the findings were summarized in the slide. Marking rubric was provided to students for grading standards of the assignment that include all the important elements needed in the assignment.

3 Result and Discussion

The results show two types of graphs created by two groups of students consisting of 10 members. Students are able to illustrate two roller coasters and explore different types of function by using piecewise function and polynomials using Desmos. Each of these roller coasters have its own criteria such as 3 extrema, loops and which consist of at least 4 different type of function for piecewise function. Whereas, for polynomial, the minimum degree must be 3 and needs to have 3 extrema with at least one of the extrema is minimum point that will represent underground track for the roller coaster created. The x-axis represents the time taken for a roller coaster ride and y-axis represents the height of designed the roller coaster. The height must not exceed 1000 m and the time must not exceed 5 min.

Figure 1 shows piecewise functions with 3 extrema: 2 maximum points, 1 minimum point, and a loop. The domain of the graph is from 0 to 5 and ranges from 0 to 200. The graph increasing at (0,1), (1.8, 2.3) and (2.8,4.3). The graph decreasing at (1,1.8)

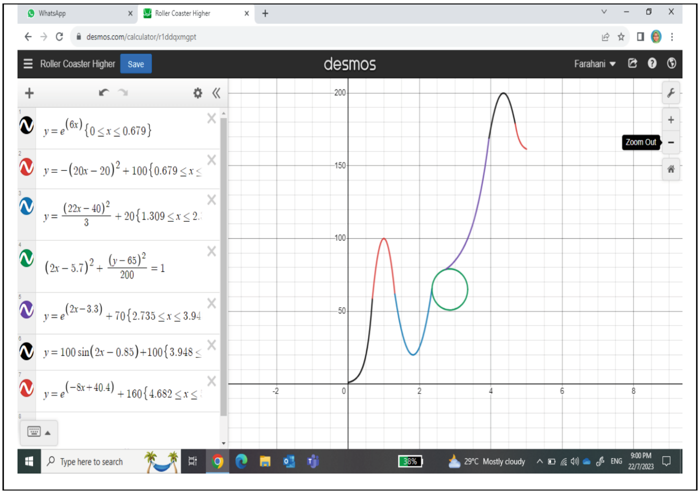

Fig. 1. Roller Coaster using piecewise function group 1.

and (4.3,5). The color in the graph represents different types of functions such as purple color represent exponential function, red color, blue color, and black color represent quadratic functions. The graph represents roller coasters with maximum height 200 m and roller coaster ride takes about 5 min. The roller coaster will attract more extreme activities lovers as it has a unique and complex design. The loop makes the rides more challenging and fun. Besides that, hills and loops help to control the roller coaster speed. However, it keeps on changing height and will cause extreme dizziness.

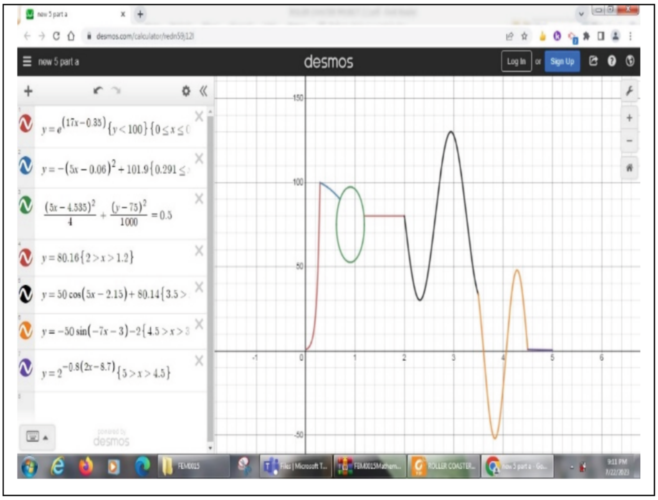

Fig. 2. Roller Coaster using piecewise function group 2.

Figure 2 shows piecewise functions with 3 extrema: 2 maximum point, 1 minimum point and a loop. The range of the graph is from −51 to 130 and domain is from 0 to 5. The x-intercept of the function is $x = 3.6$ and $x = 4.1$. The colour in the graph represents different types of functions such as green colour represents ellipse; orange colour and black colour represents polynomial. The graphs illustrate a roller coaster with an underground track with a depth of 51 m underground and the maximum height of the roller coaster is 130 m from the ground and roller coaster ride takes about 5 min. The roller coaster track is adventurous as it has different shaped tracks such as loop, hill and pass through underground. It is not suitable for beginners of roller coaster riders as it is not smooth and has sudden turns in the track. If the roller coaster is built it requires high construction cost as a lot of safety measures need to be considered.

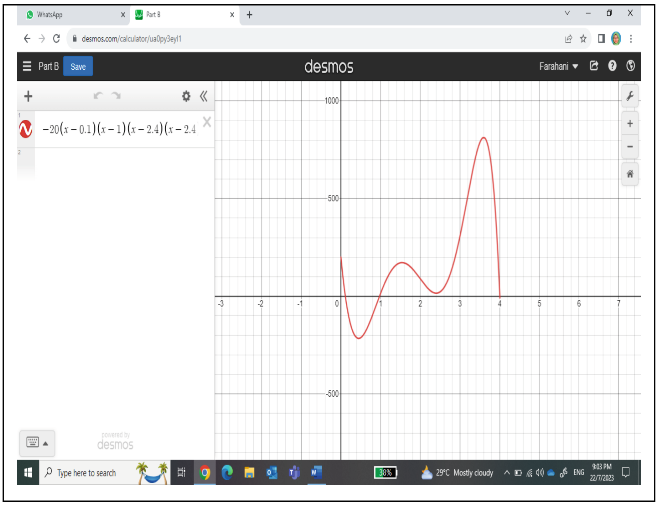

Fig. 3. Roller Coaster using polynomial group 1.

Figure 3 shows a polynomial with at least 3 extrema without loop. The graph has an imaginary root and 2 real roots where $x = 0.2$ and $x = 4$. The domain of the polynomial is from 0 to 4 and range is from −200 to 1000. The graph increasing at (0.4,1.5) and (2.4,3.6). Whereas it is decreasing at (0,0.4), (1.5,2.4) and (3.6, 4). The degree of the polynomial is 5 known as quintic polynomial with positive leading coefficient. The end behavior of the graph on the left shows that $x \to \infty$ where it goes upward and on the right $x \to -\infty$ where it goes downwards. The graph represents a roller coaster with an underground track 200 m and height of the roller coaster less than 1000 m and roller coaster ride takes about 4 min. It takes about 1 min to complete the underground roller coaster ride. The roller coaster is considered stable as it has a smooth track even though it has steep track at the end of the rides, and it will spend a lower cost to build the roller coaster compared to design roller coaster using piecewise function. However, it is less fun because the track design is simple and not challenging.

Figure 4 shows a polynomial with at least 3 extrema without loop. The graph has 3 real roots where $x = 0.5$, $x = 1$ and $x = 4$. The domain of polynomials is from 0 to 5

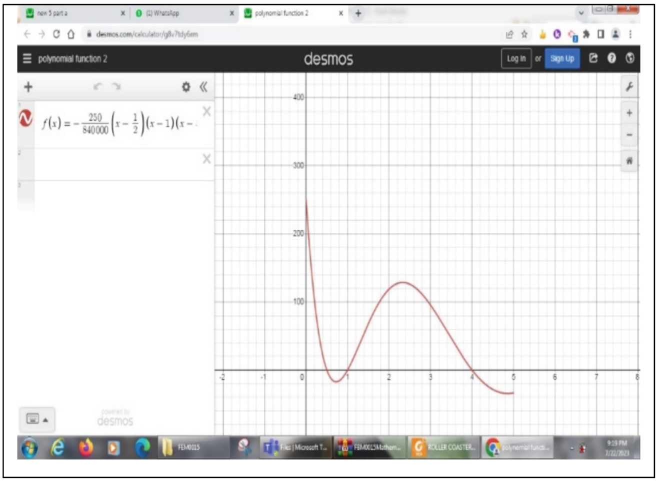

Fig. 4. Roller Coaster using polynomial group 2.

and range is from −50 to 250. The graph increases at (0.7,2.3). Whereas it is decreasing at (0,0.7) and (2.3,5). The degree of the polynomial is 4 known as quartic polynomial with positive leading coefficient. The end behavior of the graph on the left shows that $x \to \infty$ where it goes upward and on the right $x \to -\infty$ where it goes downwards. The graph represents a roller coaster with two underground tracks with a depth of 50 m underground and roller coaster ride takes about 5 min. The roller coaster ride that goes underground takes about 1.5 min. The roller coaster track design is too simple as it is suitable for beginners of roller coaster riders. It is smooth and stable with balance consistent track height that go up and down. Less cost needed to build the roller coaster compared to roller coaster design using piecewise functions.

4 Recommendation

The field of study can be extended by adding elements of animation in graph since it will create a clearer visualization and gain students' excitement to learn and explore more. For example, by applying animation in graph, graph designed will appear to keep on changing on its own as parameters changes.

5 Conclusion

This paper focuses on the experience of 127 foundation students in Engineering and Science exploring Mathematics concepts in real life world. The project comprises of designing roller coaster track by using piecewise function and polynomial and simulating it using Desmos. In conclusion, this project has proven to be a fun and effective learning experience for the students. Throughout this project, students not only be able to strengthen their understanding of complex mathematical concepts but also developed necessary skills in using the Desmos. The project also gave the students the opportunity to work in teams and be creative when designing the roller coaster, which boosted their interest in the science and engineering field. As educators, continue to search for effective teaching methods, the importance of integrating PBL with technology is becoming apparent in advancing students' academic development and preparing them for the challenges of the modern world and technology era.

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Gamification: KAHOOT in Enhancing ESL Learners' Performance and Motivation to Learn Grammar

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Abstract. The purpose of this study is to explore the possible relationship between gamification and students' motivation and performance in learning grammar in English as Second Language (ESL) classroom. The research objectives include to determine how gamification through Kahoot affects students' learning performance and motivation in learning grammar in ESL classroom and to investigate their views on gamifications element through Kahoot. A quasi-experimental study was conducted with two groups of university students. Kahoot was employed as an intervention for the experimental group, whereas the control group was taught by using the conventional method. Data was extracted from pre-test, post-test and two sets of questionnaires. The results were analysed by using SPSS IBM version 23 and descriptive statistics is analysed based on cumulative test score, frequencies, and percentage. Overall, the results revealed statistically significant difference in students' performance in learning grammar as the experimental group achieved higher post test scores than the control group. Besides, the cumulative motivation level score for learning grammar for students in experimental group was much higher than the control group. In addition, from the surveys, there was positive indication from the students' attitude in experimental group towards gamification integration in learning grammar.

Keywords: Gamification · Kahoot · English grammar

1 Introduction

Grammar can be traumatic and can cause learning anxiety to the students (Sabah, 2021). Thus, the application of games for educational purposes has been proven by many studies to be able to increase students' motivation, which is an important pervasive determinant of learning behaviour (Schunk et al., 2013). Integrating the use of Kahoot in learning grammar in ESL classroom acts as a game-based learning that can help to shape a higher level of individual's motivation.

One of the advantages of gamification is that it can stimulate learning. Students can get used to the element of confrontation, gain a sense of accomplishment or loss, and receive instant feedback (Kapp, 2012). As Kahoot is provided with limitless sources of interactive quizzes that can be implied in the classroom, the students will be more

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attentive as they want to score the best mark to get an establish rank among the students. Thus, the use of gamification (Kahoot) in ESL classroom will definitely lead the learners into applying what they have studied and revise the learned content.

Thus, this study aimed to investigate the effects of Kahoot in enhancing students' performance and motivation in learning grammar. The performance refers to the students' learning development in grammar while motivation demonstrates their enthusiasm in learning it. Their views and perceptions on the use of Kahoot are also studied in order to further understand their attitudes towards the use of gamification in ESL classroom. It is hoped that the results of the findings may provide insights into the use of Kahoot in grammar learning in ESL classrooms.

2 Research Objectives

1. to determine how gamification through Kahoot affects students' learning performance and motivation in learning grammar in ESL classroom.
2. to investigate students' views on gamifications elements through Kahoot

3 Methodology

The sampling involved 54 students who registered for an English Proficiency course in their first semester in a private university in Malaysia. The control group and experimental group consisted of 29 and 25 participants respectively. Both control and experimental groups were required to fulfil the course by attending 3 h per week session for 12 weeks. Ten grammar quizzes based on ten grammar lessons were prepared to engage the students in both groups in reviewing the lessons taught each time. But, as this was a quasi-experimental design, the control group has been given a revision by means of doing paper quizzes, and only the experimental group was treated by displaying the quizzes via Kahoot. To determine Kahoot effectiveness in delivering grammar lesson in the ESL classroom, pre-test and post-test were distributed to the students for both experimental and control group.

Next, a questionnaire adopted from Wichadee and Pattanawichet (2018) was administered to examine learners' motivation after ten grammar lessons were completed. It was distributed to both groups in their final week of the semester.

Another questionnaire was also given to investigate students' perceptions of the concept of gamification. It consisted of seven questions which related to the use of gamification technique which was Kahoot in this research. This was only distributed to the students in the experimental group to be filled once the intervention finishes. All the items included were adopted from Wichadee and Pattanawichet (2018) too due to their content validity. All the gathered data through pre-test, post-test and questionnaires was analysed by using Statistical Package for Social Sciences (SPSS).

4 Discussions

Table 1 Presented the independent samples t-test results of post-test scores for both control and experimental groups once the intervention has finished.

Table 1. Independent sample t-test results of post-test scores

Group	N	Mean	Standard Deviation
Control Group	29	69.79	9.83
Experimental Group	25	79.84	7.72

From the mean scores, it showed that the experimental group mean scores for post-test was 79.84 with standard deviation of 7.72, which was higher than control group which was 69.79 with standard deviation of 9.83.

Table 2 presents the differences in motivation levels between each group based on the total score from the questionnaire given to them after the intervention.

Table 2. Total cumulative motivation level score

Cummulative Motivation Level Score	Control Group		Experimental Group	
	F	%	F	%
10–19	-	-	-	-
20–29	1	3.4	-	-
30–39	17	58.6		
40–50	11	38	25	100

The findings revealed that the maximum total motivation level score for the control group was 48 which was lower than the students in the experimental group which scored the full score of 50. Based on the analysis, it can be concluded that 18 students from the control group who scored below 40 for their motivation level which can be assumed that most of them were less motivated in using the conventional method in learning grammar in the classroom.

Figure 1 shows students' perception towards the technique in from the chart, it is substantial to note that all the students in the experimental group showed positive attitudes towards gamified learning. Majority of them agreed that this approach enhanced their interest, engagement and understanding.

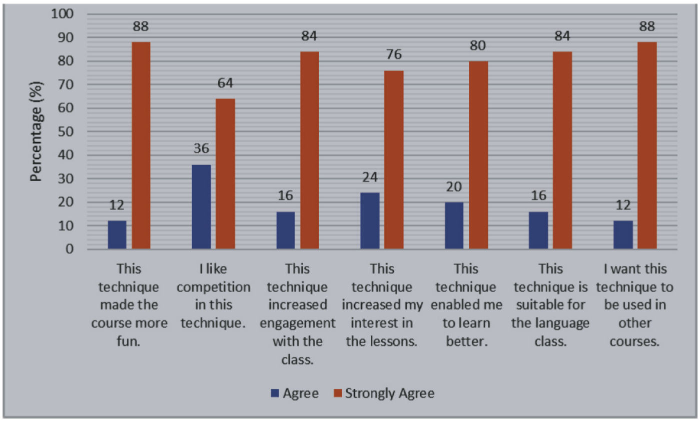

Fig. 1. Students' perception towards the gamification technique in frequency

5 Conclusion

To sum up, Kahoot is an impactful tool in enhancing students' motivation and performance in ESL classroom. The integration of gamification in learning grammar allows the students to have a more conducive and exciting atmosphere. It also stimulates students' interest in mastering grammar which will tremendously help them in improving their language proficiency.

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Gauging Students' Feedback on the Use of Virtual Reality in Learning

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Abstract. The main goal of the project was to collect feedback from students when using Virtual Reality (VR) software in learning. A VR application that supports multi-users, interaction, communication, and virtual presentation is built to gauge students' feedback. The VR application presents a module for assembling and dissembling computer parts and is created to mimic a real hands-on activity. The aim is to allow immersive experience and heightened sense of realism in students' learning. The benefits include interactive learning leading to a higher retention rate.

Keywords: Virtual Reality · virtual teaching and learning · multi-users interaction

1 Introduction

This project is influenced by the Student Voice Matters (SVM) [1] studies on how students feel about going back to school and what their goals are for their education following the pandemic. Based on the information that students disclosed, SVM [1] identified five factors to be taken into consideration to enhance the learning experience. These five factors include technology in classrooms, fun factor' of classes, learning structure & experience, student ownership of learning and matching method to modality. Out of the five, in this paper, the researcher will focus on two of the fac-tors which are technology in classroom and 'fun factor' in learning.

Based on the same survey conducted at SVM [1], students' routines are becoming increasingly reliant on digital media, and many of them are advocating for a wider use of technology in the classroom. When asked how their learning may be promoted, students consistently cite having more engaging and participatory classes as the most helpful improvement. This includes having interactive content (such as digital engagement and

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group learning activities) which are more likely to keep their interest and keep them motivated.

Based on the notion demanded by students, this paper has reason to believe that engaging classroom fusing assistive technologies such as VR has the potential to advance students' learning experience. Therefore, development of a VR application is introduced here exposing students the interactive and immersive experience. At the end of this paper, students' feedback is shared.

2 Literature Review

The development of the VR application aims to create the immersive learning experience. [2] mentioned that,

> *"A good learning experience focuses on being authentic, interactive, and collaborative to enhance engagement and improve knowledge retention. Besides, it adds value to the learner, encourages social learning, promotes learner self-assessment, and is inquiry-based. A good learning experience strengthens learning and development and, ultimately, helps improve employee performance and productivity".*

While Virtual Reality (VR) is defined as,

> *"a computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors".*

The term immersive comes up rather frequently while discussing virtual reality (VR). [3] accurately characterize the overarching notion of immersion in games as the involvement in the play, which results in a lack of awareness of time and of the actual world, in addition to a sense of "being" in the environment in which the activity is being performed. When talking about virtual reality (VR), the term "immersion" is most often used with the more specific meaning of "spatial immersion." The experience of being physically present in a nonphysical world through the use of virtual reality software is referred to as spatial immersion. The user of the virtual reality (VR) system is immersed in an extremely absorbing environment that is generated by sur-rounding with visuals, sounds, and other stimuli that create an immersive experience. When a player perceives that the simulated world is perceptually convincing, it ap-pears "genuine" and "real," and the player has the sensation that he or she is actually "there", and that is the experience of spatial immersion.

According to [4], VR technology is an ideal tool to be used in the delivery of university lectures especially in the context of blended learning. In recent years, several studies have reported the pedagogical advantages of utilizing a metaverse platform. In order to maintain students' interest and engagement in distance learning of higher education settings, Mystakidis designed a metaverse course also known as the Social VR gamification platform. To his surprise, he discovered that the postgraduate students were highly engaged in the metaverse platforms, and that the gamified features seemed to evoke their interest, motivation, and autonomy in learning. In addition, he argues that although face-to-face interactions in real life have great pedagogical values that is hard to replicate in online settings, the metaverse offers a rich alternative where a tremendous sense of telepresence can be felt by meeting in the same 3D virtual area with other avatars and acknowledging the individuals behind the multi-personas.

Through the use of a metaverse, students can have access to a variety of learning experiences that are grounded in authentic human connection and a variety of modalities. According to Kress' multimodal learning theory, students' levels of comprehension and retention increase when they are required to make use of a wider range of their sensory input during the learning process. Supporting multimodality is an important aspect of education in that it helps understand the numerous ways in which individuals communicate with each other and express themselves. By mixing the many modes such as visual, aural, linguistic, gestural, and spatial, students experience learning in a number of ways to create a diversified learning style. Especially in terms of gestural design and a spatial, the recent COVID-19 pandemic has isolated some modes of communication in educational contexts and made them difficult to implement. By releasing the visual, auditory, and linguistic modes of communication and immersing the learner in a 3D environment, metaverse education not only im-proves learning engagement by the gestural mode through avatar movement, but it also enriches learning experiences in 3D spatial design and visualization.

3 Methodology

3.1 Research Methodology

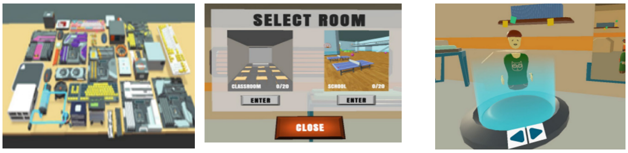
The first step in commencing this project is to gather all of the necessary information towards creating the VR application. The creation of the VR application entails creating the interface (UI) as well as the classroom's setting, objects, and avatars' 3D models. It also involves the incorporation of virtual reality functionality utilizing Unity Studio packages like XR Rig and Open XR. User testing is conducted to gain feed-back in terms of interaction and the quality of the learning experience it provides. Participants feedback is compiled and analyzed. User feedback is carefully reviewed, and adjustments to the project may be made accordingly. At this point in the process, software debugging and troubleshooting also takes place to ensure that the VR application is running without any issues.

4 Results and Discussion

4.1 The VR Application

Some parts of the VR application designs and features are shared below as shown in Fig. 1.

The VR application has many important elements and features that include avatars for students and instructors, classroom environment, game room and many more. In



Computer Peripherals *Room selection and player count* *Avatar Selection*

Fig. 1. The VR application design and features

the classroom environment there are 3D models such as tables for the instructor at the front along with whiteboard on the side for the students to look at. This virtual room can accommodate up to 12 people per session. Some other features included in the VR application are shown in Table 1.

Table 1. Features of the VR application

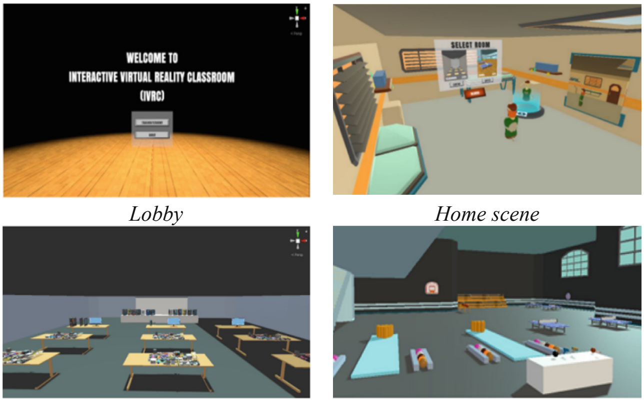
Compatibility	Oculus, Open XR
Features	Locomotion, Video Player, Player Name, Photon Voice, Room Count, Guest Session, Avatars Selection, Interactive Classroom, Environment Selection, Photon Games Environment, Interactive Games Environment, limited to 20 users in a session

There are 4 separate scenes in the VR application as shown in Fig. 2: Lobby, Home, Classroom and Gameroom. At the Lobby students will be greeted and enter their name here. The home scene serves the purpose of avatar selection, room selection, and participant count. Classroom scene is a virtual classroom and have computer to be assembled and dissembled. In this classroom, there are models of PC components for students to interact with. Computers parts such as RAM stick, GPUs, PSUs, motherboard can be grabbed by the students and fixed to the appropriate place to function. The game room offers various activities such as bowling, basket-ball, and table tennis. The environment is developed to provide a fun and engaging experience for students to virtually interact with friends. This is to reduce stress after classes and create a room for fun learning.

4.2 Students' Feedback

The incorporation of virtual reality (VR) applications into learning environments has revolutionized traditional educational methods, providing students with immersive and interactive experiences. In this sub-section, we present some of the feedback obtained from students who have experienced the VR application. Their insights shed light on the advantages, challenges, and overall perceptions of using VR in learning.

By exploring their feedback across different categories, we gain a deeper understanding of how VR enhances engagement, promotes understanding, and ignites motivation in learning. This collection of student feedback serves as a valuable resource for educators to leverage VR technology and optimize student learning outcomes.



Lobby *Home scene*

Classroom scene *Gameroom scene*

Fig. 2. Scenes in the VR application

a) *Engagement and Immersion*
Using virtual reality made the learning experience engaging and immersive. Students could experience the subject matter. As one of the students highlighted, *"The VR ap-plication captured my attention from the moment I put on the headset. It created a sense of presence and made the learning environment feel real and interactive…. Interacting with virtual objects and environments stimulated my curiosity and motivated me to explore and learn in a way that traditional methods couldn't match"*.

b) *Understanding and Retention*
The visual and interactive nature of virtual reality helped students to grasp complex concepts. They could visualize abstract ideas and understand them in a practical context. One of the students who have no knowledge on PC components and peripherals agreed that,

> *"So you're in the classroom, where you can handle [hold] the motherboard and especially for me, I'm in BBM [business] course, so I don't actually have that IT knowledge on how to set up the motherboard and all that …this [VR application] is actually quite an interesting for me to learn how to set up the hardware"*.

c) *Collaboration and Communication*
The VR application facilitated communication and discussion among classmates. This happens in the classroom as well as the game room. Students could share their observations, ask questions, and instructors could provide feedback in real-time, enhancing the learning experience. As one of the students highlighted, *"We could interact, communicate, and solve problems collectively, even when we were physically apart"*.

d) *Motivation and Interest*
The use of VR technology as an assistive technology in learning is deemed highly motivating. It creates excitement to learn, fun and interactively challenging. Students

wanted more of this type of technology for learning. As one of the students pointed out,

> *"… it's immersive and I feel like this is a right step for the current education system and we should implement more of this [type of] technology … in learning".*

e) *Challenges and Limitations*
There is a high demand among students on VR technology for learning, however the supply is deemed low from the educators to utilize the potential of these technologies in class. As highlighted by a student, *"… it's an immersive experience and engaging experience. It's something that we should be implementing since long time ago as our technology seem to be very advanced but not our education system that seems to be lacking …".*

The incorporation of virtual reality (VR) applications into learning environments has revolutionized traditional educational methods, providing students with immersive and interactive experiences. In this section, we present valuable feedback obtained from students who have experienced VR technology in their learning journeys. Their insights shed light on the advantages, challenges, and overall perceptions of using VR in education. By exploring their feedback across different categories, we gain a deeper understanding of how VR enhances engagement, promotes understanding, fosters collaboration, ignites motivation, and addresses potential limitations. This collection of student feedback serves as a valuable resource for educators and policymakers seeking to leverage VR technology effectively and optimize student learning out-comes.

5 Conclusion

In conclusion, the development of the VR application for learning is gaining popularity and positive feedback among learners. The immersive and interactive nature of VR technology offers a novel and interesting learning experience that can increase students' Engagement and Immersion, Understanding and Retention, Collaboration and Communication, Motivation and Interest. In it is hoped that educators could lever-age on such assistive technology and introduce immersive and impactful learning experiences that empower students to excel.

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How ChatGPT Affects Education Landscape: Effects of ChatGPT on Higher Education Accessibility and Inclusivity

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Abstract. The increasing use of artificial intelligence (AI) in education has led to the creation of ChatGPT. Despite its potential benefits, the effects of ChatGPT on higher education accessibility and inclusion are not fully understood. This study aims to investigate the effect of ChatGPT on the accessibility and inclusivity in higher education for students. We delivered five questions to identify the applicability of ChatGPT, including the utilization of ChatGPT in higher education, the benefits of ChatGPT in higher education, the perception of quality answered by ChatGPT, user-friendliness interface of ChatGPT, and ChatGPT on enhanced higher education accessibility and inclusivity. These focus questions were purposefully created to strategise the integration of ChatGPT within the higher education framework. Total of 85 respondents, comprising undergraduate students from Indonesia, Malaysia, and Nigeria participated in this study. It was found that a significant 75.6% of respondents feel ChatGPT has enhanced higher education accessibility and inclusivity. This highlights the potential of AI technologies to improve educational environment by increasing accessibility and levelling the learning ecosystem for students with various requirements and backgrounds. There was still a widespread distinction of knowledge and viewpoints among students. Although some students consider ChatGPT to be just marginally useful and are only slightly satisfied with its quality, others express high satisfaction. It is important to note that some students did not find ChatGPT to be useful and have reservations about its accuracy. The study contributes to a deeper understanding of ChatGPT can play in decreasing barriers to education and fostering more classroom diversity. The findings of this study can also inform the

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development of best practises for incorporating technology such as ChatGPT into higher education institutions. This would eventually optimise ChatGPT potential impact on accessibility and inclusivity. All in all, this study can play a crucial role in changing the future of higher education using ChatGPT and ensuring that all students have access to the resources they need to succeed.

Keywords: Artificial intelligence ChatGPT · Machine learning ChatGPT · ChatGPT on higher education · ChatGPT on education accessibility · ChatGPT on education inclusivity

1 Introduction

1.1 ChatGPT and Its Use in Higher Education

ChatGPT, a language model powered by AI, was developed by OpenAI. ChatGPT is a form of conversational AI natural language processing model [1, 2]. It has been trained on a vast amount of text data, thus enabling it to provide responses to text-based queries that mirrors human responses. For educational purposes, ChatGPT can be utilised in various ways to benefit students, educators, and institutions [3–5]. Figure 1. Shows the potential applications of ChatGPT in higher education sector.

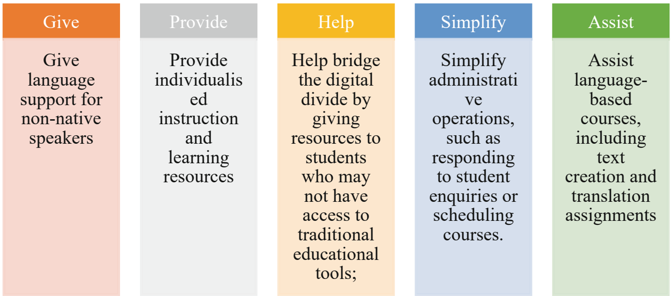

Fig. 1. Potential applications of ChatGPT

Using ChatGPT in higher education has the potential to improve the educational experience of students and provide new learning experiences [6–8]. From the university point of view, ChatGPT can assist high education institutions in improving access and equity for the students [9–13]. However, one important question is what the ethical issues are and how to guarantee that ChatGPT integration could maximise its potential benefits while minimising its potential risks.

1.2 The Impact of ChatGPT on Education

Previous preliminary studies have demonstrated that ChatGPT can have a good impact on education [14–17]. ChatGPT can provide students with individualised and easily

Improve	Improve students' motivation and engagement with course material
Enhance	Enhance students' ability to self-regulate their learning
Provide	Provide students with easy access to educational resources
Offer	Offer personalised support and feedback to students in real-time
Streamline	Streamline administrative processes, such as course registration and scheduling

Fig. 2. Various applications that ChatGPT can perform in education.

accessible information [18, 19]. Figure 2 shows several applications that ChatGPT can perform for educational purposes.

As far as the language support is concerned, previous research has demonstrated that ChatGPT are beneficial in enhancing the language skills of students, especially non-native speakers [20, 21]. In language learning, for instance, ChatGPT has been used to provide students with rapid feedback on their writing skills. This is in addition to tailored practise sessions provided by ChatGPT to improve students' proficiency.

Despite the advantages of ChatGPT in higher education, it is essential to emphasise that ChatGPT has a number of limitations such as not updated data and inaccurate response. Therefore, more research is required to fully comprehend the potential benefits and limitations of ChatGPT in higher education. Therefore, we would be able to find the best techniques for integrating ChatGPT into higher educational systems.

1.3 Theoretical Framework on Accessibility and Inclusivity in Higher Education

The theory that underpins the accessibility and inclusiveness in higher education revolves around the notion that education should be open to all students, regardless of their background or circumstances [22, 23]. This idea tries to address the systemic hurdles hindering some students from accessing and succeeding in higher education. The framework for accessibility and inclusivity in higher education encompasses several fundamental theories and concepts. These are shown in Fig. 3, focusing on four elements; universal design for learning (UDL), critical pedagogy, cultural responsiveness, and digital divide.

The theoretical framework for accessibility and inclusion in higher education provides a foundation for understanding the obstacles. They are the challenges that students face in accessing and achieving in higher education. The theoretical framework also provides the techniques that may be employed to overcome the obstacles. In short, the higher education institutions should be built more inclusive, equitable learning environments with access to education for all students.

This study aims to assess the effects of ChatGPT on the accessibility and inclusivity of higher education. How the use of language models such as ChatGPT can aid students in gaining access to education-related resources is investigated. This study also evaluates ChatGPT's potential to improve language support for non-native speakers, provide personalised tutoring and learning resources, streamline administrative processes, and bridge the digital divide by providing resources to students who may not have access to conventional educational tools. The study's ultimate objective is to analyse the influence

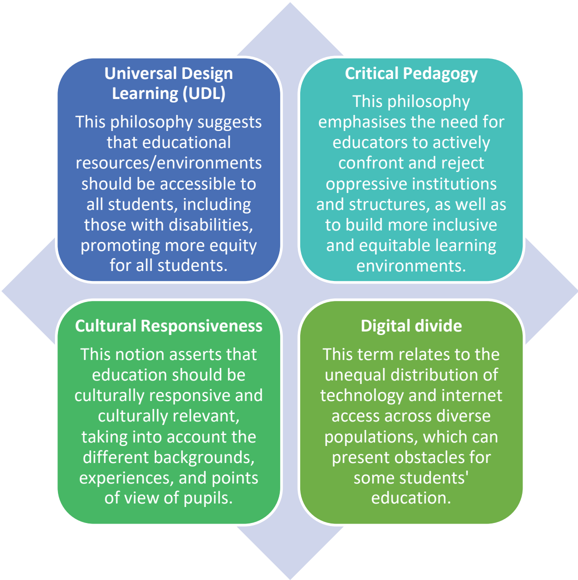

Fig. 3. Key theories and concepts that are part of the framework for accessibility and inclusivity in higher education.

of technologies such as ChatGPT on the education environment and to identify methods in which they can be used to increase access and equity for all students.

2 Methodology

With the development of machine learning such as ChatGPT, students can now receive a more individualised learning support. ChatGPT is a conversational AI model developed by OpenAI that has garnered substantial interest in recent years. ChatGPT can provide responses to natural language queries, making it a great resource for educational purposes. This study aims to obtain a deeper understanding of the impacts of ChatGPT can have in improving the quality of education for students and providing more inclusive and accessible learning opportunities in higher education.

We delivered five questions to identify the applicability of ChatGPT, including the utilization of ChatGPT in higher education, the benefits of ChatGPT in higher education, the perception of quality answered by ChatGPT, user-friendliness interface of ChatGPT, and ChatGPT on enhanced higher education accessibility and inclusivity. These focus questions were purposefully created to strategise the integration of ChatGPT within the higher education framework.

The target population for this research comprises undergraduate students from Indonesia, Malaysia, and Nigeria. The were 85 respondents. The questionnaires were disseminated online. The data collection spanned over three months, ensuring adequate response rates. Ethical considerations are important to this study. All participants were informed about the research objectives, and their confidentiality are guaranteed. It is important to acknowledge potential limitations of our methodology, such as response bias, underrepresentation of certain regions or groups, and possible misunderstandings about ChatGPT's capabilities. However, our approach provides a multifaceted insight into the role of ChatGPT in shaping the higher education landscape where different point of views are presented in the results and discussion.

3 Results and Discussion

This study aims to evaluate the ChatGPT on inclusivity and accessibility in higher education. We delivered five questions to identify the applicability of ChatGPT, including the utilization of ChatGPT in higher education, the benefits of ChatGPT in higher education, the perception of quality answered by ChatGPT, user-friendliness interface of ChatGPT, and ChatGPT on enhanced higher education accessibility and inclusivity. These focus questions were purposefully created to strategise the integration of ChatGPT within the higher education framework.

Figure 4 shows how frequently the respondents use ChatGPT. As can be seen from the figure, 31% and 34.5% of respondents reported using ChatGPT sometimes and rarely. The total number from these two respondents' group are significant amount and could be caused by a number of reasons, including a lack of familiarity with ChatGPT, a preference for traditional study methods, or the difficulty of incorporating AI technologies into academic tasks. It is possible that these students do not fully trust or understand the educational potential of AI, explaining why ChatGPT was used infrequently. On the other hand, 26.2% of respondents reported using ChatGPT frequently in higher education. Furthermore, not even 10% respondents reported using ChatGPT regularly, with 8.3% responding almost always use ChatGPT, indicating user trust in AI tool such as ChatGPT. This finding is in line with the work of Tlili et al. [10] who reported the reliability and trustworthiness of AI systems, examining the benefits and drawbacks of employing ChatGPT in the classroom. Despite the potential, Wang et al. [24] reported that ChatGPT has room for enhancement in a number of key areas.

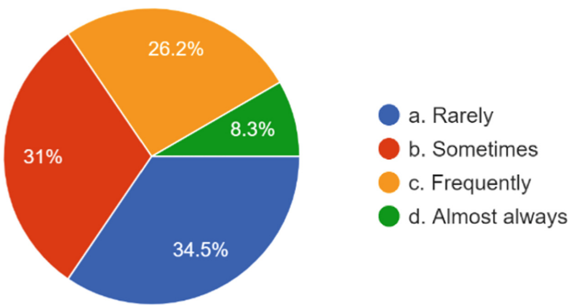

Fig. 4. The utilization of ChatGPT in higher education

Figure 5 shows the benefits of using ChatGPT in higher education setting. The fact that 45.3% of respondents said that ChatGPT was moderately helpful illustrates that many students regard it as a good source for particular academic questions, even when it is not a comprehensive response. A sizeable number of people (33.7%) responded to the survey and indicated that ChatGPT was at least slightly helpful to them. This demonstrates a substantial level of dependence on the AI technology in students' academic achievement. It is probable that the respondents are concerned about the usefulness and efficiency of ChatGPT in providing answers and pertinent information, suggesting that they have some confidence in ChatGPT ability to provide academic assistance. Furthermore, 17.4% of respondents stated that ChatGPT was extremely helpful, showing a significant dependence on this AI technology. These respondents trust the responses provided by ChatGPT to answer specific issues pertaining to their problems. On the other hand, the fact that 3.5% of students did not find ChatGPT useful shows that AI tools such as ChatGPT will likely not satisfy all students' requirements or preferences.

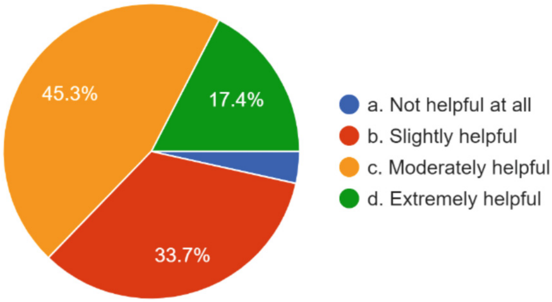

Fig. 5. The benefits of ChatGPT in higher education

In terms of the perception of quality answered by ChatGPT, Fig. 6 shows the respondents results. The fact that 48.8% of users rated moderate satisfaction suggests that many individuals consider ChatGPT a helpful service while occasionally having reservations about it. Interestingly, 11.6% of respondents indicated they were highly satisfied, indicating they had a full trust in ChatGPT's capabilities. This is in line with previous study. Sharma et al. [25] discussed the use of ChatGPT in plastic and reconstructive surgery, focusing on the ways in which it may increase productivity for tasks such as manuscript writing and patient engagement. This suggests that students respect ChatGPT's capacity to answer questions about homework and give support and that they know the benefits and drawbacks of using the platform. On the other hand, only 4.7% of respondents reported being completely unsatisfied, highlighting the likelihood that AI tools have serious limitations. This underlines the importance of further development and the importance of AI systems to match human expectations. It is important to note that the performance of ChatGPT might shift depending on the specific domain, dataset, and prompt. To fully examine the advantages and limitations of ChatGPT in higher education setting, further research and analysis are required.

Figure 7 shows the results for ChatGPT's usability and accessibility. While 44.2% thought it was moderately accessible or user-friendly, 33.7% said it was slightly accessible or user-friendly. The 16.3% of respondents who rated extreme accessibility were pleased with the user interface. However, the 5.8% who considered it inaccessible or

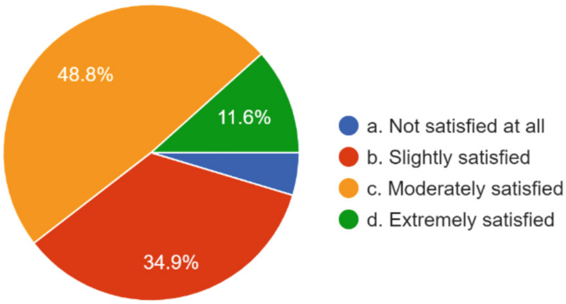

Fig. 6. The perception of quality answered by ChatGPT

unusable imply that there may be usability issues with ChatGPT interdace. This emphasises the significance of building AI interfaces with user-centric approaches, particularly in educational settings. ChatGPT offers a user-friendly interface formatted as a conversation, allowing users to communicate with the model using normal language and obtain virtually rapid results as reported by Carvalho et al. [26]. This implies that the interface is intended to be simple and straightforward to use. Note that ChatGPT is popular partly because of its user-friendliness, ease, and efficiency, indicating that consumers find the interface to be accessible and simple to use. Furthermore, Nastasi et al. [27] emphasised ChatGPT's potential as a readily available source of medical advice for patients, implying that the interface is meant to be user-friendly and accessible to a wide variety of users. These references show that the ChatGPT interface is intended to be user-friendly and accessible, allowing users to engage with the model using normal language and receive rapid results. The good public discourse and popularity of ChatGPT enhance its usability and convenience of use even further.

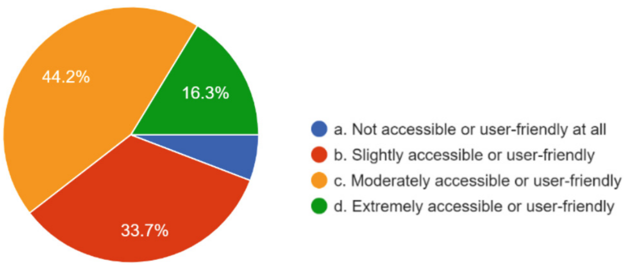

Fig. 7. User-friendliness interface of ChatGPT

This study aims to evaluate the ChatGPT on inclusivity and accessibility in higher education. By investigating the effects of ChatGPT on higher education, useful insights can be provided to develop future AI-powered educational tool. As far as accessibility and inclusivity are concerned, Fig. 8 shows the results from the survey. A significant 75.6% of respondents feel ChatGPT has enhanced higher education accessibility and inclusivity. This highlights the potential of AI technologies to improve educational environment by increasing accessibility and levelling the learning ecosystem for students with various requirements and backgrounds. The 24.4% who did not share this attitude, on the other hand, highlight the necessity of taking into account individual experiences and expectations when deploying AI-driven solutions. According to Bong and Chen [28], enhancing lecturer competency in digital accessibility is critical for inclusive education. They emphasise the need of educating faculty members to provide students with accessible and inclusive digital learning resources and settings in higher education. This shows that ChatGPT has the potential to increase higher education accessibility and diversity by increasing lecturer competency in digital accessibility, clarifying complicated subjects, and assisting students with impairments. It is crucial to emphasise, however, that more studies are required to properly understand the use of ChatGPT in higher education settings.

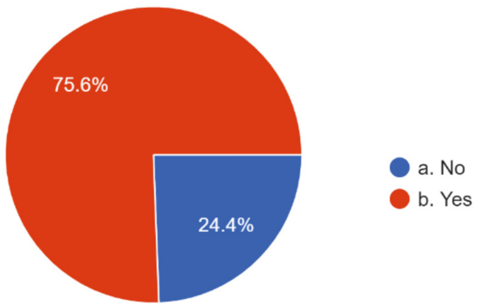

Fig. 8. ChatGPT on enhanced higher education accessibility and inclusivity

To explore more of ChatGPT on the accessibility and inclusivity of higher education, the use of ChatGPT in higher education may increase students' access to educational materials and support, especially for those who experience educational hurdles owing to their background, location, or impairments. Specifically, some potential major discoveries may include four points as shown in Fig. 9 below.

It is important for higher education institutions and policymakers to take into account the role of AI and technology in higher education. B considering the potential benefits and limitations of ChatGPT and other AI-powered technologies, institutions can develop inclusive and impartial learning environments that promote the success to all students.

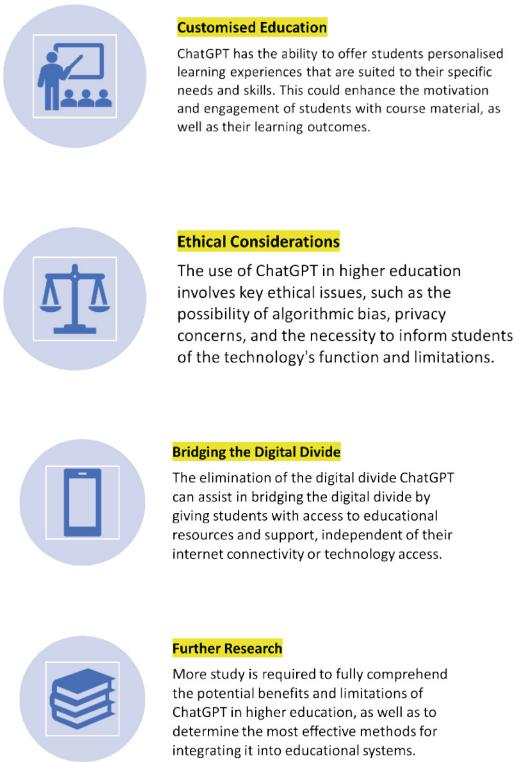

Fig. 9. Potential major discoveries of ChatGPT on the accessibility and inclusivity in higher education

4 Conclusion

ChatGPT is capable of some important activities for educational purposes, including question answering, text generation, and natural language processing. This study sheds insight on the influence of ChatGPT on the accessibility and inclusivity in higher education. With breakthroughs in artificial intelligence and machine learning, natural language processing models such as ChatGPT have the potential to significantly improve the educational experience for students from a variety of backgrounds.

The results of five important questions have been elaborated in the discussion section. It was found that there was still a widespread distinction of knowledge and viewpoints among students. A substantial percentage of the respondents believe ChatGPT is a valuable tool, particularly concerning accessibility, inclusivity, and increased information availability. Although some students consider ChatGPT to be just marginally useful and are only slightly satisfied with its quality, others express high satisfaction. It is important to note that some students did not find ChatGPT to be useful and have reservations about its accuracy. Due to ChatGPT has different effects on student involvement and participation, there is a requirement for a well-rounded integration approach to maintain ethical aspects and integrity in higher education. Lastly, it is worth AI's potential to improve accessibility and inclusivity while addressing concerns about accuracy to make the most of ChatGPT in higher education settings.

By analysing the effects of ChatGPT on higher education, this study provides institutions, educators, and policymakers with significant insights for their efforts to promote education access and equity for all students. Considering the constantly changing landscape of higher education. This work can also serve as a foundation for future research of ChatGPT in education sector.

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Implementation of Sandbox Model Experiment Among First and Fourth Year Students of BSc Petroleum Geoscience Course at Universiti Teknologi PETRONAS, Malaysia

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Abstract. Sandbox model provides an interactive platform to study the deformation caused by tectonic forces and its effects on the development of different geological basins. However, the actual educational benefits of incorporating sandbox modeling into geoscience courses in higher education settings, particularly in Malaysia, have not been explicitly studied and examined. At Universiti Teknologi PETRONAS, Malaysia, assessment on the awareness of knowing the purpose of the analog sandbox model among geoscience students have been conducted among first-year Structural Geology and fourth-year Geodynamic and Basin Evolution students. This assessment was followed by the implementation of sandbox model experiments based on pre-, syn-, and post-experimental stages. The experiments were carried out at different times for first-year (beginner) and fourth-year (advanced) undergraduate geoscience students, considering their varying course learning outcomes and levels of prior knowledge. Upon completion of the experiments, a survey was conducted to assess the students' acceptance of the sandbox experiment as an interactive and experiential learning tool. This is followed by the instructor's observation of the students' understanding based on their final assessments submitted as part of their coursework for the respective subject. The results indicate that not all geoscience students were aware of the existence of sandbox equipment at the university, with only 30% of the students understand the exact purpose of the sandbox model experiment. However, the post-experimental survey show that all participating students are satisfied with their learning outcomes from the sandbox experiment. Although, based on the instructor's observations indicate that fourth-year students had a better grasp of the technical concepts behind this experiment compared to first-year students, who treat the sandbox experiment as a fun and interactive learning experience outside of traditional classroom teaching.

Keywords: analog sandbox · sandbox model · active learning · geological modelling · interactive learning

1 Introduction

In geoscience education, one of the five general distinctive educational attributes that plays a vital role in the curriculum is high-level spatial capacity thinking [3]. Sandbox experiment is a simulation of real-geological structure formation in a laboratory setting.

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It consists of a fixed flat surface where modeling materials, primarily sand, clay, and silicone, are deposited and it includes a movable wall that can either move forward or away from the depositional materials, exhibiting compression or extensional deformation behavior, respectively. This movement is controlled by a piston actuated by a lead screw on the mobile wall [1].

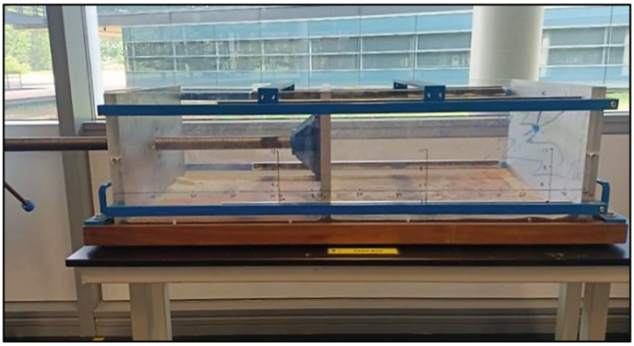


Fig. 1. The analog sandbox equipment at Universiti Teknologi PETRONAS used for this study.

Through setting up experiments, modifying parameters, and analyzing the results, students develop the capability to recognize patterns, make predictions, and draw plausible reasoning and logical conclusions. These skills are of utmost importance for future geoscientists as they equip them to interpret real-world geological data and make well-informed decisions in their professional careers [2].

Students can efficiently simulate tectonic processes, such as plate divergence or convergence through the extension or compression of sand within a sandbox model. This form of interactive learning has demonstrated that students tend to derive enjoyment from actively participating in their lessons, resulting in improved attention that contributes to the development and enhancement of students' critical thinking and comprehension skills [4]. The deformational process and resulting structures observed in sandbox modeling not only provide further insight into actual tectonic phenomenon but also facilitate in interpreting the nature of the associated mechanism [5]. Ultimately, this enhances the visualization and imaginative skills required to be a geoscientist.

1.1 Background of the Study

Modeling is a vital tool for geoscience students to develop a more comprehensive spatial and temporal perspective for field observations [5]. Recognizing its significance, a group of researchers at Universiti Teknologi PETRONAS (UTP), Malaysia, has constructed an analog sandbox model for educational and research purposes (Fig. 1). Unfortunately, this sandbox equipment remained underutilized for some time due to certain issues. Since early 2022, the sandbox equipment has been reintroduced into teaching and learning activities for students pursuing a Bachelor of Science (Hons) in Petroleum Geoscience, particularly for subjects related to structural and basin evolution. Data on the students' awareness levels, satisfaction, and improvements in teaching and learning have been collected from the students involved in the years 2022 and 2023.

This paper aims to present the quantitative outcomes collected from geoscience students at UTP in the years 2022 and 2023, following the reintroduction of the sandbox equipment for teaching and learning purposes. The selected nineteen participating students from two courses: Structural Geology (beginner-first-year) and Geodynamic and Basin Development (advanced-fourth-year) curriculum within the BSc Petroleum Geoscience program. The goal was to assess students' awareness and acceptance of visualization learning using a sandbox experiment/model. By comparing the acceptance levels between these two different learning levels, we aim to evaluate the effectiveness of this sandbox experiment as a learning tool (Fig. 2).

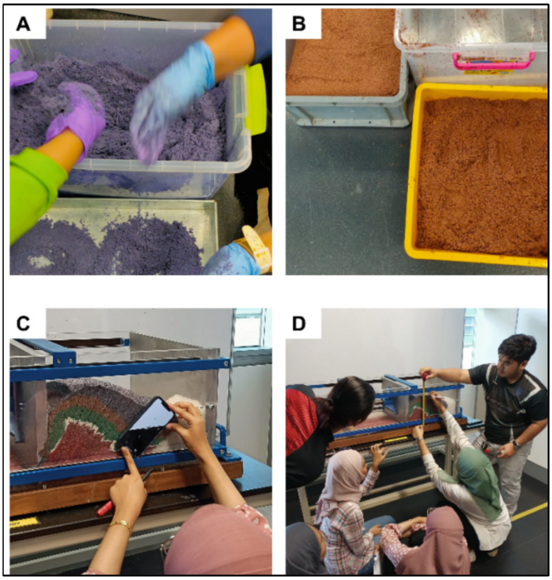


Fig. 2. Stages of sandbox experiments. Pictures A and B are showing the pre-experimental stage where the students are involved with sand coloring activity and drying them in the oven/open space. Pictures C and D are showing the syn-experimental stage. C) A student is measuring the variation in dipping angle for the faults that formed during the compressional deformation. D) Students are measuring the thickness of the accumulated sand after the deformation to reflect the mountain building process in tectonic.

2 Methodology and Dataset

2.1 Study Participants

This study was conducted at the Universiti Teknologi PETRONAS (UTP), in Seri Iskandar, Perak, Malaysia. The study participants involved 7 students who were enrolled in the first-year course of Structural Geology and 12 students who were enrolled in the fourth-year course of Geodynamic and Basin Evolution. The participants from Structural Geology course are students who only had four months of prior experience in the basic geology from the previous semester before enrolling in the Structural Geology course. On the other hand, the participants from Geodynamic and Basin Evolution are highly experienced undergraduates who are in the final semester of study. All 12 participants of these advanced-level undergraduates had attended eight months of internship training and were concurrently working on their individual Final Year Projects during the time of this study. The study was conducted over different periods: from September to December 2022 for the Structural Geology participants and from January to April 2023 for the Geodynamic and Basin Evolution participants.

2.2 Experimental Setting

The technical aspect of this study involved designing the sandbox experiment, comprising three experiment stages: (i) Pre-Experiment, (ii) Syn-Experiment and (iii) Post-Experiment. Before initiating the pre-experiment stage, students' awareness of the sandbox experiment and its availability in UTP was assessed through an offline questionnaire. The collected responses from participants in both courses' groups were then compiled and analyzed.

During the pre-experimental stage, the instructor provided a guidebook and held a physical briefing session with the students to ensure that all students were well-informed about the necessary steps and tasks. This stage also involved the active participation of students, tutors, and lab technologists in activities like coloring and drying the sand. These preparatory activities were carried out one to two weeks prior to the actual experiment. Both the first-year and fourth-year students who participated in this study followed the same steps during the pre-experimental stage. As the sandbox experiment had been newly re-introduced into their respective courses after a prolonged absence in the previous semesters, the mapping of the course outcome and the activity conducted in class has been aligned and informed to all the students during the pre-experimental stage.

The technical learning outcomes for the sandbox experiment were set to three: (i) to observe and measure changes in the topography and cross-sectional views before, during and after the deformation; (ii) to sketch, label and characterize changes in the cross-sectional view on the geological structures; and (iii) to discuss the process involved in the formation of these geological structures. For fourth-year students, the first objective was further refined to focus on deformation in compressional and extensional tectonics. Additionally, the last objective encompassed the examination of how these deformations impact the characteristics of sedimentary basin forms.

The syn-experiment activities were conducted within three to four hours in the laboratory. During the syn-experiment, students were tasked with layering the sands, applying stress or force to the sand layers, observing the resulting deformations, and collecting geological data, (i.e., displacement, dipping angles, intensity of faulting, etc.) to the provided data collection sheets. Throughout the process, videos were recorded, enabling students to revisit their experiments when preparing their reports. In the syn-experimental stage, the technical tasks given for fourth-year (advanced) level students are more rigorous compared to the first-year (beginner) level students, even though the set objectives for both groups remained the same. Specifically, fourth-year students were required to analyze the geometry of the sedimentary basins formed as a result of the deformations occurring during the experiment, where this aspect was not assessed for the first-year Structural Geology students. Data collection sheet was provided for both years to utilize during the experiment. Furthermore, fourth-year-advanced-level students were tasked with analyzing different tectonic settings in two distinct sets of experiments: the first set (Set 1) focused on observing extension and compression, while the second set (Set 2) involved observing compression with salt mounting on one end.

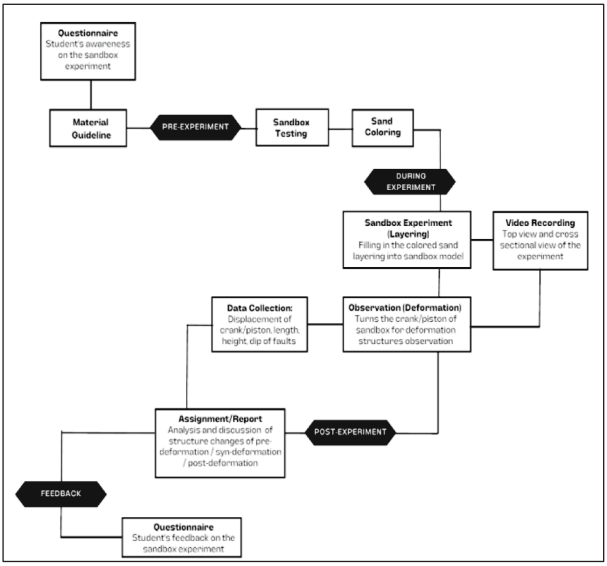


Fig. 3. The flowchart showing stages and steps involved in conducting the sandbox model experiment and data taken for this study.

All students were required to prepare a post-experiment report after completion of the analog sandbox experiment in the laboratory. The specific requirements for these final experiment reports differed between first-year and fourth-year varies. The first-year students were instructed to prepare animated presentations showing the structural changes they observed during the syn-experimental stage. In contrast, the fourth-year students were instructed to prepare a written report that emphasized the parameters involved within various geological settings tested during the syn-experiment stage.

Upon submission of the final assignment (animated presentation or full written report), participants from both courses' groups were invited to provide feedback on their overall experience using the sandbox equipment for model experiments. Subsequently, the feedback from participants at both the beginner and advanced levels of the geoscience course was compared and analyzed. The summary of the method taken in the experiment and observation is shown in Fig. 3.

3 Results and Discussion

3.1 Awareness Level of Participants on Sandbox Experiment

A survey conducted before the students were introduced to the sandbox model experiment had revealed that 68.4% of the participants were aware of UTP's in-house facility for analog sandbox equipment in our laboratory, while another 31.6% were unaware of its existence at UTP. The majority of participants were aware of this equipment due to its prominent display next to the laboratory window, where all students regularly pass by and can take a peek at the sandbox.

Concurrently, the participants were asked about the purpose of conducting the sandbox experiment. This question aimed to assess whether geoscience students were familiar with the purpose behind the sandbox experiment. The results revealed that 5.3% of the participants had no idea and knowledge about this sandbox experiment's purpose, while 26.3% of the participants thought that sandbox equipment was used to display soil, sand, and rock layering. Another 31.6% of the participants understood that the sandbox experiment was designed to simulate various geological structures, such as folds and faults 36.8% of the participants were aware that the sandbox experiment aimed to simulate different tectonic scenarios and visualize deformation.

The profound understanding among the participants who answered the first and second options in this question were mostly from the first-year Structural Geology students, while the fourth year of Geodynamic and Basin Evolution students were mostly cognizant of the purpose of this sandbox experiment, as evidenced by their selection of the third and fourth options in response to this question.

Although sandbox experiment was not part of the syllabus for both courses and have not been included in these courses for many semesters before Year 2022 and 2023, an overwhelming 89.5% of the student participants from both courses expressed their interest in trying the sandbox experiment if given the opportunity. Only 10.5% of the participants chose the "Maybe" option. Based on these results, the instructor decided to resume the sandbox experiment as a teaching and learning tool during the semesters of September 2022 and January 2023.

3.2 Students' Reflection on the Sandbox Experiment

Another survey was conducted at two to three weeks duration from the completion of the sandbox experiment. This survey allowed students to reflect on their experience with the experiment and their final assignments, which included animated presentations for the first-year Structural Geology course and full written reports for the fourth-year Geodynamic and Basin Evolution course. The purpose of this survey was to assess the students' satisfaction and their improvement in technical knowledge following their participation in the sandbox experiment.

Based on the findings of the study, both beginner and advanced-level students expressed favorable acceptance of the sandbox experiment, with 100% of all students reporting satisfaction with the teaching and learning process. Additionally, participants were asked whether the learning objectives had been achieved. All participants agreed that they had fully attained the first and second objectives. However, 88% of first-year participants believed that the third objective of the experiment had been accomplished, while 90.9% of fourth-year participants felt they had successfully completed the third objective of their experiment. On the other hand, 12% of first-year participants and 10.1% of fourth-year participants had doubts about whether they had achieved the third objective. These results indicate opportunities for improvement in future sandbox experiments involving different sets of student participants. The instructor will need to focus on explaining and discussing the third objective more comprehensively to ensure that all students grasp the technical aspects of the experiment.

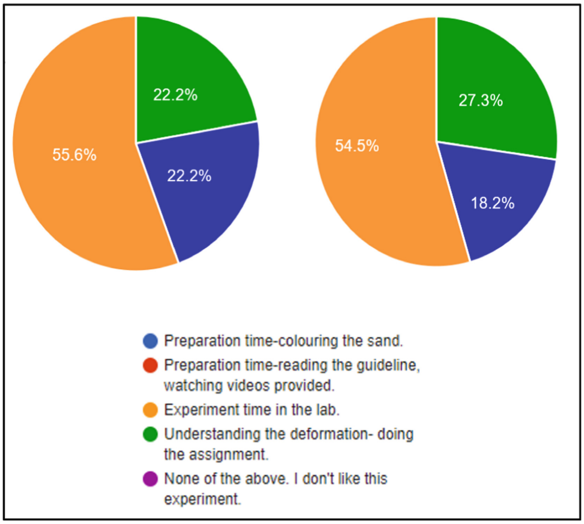


Fig. 4. Percentage of responses from the first-year students (left) and fourth-year students (right) of the question – Which part do you like the most on this sandbox experiment?

The students from both courses are also asked regarding which part of the experiment they like the most., half of the students approximately 55% students from first-year-beginner and fourth-year-advanced levels enjoyed the time spent in the laboratory during the syn-experimental stage. The 22.2% of beginner level and 27.3% of advanced level students enjoy the part where they could enhance their understanding of structural and tectonic deformation processes while working on their assignments. Another 22.2% of first-year-beginner and 18.2% of fourth-year-advanced level students appreciated the time spent in preparation, particularly the sand coloring phase during the pre-experimental stage (Fig. 4).

The results from the post-experimental stage survey clearly highlight that interactive learning through the sandbox enhances engagement and attention in the subject matter, enabling the application and enrichment of theoretical knowledge. Overall, the data strongly suggest that students find the sandbox experiment learning process enjoyable, and they exhibit a positive perspective and acceptance of sandbox experiment-based learning. These findings strongly imply that introducing geoscience sandbox

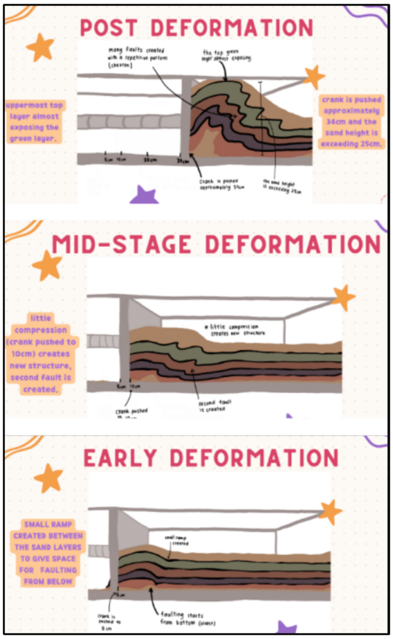


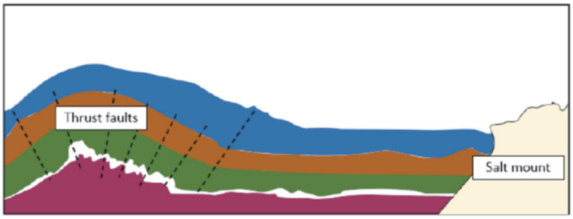
Fig. 5. Example from animated presentation prepared by a group of Structural Geology student (first-year-beginner level) after the completion of sandbox experiment showing their level of observation and sketching skills had improved.

experiments can offer significant advantages for education and visualization in learning environments.

3.3 Improvement in the Observatiom Skills and Analysis of the Geological Deformation

The first-year Structural Geology students were able to connect the theoretical processes they learned in lectures with the deformation processes they observed during the sandbox experiment conducted in the laboratory. Through their submitted assignments and the feedback presented in Sect. 3.2, it was evident that these first-year students had made notable improvements in their sketching skills and managed to categorized their observation into early, middle and late stages of compressional tectonic deformation. These students also pay detailed attention to the shortening involved by measuring the horizontal distance changes along the sandbox. This experiment enabling them to describe and correlate the type of thrusting observed during the syn-experimental stage. These first-year students also made connections to the presence of secondary structures such as chevron folds and accretion wedges in their final presentations (Fig. 5).

Both group of the first-year and fourth-year students were provided with datasheets to record measurements during the syn-experimental stage and the instructor and tutors had reminded both groups of students to record their observation and measurement in the datasheet. However, the first-year students were only able to measure the length of the shortening that occurred before and after deformation (Fig. 5). They did not measure the changes that occurred during the course of the experiment. This outcome was expected for the first-year group, as their foundational knowledge of geology was still relatively limited at the time this experiment was conducted.



Displacement of crank/force (cm)	Length of the model (cm)	No. of faults	Dip of the youngest fault (°)	Dip of the faults that occurred earlier (°)	Height of the new fault (cm)	Height of the fault that occurred earlier (cm)
0.0	74.8	-	-	-	-	-
9.8	65.0	-	-	-	-	-
15.9	58.9	3	22	-	8.4	-
18.2	56.6	5	21	22	22.4	8.4
21.4	53.4	7	24	21	16.8	22.4
26.3	48.5	8	25	24	19.6	16.8
36.3	38.5	10	40	25	30.8	19.6

Fig. 6. Example from written report of a fourth-year student who participated in this sandbox experiment showing details observation from the experiment conducted, assisted with recording of the measurement for each structural deformation that occurred during the simulation process.

Nevertheless, the fourth-year students had demonstrated the higher level of readiness in data collection by recording various measurements in the provided data sheets. This included data on the length of the model, the presence of faults, dipping angles, changes in dip angle, and the height of the structures. Their readiness and commitment to the experiment were clearly evident. In particular, the fourth-year students from the Geodynamic and Basin Evolution course delivered well-written reports that exhibited the qualities of scientific reporting from data recording, error analysis, observation and evaluation of the results (Fig. 6).

4 Conclusion

Overall, sandbox experiments offer geoscience students an interactive and practical approach to learning about geological processes. Through participation in these experiments, students gain a deeper understanding of Earth's structure, processes, and the mechanisms involved. Ultimately, these experiments enhance their skills and abilities as future geoscientists.

The findings of this study have shown that the integration of an analog sandbox simulation into geoscience education offers an exciting and engaging learning environment. The analog sandbox has the potential to enhance student engagement, deepen conceptual understanding, and ignite a passion for geoscience. This is achieved by combining hands-on manipulation, spatial and temporal problem-solving, and collaborative learning. The focus on learning outcomes related to the sandbox experiment for both beginner and advanced-level students can be considered a success. The majority of students agreed that the application of the sandbox in geoscience education enabled them to visualize real-time tectonic settings. Still, based on the quality of the final assignment submitted by these two groups of students from beginner and advanced levels, it revealed that a solid geological fundamental and geoscience background is important and necessary for the students to grasp the technical concepts behind the sandbox model experiment.

As an interactive learning activity, the sandbox provides an enjoyable method for first-year students to visually comprehend the formation of geological structures covered in their lectures. The sandbox model experiment has evolved into a valuable learning tool within the geoscience education system and is likely to remain so in the foreseeable future. This is due to its ability to foster a bidirectional relationship between the study of geoscience and spatial visualization skills, offering an interactive method in exploring geoscience knowledge that surpasses conventional teaching methods. Further research and development efforts are required to investigate the specific applications and pedagogical strategies associated with integrating the analog sandbox into geoscience curricula in order to ensure its successful implementation and continued effectiveness in educational settings.

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Interactive Learning for Linear Algebra Using Augmented Reality as Visualization Approach

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Abstract. This research paper presents a comprehensive exploration of the integration of augmented reality (AR) technology in the context of matrix visualization for mathematics education focusing on Linear Algebra (LA). The objective is to investigate the potential of AR as a tool for enhancing understanding and interaction with matrices thus promoting a deeper comprehension of abstract mathematical concepts. AR enables learners to visualize matrices in a three-dimensional space, creating an immersive and engaging learning experience. The interactive nature of AR allows users to manipulate and explore matrices consequently facilitates a hands-on approach to learning. Various matrix operations, including matrix multiplication, transformation, and determinants, can be visualized and interacted with in real-time. The paper highlights that the integration of AR technology in mathematics education fosters a deeper understanding of matrix concepts and their practical applications. By bridging the gap between abstract mathematical representations and real-world scenarios, AR facilitates a more intuitive grasp of matrix operations and their relevance in various fields. The findings of this research paper emphasize the transformative potential of AR in mathematics education, providing educators and learners with an innovative approach to enhance the understanding and visualization of matrices. The insights gained from this study contribute to the growing body of knowledge in the field of AR-enhanced mathematical visualization and pave the way for further research and development in this domain.

Keywords: Augmented Reality · Visualization · Linear Algebra · Interactive Learning

1 Introduction

Linear algebra (LA) is a branch of mathematics that deals with the study of vectors, vector spaces, linear transformations, and systems of linear equations. It provides a powerful framework for solving problems involving multiple variables and equations. The field is vast and finds applications in many areas, including physics, engineering, computer science, finance, economics, and data analysis. The ability to understand and apply LA

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concepts is crucial for students pursuing degrees in these disciplines [1]. Learning LA can be challenging for many students. One of the reasons is the abstract nature of the subject. LA, as one of the most abstract strands in mathematics, often poses difficulties for students [2]. Students may struggle with understanding algebraic concepts and notations, as well as translating real-world problems into mathematical language. This difficulty can further hinder their ability to solve algebraic problems and develop a strong foundation in linear algebra. Learning Linear Algebra geometrically remains a challenging task, because it requires visualizing abstract concepts such as matrices and vector spaces. To address these challenges, the use of augmented reality as a visualization approach in learning linear algebra has shown promising potential. Using visualization approach in teaching and learning increases the learning interest and academic performance of students [3, 4]. Augmented reality is a technology that overlays digital content in the real world, providing users with an interactive and immersive learning experience. Augmented Reality (AR) in mathematics enables human-computer interaction by augmenting 3D virtual information in a real-life environment thus giving the user a natural learning experience [5]. The use of AR in various fields has many benefits, including practicality, transparency, knowledge comprehensiveness and interactivity [6]. By using augmented reality, students can visualize abstract concepts more tangibly [7]. AR can be a powerful tool for visualizing and exploring concepts in linear algebra thus enhancing the understanding of linear algebra. For example, in learning about vector spaces, students can use augmented reality to see vectors and their operations in a three-dimensional space.

This visual representation can help students grasp the geometric interpretation of linear algebra concepts, which is often difficult to comprehend through traditional textbook explanations.[8] Additionally, augmented reality can provide students with interactive and hands-on learning experiences. For example, students can manipulate virtual objects and perform operations on them in real time using augmented reality applications. These interactive activities promote active learning and engagement, allowing students to explore linear algebra concepts more intuitively. Research has shown that augmented reality can effectively enhance students' understanding and retention of abstract scientific concepts [9, 10]. Furthermore, augmented reality can adapt to students' individual learning needs and pace.

By allowing students to interact with the content at their own pace and providing personalized feedback, augmented reality can cater to different learning styles and preferences. In a study, it was found that students who used augmented reality for learning linear algebra demonstrated improved understanding and engagement compared to those who relied solely on traditional instructional methods [11]. These findings suggest that incorporating augmented reality into the teaching of linear algebra can be a valuable tool for educators to enhance students' learning experiences and outcomes. Furthermore, augmented reality can provide real-world applications and examples that connect linear algebra to other subjects and disciplines. For example, augmented reality can be used to simulate real-life scenarios where linear algebra is applied, such as in engineering or computer science [12]. This interdisciplinary approach can help students see the practical relevance and importance of linear algebra in various fields, motivating them to engage more deeply with the subject.

There are several possibilities for visualizing linear algebra concepts using augmented reality. Firstly, vector visualization where AR can overlay virtual vectors onto the real world, allowing users to see and interact with vectors in three-dimensional space. This can help in understanding vector addition, scalar multiplication, vector projections, and other vector operations. Users can manipulate the vectors in real-time, observing how they change and interact with each other. Secondly, matrix transformations where AR can illustrate matrix transformations by overlaying virtual objects onto real-world scenes. Users can visualize how objects deform, rotate, or scale when transformed by different matrices. This can aid in understanding concepts such as rotation matrices, shearing, and scaling transformations. Thirdly, eigenvector and eigenvalue visualization where AR can represent eigenvectors and eigenvalues as virtual arrows, or lines superimposed on objects in the real world. Users can observe how the objects behave when transformed by the corresponding eigenvectors, providing insights into the concepts of eigenvalues and eigenvectors. Fourthly, system of equations visualization where AR can display a system of linear equations in a real-world context. Users can visualize the equations as virtual planes or surfaces and observe how they intersect or coincide. This can aid in understanding concepts like the solution space, inconsistent systems, and dependent systems.

As an interactive learning tool, AR can provide interactive learning experiences, where users can explore various linear algebra concepts through virtual simulations and games. Users can solve puzzles, manipulate virtual objects, and interact with visual representations of vectors, matrices, and transformations. The immersive and interactive nature of AR can enhance the learning experience, allowing students to grasp abstract concepts more intuitively and engage in hands-on exploration of mathematical ideas.

2 Augmented Reality for Visualization

Augmented Reality (AR) is a powerful tool that can assist individuals in understanding concepts related to 3D object manipulation derived from linear algebra. The followings are how AR can assist in this area:

2.1 Visualization of Transformation

The primary strength of AR lies in its ability to visualize different linear transformations and demonstrate how they affect 3D objects by performing operations such as translation, rotation, or scaling on virtual models. These dynamic features result in a better understanding of linear algebra concepts and the ability to grasp them quickly.

2.2 Interactive Manipulation

Augmented Reality's interactive manipulation tool provides users with the opportunity to apply linear algebra operations directly to 3D virtual objects for an enhanced learning experience.

2.3 Real-Time Feedback

Users can use matrix multiplication or vector addition to manipulate and transform virtual objects in real time. As a result of this interactivity users gain insight into how linear algebra concepts have a direct effect on the behavior and appearance of 3D objects.

2.4 Comparative Analysis

AR enables comparative analysis by offering side by side displays of variously transformed versions of an object: allowing learners to compare different rotational matrices or scaling factors simultaneously.

2.5 Guided Tutorials

This has become a fundamental component for beginner learners using AR applications providing step by step guided tutorials that visually demonstrate through interactive examples within the AR environment.

Visualization tools have the potential to demonstrate different transformation methods with manipulation of virtual objects in real time to learn linear algebra principles in an immersive and unique learning method. The integration of visualizations, interactivity, real-time feedback, comparative analysis, and guided tutorials via AR technology can facilitate a richer understanding of how linear algebra impacts the manipulation of 3D objects and thereby enriching the learning experience.

3 Visualization Framework Development

Unity 3D is an effective tool when it comes to creating mathematical visualization tools because it offers robust capabilities for building interactive designs with dynamic representations of complex concepts. Listing the steps considered to design visualization framework:

3.1 Scene Setup

Started by creating a scene where visualization will take place consisting of elements such as lighting, cameras and any other assets that will aid the visualization. For that purpose, first 2D scenes are developed with basic interactivity to get functionality developed as shown in Fig. 1. Once functionality is validated, scenes are ported to AR.

3.2 Mathematical Modelling and Mapping

Defined mathematical model and determined the most effective equations, formulas or algorithms that will generate the data for visualization. Then visualization is mapped all relevant mathematical data to visual elements within Unity as shown in Fig. 2. For example, the first column of a 3×3 matrix becomes the basis vector for the x-axis (Ix, Iy, Iz) and the same for the y-axis and z-axis as given below.

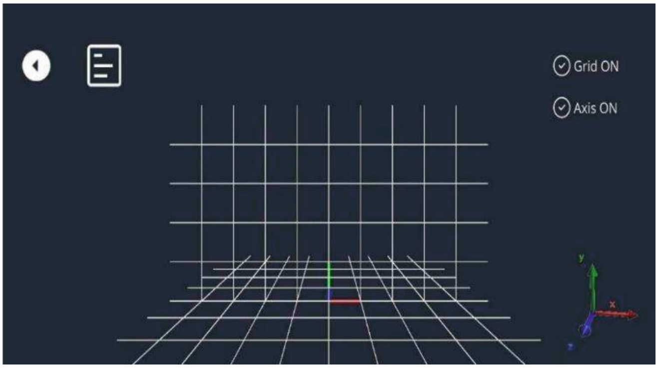

Fig. 1. Non-AR Interactive 3D Cartesian Plane

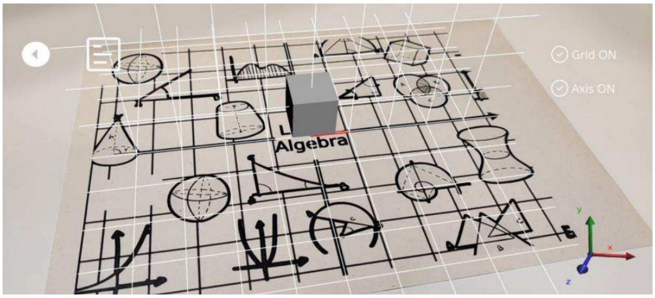

Fig. 2. Sample Activity with Identity Transformation Matrix Applied to Cube

1. Translation: In order to apply a translation to an object user needs to modify the values in the fourth column of the matrix, which represents the translation vector. By adjusting these values user will be able to move the object along the x, y, and z axes.
2. Rotation: This can be achieved by altering the values in the upper left 3×3 submatrix of the transformation matrix. Each row and column correspond to an axis (x, y, and z) and by modifying the values in these rows and columns user can rotate the object around its respective axes.
3. Scaling: Scaling operations are performed by modifying the values in the diagonal elements of the upper left 3×3 submatrix. The scaling factor for the object can be determined by uniformly or independently adjusting these values along the x, y, and z axes.
4. Shearing: Shearing involves making changes to the non-diagonal elements of the upper left 3×3 submatrix. This process skews or distorts the object along one or more axes. Resulting in deformation or perspective effects.
5. Projection: In perspective projection, the transformation matrix includes modifications to convert 3D to 2D screen space. This involves adjusting the values in the fourth row of the matrix.

   It is important to note that manipulating a 4×4 transformation matrix requires an understanding of matrix operations such as multiplication, addition, and inversion.

By applying these operations correctly, user can create complex transformations that combine translation, rotation, scaling, shearing, and projection to achieve the desired visual effects in a 3D environment.

3.3 Interactivity

Visualizations are designed with dynamic and enhance understanding of mathematical concepts using interactive animation using object movement, transformation or transitions whilst creating an environment allowing users to manipulate parameters or explore different scenarios.

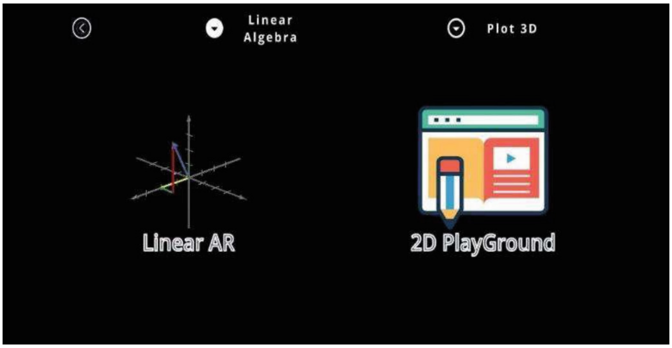

Fig. 3. Main Activity Scene of Application

The main menu of a Unity application serves as the hub for navigating different sections and functionalities within the application. It typically includes various interactive elements and options that allow users to access different features and modes as shown in Fig. 3.

3.4 Design

Designing an interface with relevant controls & settings which reflect mathematical visualization is essential in enabling users to attain desired results. This can feature components like buttons and sliders for adjusting variables, changing display options, or analyzing data. To demonstrate a scaling transformation, interactive 3×3 matrix is provided to user modifying which basis vectors undergo a linear transformation that modifies their lengths while preserving their directions. In this case, the length of the x-axis basis vector is scaled up, while the y-axis basis vector remains unaffected. The x-axis basis vector retains its original length and direction, shown as a horizontal arrow. However, the y-axis basis vector is scaled up, indicating the impact of the linear transformation. The magnitude of the scaling can vary based using 3×3 matrix (Fig. 4).

3.5 Graphs

Graphs, charts, and custom plot representations provide greater visual context by providing clearer insights additional libraries besides default options available from Unity can

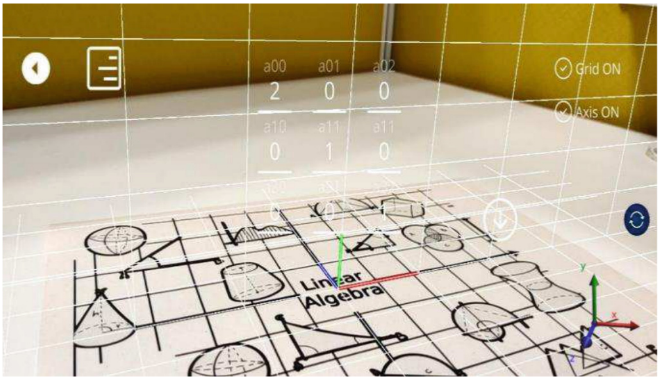

Fig. 4. 3 × 3 Transformation Unity Activity to Scale Basis (i, j, k) Vectors

be utilized too. For example, Fig. 5 visually represents this shearing effect by showing the transformed basis vectors. The x-axis basis vector remains unaltered, depicted by a horizontal arrow. However, the y-axis basis vector is shifted horizontally, indicating the shear transformation. The degree and direction of the shear can vary depending on the specific parameters of the linear transformation applied. This diagram illustrates how linear transformations can be utilized to manipulate basis vectors and introduce shearing effects in a coordinate system. It serves as a visual representation of the concept, aiding in understanding the geometric implications of linear transformations in two-dimensional spaces.

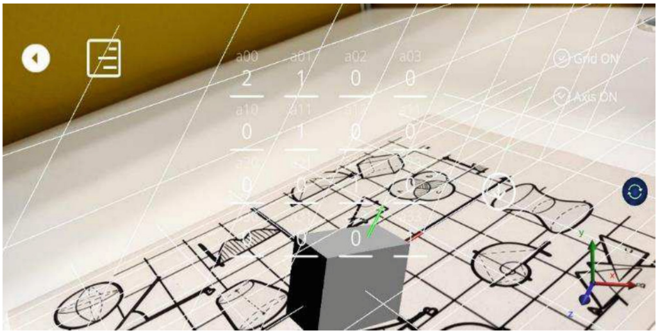

Fig. 5. 4 × 4 Transformation Matrix to Shear Basis (i, j, k) Vectors and 3D Object (Cuboid)

3.6 Annotation and Text

Adding helpful annotations to provide formal explanations for additional insight may help users understand more about mathematical concepts as shown in Fig. 6.

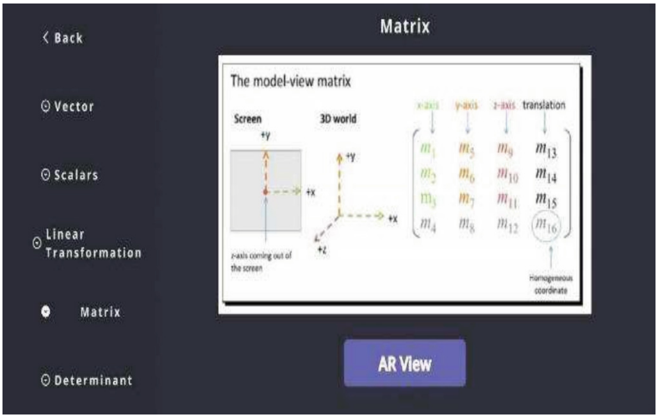

Fig. 6. Linear Algebra activities to start a scene with AR view.

3.7 Testing

During any visualization tool development, regular testing sessions to finetune overall performance responsiveness alongside effectively checking accuracy usability should always be favored. For optimal performance of your mathematical visualization tool, obtaining input from users or domain experts can assist in refining and improving its ability to convey theoretical concepts precisely.

It is important to remember that efficacy lies in accurately capturing theoretical equations and providing clear visual aids when exceeding educational goals through this software. Accordingly, expert advice could lend itself towards ensuring accuracy while contributing significant educational value.

4 Reviews from Educators and Students

Following the experimental phase, 24 participants including students and educators from Computer Science Engineering Department, Chitkara University, India and educators from Universiti Teknologi PETRONAS, Malaysia provided feedback on their experience with the augmented reality-based visualization application for learning transformation matrices. The recorded observations from the students include the following:

> "I must express how much of a gem augmented reality app is for visual learners like me. The way it uses AR to bring linear algebra concepts to life is astonishingly amazing. The ability to interact with matrix multiplication and witness their transformations in real time has made this subject so much more accessible and exciting for me".

> "It has undeniably sparked a newfound love for linear algebra within me".

> "The incorporation of augmented reality in visualizing vectors, matrices, and transformations is truly groundbreaking. This technology has profoundly enhanced my understanding of the subject matter and significantly increased myself assurance".

"If you find yourself grappling with linear algebra. I highly recommend giving this app a chance as it is sure to surpass your expectations."

5 Conclusion

Matrices are crucial mathematical concepts used in a variety of fields such as data analysis, computer science, mathematics, & physics among others. Augmented Reality (AR) integrates this abstract mathematical concept into the authentic everyday world through immersive encounters. Enhancing the understanding of this scientific model improves as one interacts with it in a three-dimensional space. This improved comprehension sparks creativity intended for mathematics, engineering, science, among other related disciplines.

With Augmented reality technology, witnessing matrix matrices is like having a live representation of mathematical operations. This technology enables the overlaying of virtual content (matrices) onto the physical world creating an exceptional visual learning experience. Matrixes appear as floating 3D concepts projected over flat surfaces or integrated into the learners' environment allowing for interactive and immersive learning. This feature creates a blended reality where you can see and engage with matrices in all dimensions.

Incredible AR features that make understanding matrices more accessible to learners include adjustable size and shape of the matrices according to critical elements or specific visualization preferences required by teaching staff. Users can change angles at which they view or manipulate matrices for better understanding, zooming into specific elements in real-time making interactions three-dimensional and dynamic.

AR technology bridges the gap between abstract engineering concepts & their applications in everyday life such as cell phones, motors, & cars. It offers enhancements such as visual cues& annotations. Through this platform, students interact with scenarios by adjusting matrix dimensions or parameters observing their overall impact on visual representational variations. AR integration encourages creative solutions development, and intuitive matrix understanding across different fields nurturing a deeper appreciation of complex math concepts' power in solving real-world problems.

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Implementation of Microlearning Along with Problem Based Learning to Improve Students Performance: A Review

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Abstract. This article examines how problem-based learning (PBL) along with bite-sized learning known as microlearning has been implemented and how it has affected students' performance. In order to tackle complicated problems and deal with real-world circumstances, PBL is a crucial component of courses with higher cognitive levels according to the Bloom taxonomy. The lengthier duration of PBL, particularly for project-driven courses, may raise some questions about the effectiveness and efficiency of students, particularly if they are working in groups. When PBL is combined with other techniques, student creativity and productivity can be increased. When used in conjunction with PBL, microlearning in the form of quick videos, tests, and lectures between lessons increases student motivation and improves their understanding of a specific tutor-posted topic. Various aspects of the motivational impact of emerging new technologies, mobile learning and other research are covered.

Keywords: Microlearning · Mobile Learning · Problem based learning

1 Introduction

Technology advancements like smartphones and e-learning are inspiring us to use innovative teaching methods. To effectively handle the emerging requirements in the digital era, the teaching methodology should be effective. Collaboration, active learning, and instructor presence are all strongly related to how effectively and motivated students are in online courses to handle challenging issues [1, 2]. According to some study, when compared to traditional education, online learning is just as successful at improving students' exam scores. Other studies show that pupils receiving traditional education did better than those in the online segment. A reference or theory that is demonstrated in the application of education, which is based on interpersonal interactions in social life, is the educational learning process. Education is a process of contact between two people (teachers and pupils), or even between two generations, which enables the younger generation to grow. In educational activities, self-development takes place. As a result,

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instructional activities can be carried out in a family, school, or community setting. The learning model, according to Nurulwati [3], is a conceptual framework that can methodically describe the steps for organizing learning experiences to achieve specific learning objectives. It also acts as a guide for learning designers and teachers in planning teaching and learning activities. One of the successful techniques used by several researchers over the past few years is problem-based learning (PBL). Using actual problems from the real world as a starting point, the Problem Based absorbing (PBL) paradigm helps students develop their critical thinking and problem-solving skills while also absorbing facts and concepts. The basis of problem-based learning is a collaborative approach, claims [4]. The way that learners organize their knowledge is by developing arguments based on all the information they have and all the experiences they have had through engaging with others. With problem-based learning, teachers expect that students will be able to address issues with a range of potential solutions and recognize the root causes of current issues.

Nevertheless, despite all of PBL's benefits, there are some drawbacks as well, including inconsistent knowledge acquisition, a lack of training, and a significant time commitment [5]. As a result, different approaches besides PBL must be used in order to consistently impart knowledge and simultaneously inspire the pupils. Microlearning, also referred to as bite-sized learning, is one technique that can be utilized for this goal. The following [6, 7] are a few ways that microlearning can be implemented.

- Conventional learning materials divided into smaller modules.
- Short collaborative quiz, infographics, gamification, etc.
- Short videos, E-learning, technology based short videos such as Augmented Reality (AR), etc.

Some academics have advocated the use of hybrid or blended instruction in response to the argument over the effectiveness of online versus traditional teaching. This kind of training is thought to combine the benefits of both online and traditional instruction while also putting an end to the lengthy argument. However, contrary to what is frequently said in the literature, hybrid training would not always integrate the advantages of both styles of instruction. Instead, if its application is not based on solid and reliable theoretical foundations, it may possibly combine the deficiencies rather than the positives. Therefore, it's critical to realize that instructional design and pedagogy play a major role in how effectively students are taught, regardless of the use of technology. Using instructional technology should complement pedagogy since it serves as a tool rather than a goal in and of itself. Consequently, an effective hybrid teaching considers questions like "what" learning activities are conducted "where" by maximizing the advantages of both in-person interactions and technology. In order to be easily understood and retained for a longer period of time [9, 10], the efficiency with which the microlearning information is developed must also be correct [8]. Additionally, it should be remembered that each learner has a varied level of learning capacity. According to Hermann Ebbinghaus' forgetting curve, one benefit of microlearning is that pupils can retain the information for a very long time, as illustrated in Fig. 1. Microlearning does have some restrictions and drawbacks, though. Unstructured microlearning materials have a negative impact on learning time and cause students to spend more time learning [11]. Furthermore, using microlearning techniques alone to solve complicated issues and scenarios is challenging.

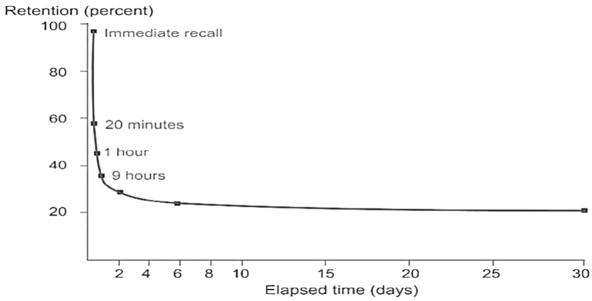

Fig. 1. Ebbinghaus' Forgetting Curve [12]

2 Implementation of PBL and Microlearning

Numerous studies looked at how PBL affects students' motivation [13–15]. In these studies, several parameters have been examined. The findings of these studies demonstrate a direct correlation between students' motivation and performance and their prior knowledge, the difficulty of the issues, and the effectiveness of the tutorial group. Through group performances, tutor performance and problem quality had an indirect impact on interest. The casual PBL model is depicted in Fig. 2 [14, 16]. The image illustrates the relationship between past knowledge and achievement as well as interest in the subject matter. However, the quality of the problems and the tutor's performance have a direct impact on how well the group functions, which results in higher achievement and more efficiency (time spent on individual study). The outcomes also demonstrate a direct correlation between problem quality and subject matter interest. According to these findings, engaging problems is crucial for motivating students.

2.1 Microlearning: Emerging Educational Technologies

Numerous publications have been published on microlearning-based instruction that uses a variety of technologies, including social media, e-learning platforms, and smartphone applications [26–35]. These studies demonstrate that microlearning has a greater impact than traditional learning methods in terms of reducing learning time, increasing accuracy, and boosting student productivity during the stages of knowledge acquisition and analysis. The improvement in cognitive efficiency after exposure to the microlearning approach is much more pronounced at the higher level of cognition [21].

Another recent innovation in technology-based education is Augmented Reality (AR) and Augmented Virtuality (AV) inside Mixed Reality (MR). Paul Milgram's [36] relationship between augmented reality and virtual reality is depicted in Fig. 3. Over the past few years, augmented reality has been developed for a variety of courses and as microlearning. For instance, in addition to mobile learning, Cai and Chen [37] experimentally studied AR technology. They utilized AR-based microlearning techniques. The focus of their computer science research was on college students' CPU and hardware. It was demonstrated that while combining AR technology with mobile learning can enhance learning, there are still technical hurdles that must be overcome in the future before the full potential of this technology can be realized.

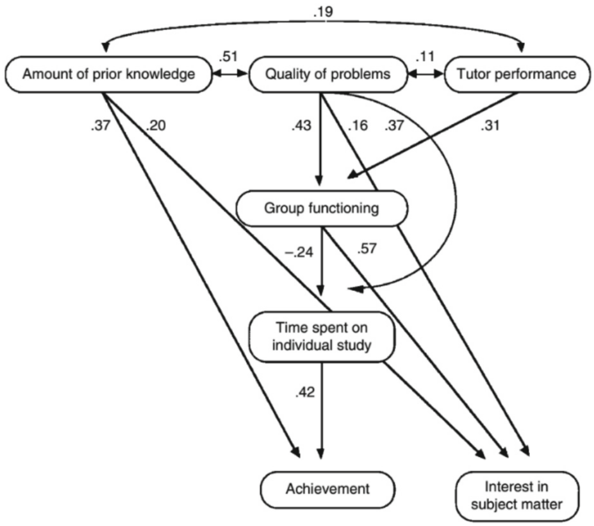

Fig. 2. PBL model by Schmidt [14, 16]

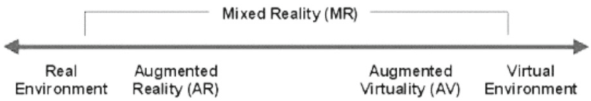

Fig. 3. AR and VR links defined by Milgram [36]

Microlearning has also been used in addition to blended learning strategies. One of the most effective techniques for blended learning, which combines in-person and online instruction, is the flipped classroom. However, there are some issues with the flipped classroom that can be resolved by combining with the microlearning technique, such as the lack of interaction and incentive for pre-class tasks caused by poor online instruction design [38]. Several techniques and formats are utilized in the microlearning process:

- Applications: Statistics show that among Android users, educational apps are the second most popular, while among iOS users, they are the third most popular. They enable you to use all the methods of contemporary microlearning to transform a smartphone into an educational facility.
- Videos: They combine the benefits of both audio and visual content, enabling you to convey information quickly and clearly. The impact of brief video snippets with focused information and entertaining aspects is stronger than that of written sources. Such content is also simpler to disseminate.
- Games: studies from multinational team from Greece, Finland and China found that gaming boosts educational effectiveness by over 35%. Quick, five-minute games enable students to remember and repeat the material that has been studied and adding daily goals, ratings and challenges keeps the process active.
- Infographics: The information is more memorable because of its visual format, which enables quick understanding of the issues addressed.

- Social media: In addition to ensuring quick content delivery, its application in the learning process encourages the growth of a group of like-minded individuals.

3 Conclusions

The application of PBL and microlearning is examined in this research. When used alone, PBL has some drawbacks, including the requirement for a lot of time and training, which deters students from using the method since they lack desire. Microlearning can, however, be used in conjunction with PBL to boost motivation and success. The literature review covered the relationship between the amount of time needed, learner motivation, prior knowledge, and achievement. Additionally, bite-sized lectures can be presented utilizing several forms, including augmented reality, blended learning, the flipped classroom, quizzes, and gamification. The process of problem solving instructs or prepares students to be able to solve issues in accordance with the scientific discipline they are learning. Students who learn problem-solving skills will be able to construct their prior knowledge with fresh information discovered in groups in order to solve challenges that correspond to the reality in the classroom setting. Students learn environmental sensitivity, issue-reading skills, and how to strive to discover the best answer to a problem through problem-solving. With the aid of real-world situations, students can learn how to think critically, develop problem-solving abilities and absorb important facts and ideas from educational materials in the framework of problem-based learning. PBL teaches students how to respond to a problem and attempt to discover a solution by exercising critical thought, conducting analyses and organizing actions to address problems methodically. To enhance student learning outcomes, teachers might substitute problem-based learning and problem-solving learning models into the teaching and learning process. Motivation, prior knowledge, and achievement. Additionally, bite-sized lectures can be presented utilizing several forms, including augmented reality, blended learning, the flipped classroom, quizzes, and gamification. The process of problem solving instructs or prepares students to be able to solve issues in accordance with the scientific discipline they are learning. Students who learn problem-solving skills will be able to construct their prior knowledge with fresh information discovered in groups in order to solve challenges that correspond to the reality in the classroom setting. Students learn environmental sensitivity, issue-reading skills, and how to strive to discover the best answer to a problem through problem-solving. With the aid of real-world situations, students can learn how to think critically, develop problem-solving abilities and absorb important facts and ideas from educational materials in the framework of problem-based learning. PBL teaches students how to respond to a problem and attempt to discover a solution by exercising critical thought, conducting analyses and organizing actions to address problems methodically. To enhance student learning outcomes, teachers might substitute problem-based learning and problem-solving learning models into the teaching and learning process.

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Investigating the Impact of the Learning Management System Usage on the Students' Performance for Object-Oriented Programming Course

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Abstract. Learning Management Systems (LMS) are pivotal in contemporary education, enhancing curriculum delivery and course management. Their multifaceted tools and features allow educators to craft a dynamic and interactive learning experience tailored to meet diverse student needs and preferences. Furthermore, the analytical capabilities of an LMS provide invaluable insights from student engagement and usage data, potentially revolutionizing teaching and learning processes. This research delved into the LMS usage patterns for a specific course, seeking to discern its influence on students' course performance. Engagement data related to various course activities and resources within the LMS were extracted and analyzed. Descriptive statistics were employed to interpret the findings. Notably, a positive correlation emerged between high LMS usage and superior student performance. However, this correlation was absent in the low and medium usage groups. These results underscore the importance of adeptly integrating LMS into course delivery and the value of harnessing LMS analytics data.

Keywords: Learning Management System (LMS) · LMS analytics · LMS usage · LMS engagement · students' performance

1 Introduction

The advent of digital technology in education has triggered a paradigm shift in the way educational outcomes are tracked, measured and analysed. One such innovative approach to education that has gained momentum in recent years is learning analytics from the Learning Management System (LMS). This system leverages students' digital data to enhance engagement and instructional out-comes [1]. LMSs serve as a conduit for student engagement, enhance cognitive retention [2], and provide platforms for capturing data about student engagement, thus offering opportunities to identify at-risk students [3]. This underscores the role of the LMS as a potential tool for improving cognitive outcomes in students.

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Despite the increasing utilisation of LMS in online education, several studies have not explored potential changes in student engagement over time [3]. This suggests a significant research gap that future studies should aim to address. The number of interactions with the LMS has been found to be a reliable indicator of student performance [4]. This implies that analysing LMS data could potentially help educators track students' learning progress in real-time, further aiding the development of effective pedagogical strategies. Thus, harnessing the power of learning analytics and LMS could revolutionise the way student achievement is measured [5].

This study seeks insights into the association between LMS utilisation and students' performance using LMS analytics data related to course activities undertaken by students. Usage data from the LMS is examined and analysed to determine the usage level for a selected course. This data is then employed to investigate the relationship between usage levels and student performance. The results of this study aim to provide an insight on the necessity and significance of integrating LMS effectively into teaching and learning strategies.

2 Background

2.1 Learning Management System (LMS)

A Learning Management System (LMS) is a digital platform enabling educational institutions to manage, deliver, and track educational courses and training pro-grams. More than just a content delivery system, an LMS serves as a virtual class-room, fostering student participation, facilitating interaction and collaboration, and offering a plethora of resources. Through the LMS, students can access course materials, engage in discussion boards, take quizzes, submit assignments, and communicate with peers and instructors. The data garnered from these inter-actions allows for the discernment of patterns and trends in student behaviour, shedding light on their levels of engagement and academic participation.

An evolving hypothesis in the educational research landscape suggests a positive correlation between frequent LMS usage and enhanced academic performance of students [6, 7]. Essentially, this hypothesis proposes that students who consistently and effectively engage with LMS tools and resources tend to achieve better learning outcomes and secure higher grades than their counterparts who minimally use the LMS or abstain from it. Interactions within the LMS—whether accessing materials, joining online discussions, or submitting assignments—may be strong indicators of a student's academic trajectory.

This theory aligns with previous research findings suggesting that active participation in learning activities, both in a physical classroom and online environment, contributes significantly to academic success. However, it is important to validate this hypothesis with further research, taking into consideration various confounding factors that may impact a student's academic performance.

2.2 The CSEB3313 Object-Oriented Programming Course

During the 2022/2023 academic session's Semester 2, this study focuses on the CSEB3313 Object-oriented Programming course, part of the Bachelor of Computer

Science programme at Universiti Tenaga Nasional. It involves 34 students from Sect. 1. The course sets three primary learning objectives, enabling stu-dents to:

- Understand the object-oriented principles in system development.
- Apply these concepts in real-world system development.
- Design systems that address various challenges using the object-oriented approach.

Structured as a 3-credit hour course, the teaching methodology blends face-to-face and online lectures, supplemented with hands-on programming labs and group discussions. The intent is for students to firmly grasp object-oriented programming principles. This understanding is facilitated by instructor-led lectures, in-class exercises, group deliberations, and reflective sessions. Diverse code/program examples were meticulously discussed and expanded upon. Hands-on labs further reinforced the teachings, challenging students to create programs addressing specific problems.

For assessment, a mix of quizzes, tests, programming assignments, group pro-jects, and final examinations (both practical and written) were employed. Re-sources for this course encompassed instructor-provided lecture notes, recorded lectures, YouTube tutorials, sample programs, and problem exercises. Most of these materials were accessible to students via the LMS. Within the LMS, re-sources were categorised as 'file', 'folder', 'URL', and 'label', while assessments were tagged under 'assessment' and 'assignment'. The course also integrated external tools like Mentimeter and Padlet via embedded codes to enhance class activities and learning evaluations. By semester's end, the students' performance and achievement were gauged via continuous assessments and final examination results.

3 Method

Our main motivation and objective for the development of this work is to investigate the impact of LMS usage on the students' performance of the course. Every student has their own way of learning and the amount of time they spent on LMS learning activities was also varied. Thus, the hypothesis of this study is the higher frequency usage of LMS correlates positively with the academic performance of students. This implies that students who utilize LMS tools and resources regularly and effectively would demonstrate improved learning outcomes and higher grades in comparison to those students who use the LMS minimally or not at all.

Data for this study was collected via the LMS analytics and students record i.e. grades in this course. Course logs from the LMS show activity within the course and it allows instructors to see what resources are being used and when. They can check to see if an individual student has viewed a specific resource or participated on a specific activity on a specific day. Figure 1 shows the interface of LMS to obtain the course logs. The logs report consists of event context, component and event name of all activities deployed in the course page. In this study, the usage of LMS is described as the frequency or the number of views to the course page's activities by the students throughout the semester. The collected data, which initially comprised over 16 thousand rows of data, then being processed and cleaned using pivot table tools in Microsoft Excel to acquire the information needed for statistical analysis.

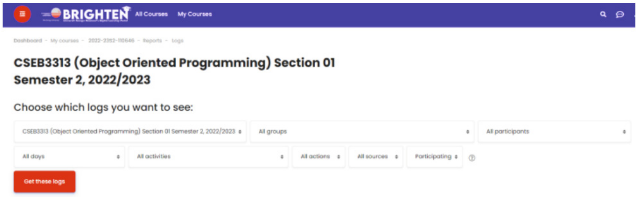

Fig. 1. LMS interface to obtain the course logs.

Any student who did not have a grade or has with-drawn from the course was also removed from the sample. The post-cleaning data consists of a total of 13,297 number of views by all 34 students in this course. Students are then grouped into three groups of different level of LMS usage – high-usage, medium-usage and low-usage, with approximately equal number of students per group - 11, 12 and 11 respectively. Meanwhile, for students' performance, the course grades comprise of 12 grades: A+, A, A−, B+, B, B-, C+, C, C−, D+, D and E. Students who obtained E grade are considered to have fail the course. This study uses descriptive statistics method to analyse and to provide insights from the gathered data.

4 Results and Discussion

4.1 Respondent Background

The total number of students in this study is 34 and the breakdown based on gen-der is as shown in Table 1.

Majority of the students in this course are from year 2 in their studies except some of them are in year 1 because they were entering the programme through diploma qualification.

Table 1. Demographic characteristics of the respondents

Aspect	Characteristics	n (%)
Gender	Male	24
	Female	10

4.2 Descriptive Statistics Analysis

The first analysis carried out was on the descriptive statistics by investigating the number of views of LMS course page activities for each student. Total number of views is 13,297 from the total of 34 students in the studied course, with the range of views is between 201 and 871. The mean is 385.18 (std. dev. = 149.47) and the median is 362. Table 2 shows the pattern of usage by gender of students. The data indicate that, on average, female students (mean = 426.9) engaged with LMS more than the male students (mean = 376.17).

Table 3 presents the usage for each activity adopted in the LMS course page. The activity or component comprises of assessment, assignment, file, file submissions, folder, forum, online text submissions, submission comments and system. The data exhibit that assignment has the highest number of interactions with 4,479 views (mean = 129.62, std. dev. = 56.23), followed by assessment, system, file, and file submissions with 3,173 (mean = 92.15, std. dev. = 51.00), 2,648 (mean = 76.50, std. dev. = 46.14), 2,339 (mean = 67.82, std. dev. = 39.83), and 542 (mean = 15.71, std. dev. = 4.71) views respectively. It shows that the students give their commitment and engagement more to the activities related to the assessment and learning of the course compared to other activities. A lower number of inter-actions are found for folder, online text submissions, forum and submission comments with 69, 36, 7 and 4 views respectively. Since the course was also using an off-LMS communication channel i.e. Telegram, that would be the reason why forum was barely used in the LMS as Telegram would be more convenient for small or casual discussions.

Table 2. LMS usage by gender.

Gender	Total no. of views	Mean (average no. of view per student)	Std. Dev.	Min.	Max	Median
Male	9028	376.17	117.13	201	714	356
Female	4269	426.90	172.19	255	871	385
Total	13297	385.18	149.47	201	871	362

Table 3. LMS usage by activity

Activity	No. of view	Mean (average no. of view per student)	Std. Dev.
Assessment	3173	92.15	51.00
Assignment	4479	129.62	56.23
File	2339	67.82	39.83
File submissions	542	15.71	4.71
Folder	69	2.34	1.95
Forum	7	1.17	0.43
Online text submissions	36	2.40	1.44
Submission comments	4	0.80	0.43
System	2648	76.50	46.14

4.3 LMS Engagement vs. Performance

Further analysis was performed to explore the influence of LMS usage on students' performance by grouping the students into three equal-size groups. The first group represents the high-level usage, the second group represents the medium-level usage, and the third group represents the low-level usage of the LMS. For each group, the grades of the students are analysed and tabulated.

Table 4 shows the course grades that are mapped to the three usage level groups. For the low-usage group, 27.27% obtained A grades (A+, A, A−, 36.37% obtained B grades (B+, B, B−), 27.27% obtained C grades (C , C, C−) and 9.09% obtained D or E grades (D+, D, E). The medium-usage group is constituted by the biggest percentage coming from A grades (33.33%), followed by C grades and D or E grades (25.00%) and the smallest portion from B grades (16.67%). Finally, the high-usage group comprises of A grades with the highest population (54.55%), followed by B grades (36.36%) and C grades (9.09%).

Table 4. Course grade by LMS usage group

Activity	LMS usage group		
	High (%)	Medium (%)	Low (%)
A+	9.09	16.67	0.00
A	9.09	8.33	9.09
A-	36.36	8.33	18.18
B+	9.09	8.33	9.09
B	18.18	0.00	9.09
B−	9.09	8.33	18.18
C+	9.09	16.67	0.00
C	0.00	0.00	18.18
C−	0.00	8.33	9.09
D+	0.00	8.33	9.09
D	0.00	16.67	0.00
E	0.00	0.00	0.00

Figure 2 visualises the course grades achieved by the students in comparison with the LMS usage groups. For the low-usage group, there is no significant influ-ence of LMS usage on the grades that can be observed as grades are distributed in almost all grades. However, none has obtained the best grade A+ in this group.

A similar observation can be found for the medium-usage group although an in-crease in high achievers can be noted. However, for the high-usage group, the result indicates that the LMS usage correlates positively with the students' performance as the A grades (54.55%) and B grades (36.36%) are dominantly contributing to this group. Hence, we found that the higher usage of LMS demonstrates improved academic performance of students in comparison to those students who use the LMS slightly.

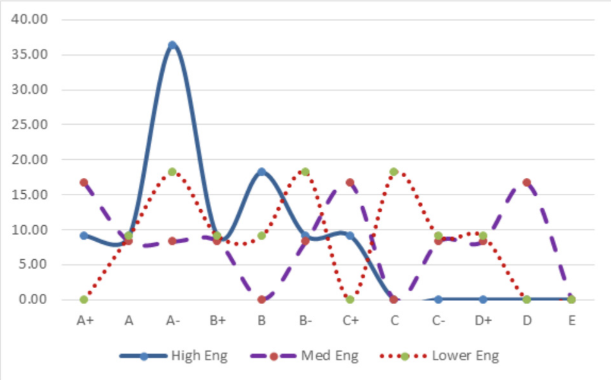

Fig. 2. Course grades in comparison with the LMS usage groups.

5 Conclusion

This study has revealed that the usage of the LMS correlates positively with the students' performance, especially for the high-usage group. The data used in the study was collected from the analytics of the LMS through the course logs. From the conducted descriptive statistics analysis, it showed that the higher us-age or activities performed in LMS using its tools and resources, the better grades the students get. The outcomes indicate the importance of integrating LMS effectively into the course delivery and encouraging students to engage more actively with LMS activities and resources. Leveraging LMS analytics data is advantageous as it could identify students' participation and engagement level with the arranged activities and resources in the LMS. The result also tells us the significance of understanding which features of the LMS contribute most to improved performance and hence can guide the design of a more effective and user-friendly LMS course page.

As there could be various factors that contribute to students' performance, positive correlations found in this study between LMS usage and course grades, do not ascertain the causality. Other factors such as student capabilities, characteristics, motivation, attitude and prior academic achievement could also be influencing the results. Moreover, students who use LMS highly might be more motivated and academically inclined. The study was also zoomed on to a specific course, thus could limit the generalisability of the results to other courses or student populations.

To address these limitations, future research could employ experimental and other qualitative methods to gain deeper insights into students' LMS experiences and motivations. Additionally, using multiple data sources, such as surveys and interviews, can provide a more comprehensive understanding of the relationship between LMS usage and student performance.

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Introducing Artificial Intelligence Through Classroom Debates: A Student-Centric Approach

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Abstract. Learning artificial intelligence (AI) demands students to grasp underlying concepts and cultivate critical reasoning for real-world problem-solving. However, conventional unidirectional pedagogies often struggle to foster these aptitudes. This paper introduces an innovative approach, employing classroom debates as an initial-week activity to familiarize students with AI concepts. Divided into supporting and opposing teams, students are tasked with finding points substantiating their positions. Subsequently, a few students will be selected to engage in the debate, while the remaining act as citizen juries, responsible for voting on the winning team. By fostering an open, explorative atmosphere, this approach allows educators to gauge prior knowledge, nurture critical thinking, and ensure engaging sessions. The effectiveness of this approach was evaluated through a survey capturing student perceptions. The results revealed a positive response, with mean scores for each question ranging from 5.24 to 6.21. Nonetheless, the significant standard deviation across questions underscores varying opinions and view-points. Notably, the question with the highest mean and lowest standard deviation pertains to students' preference for learning through this activity compared to traditional methods.

Keywords: debates · artificial intelligence · student-centric · pedagogy

1 Introduction

As artificial intelligence (AI) emerges as a defining force across industries, equipping students with a foundational understanding not only prepares them for the future but also empowers them to engage critically with the digital landscape. However, the traditional learning method is often dull and fails to empower students to shape their learning experiences. The shift towards a student-centred learning approach in education has garnered positive responses. To enhance students' ability to take control of their learning, various teaching methods have been introduced in classrooms at all levels of study.

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Among these methods, debates are particularly common, especially in language classes. Engaging students in debates encourages active thinking, questioning assumptions, and articulating viewpoints, which are vital for developing a robust understanding of AI. Besides enhancing language proficiency, especially communication skills [1], learners also develop reasoning, problem-solving, critical thinking, and research abilities. Most of the reviewed literature on using debates in instruction [1–5] highlights the development of critical thinking skills. Active student engagement in debates further nurtures critical thinking, especially when students actively analyze and discuss topics [6]. Additionally, Othman et al. [7] emphasized that "through argumentation, reasoning, explanation, and questioning, students felt their critical thinking had improved" (p. 662). Thus, it is clear that integrating debates as part of classroom strategy would ensure that learning would be engaging, interactive and inquisitive.

This paper examines the application of classroom debates as an innovative approach to introducing AI to students. By harnessing the power of discourse, educators can create an environment where students not only gain insights from instructors but also contribute actively to their own learning. Through this approach, students can engage with AI concepts, explore its ethical and practical dimensions, and develop a foundational knowledge that extends beyond mere memorization. This paper discusses an approach to include classroom debates as part of the teaching and learning strategy and investigates students' perceptions of such inclusion.

2 Related Work

Contrary to common practice, the use of debates in instruction is not limited to language classrooms only. Ramlan et al. [4] reported enhanced level of confidence among medical undergraduate students when debates were used as a teaching strategy. Roy and Macchiette [8] examined the relevance of integrating debates in marketing curriculum and concluded that "debate on controversial issues in marketing can innovatively encourage critical thinking in clearly observable ways" (p.272). Apart from that, a study by Brown [2] reported childhood studies students had positive perspectives when debates were included in their modules. The students' positive feedback on debates were mainly related to the opportunity to express them-selves freely, experience collaborative learning as well as develop critical thinking and research skills [2].

Several other reviewed literatures [1, 3, 5, 6] have revealed similar findings on students' positive views on academic debates. The benefits of integrating debates in instruction are perceived well by students and observed by instructors. Keeping in mind the importance of student-centric approach, debates allow students to construct meaning through experience and interactions with other students. Preparing for a classroom debate opens opportunities for cooperative and interactive learning [5]. It was further reported that debates could also enhance learning experience by encouraging content mastery. This is a crucial part whereby students take charge of their own learning as they improve their research and organisation (of information) skills [1–4].

In comparing various debate designs for classroom use, Brown and Wilson [3] found that effective debate designs would allow students to understand differing perspectives other students might have, consider and perhaps change their own personal views as well as develop better skills to use relevant sources for their argument. These designs promote a deeper understanding of diverse perspectives among students, encouraging them to appreciate differing viewpoints. Debates also create an environment where students critically evaluate their own beliefs and potentially revise their positions, fostering intellectual growth. Moreover, these designs emphasize the development of research and argumentation skills, as students are required to find and employ relevant sources to support their arguments. This not only enhances their ability to construct compelling arguments but also sharpens their information literacy and capacity to discern credible sources.

In other words, using debates in instructions helps students to develop in-depth understanding of topics and using such knowledge to prepare sound arguments rather than being spoon-fed and imposed on by their instructors. These findings collectively underscore that debate, with its capacity to nurture critical thinking, foster cooperation, and stimulate active engagement, offers a fitting strategy for introducing AI concepts in the initial classroom setting.

3 Methodology

This study was conducted based on the implementation of a classroom debate in an artificial intelligence course at a public university in Malaysia. The classroom debate took place during the first tutorial session of the semester and has been carried out for two semesters thus far. In total, there were four sessions, two for each semester.

3.1 Class Implementation

In the initial week of this course, students are introduced to the fundamentals of Artificial Intelligence, providing them with a comprehensive preview of the semester's AI curriculum. Traditionally, during the first tutorial session, students were tasked with researching AI-related information and composing concise reports based on their findings. However, this conventional approach was found to be uninspiring and deficient in promoting critical thinking and the development of essential soft skills.

Recognizing the need for a more engaging and interactive learning method, an innovative AI classroom debate was introduced in the first semester of the 2022/2023 academic year. This strategic shift aimed to foster a more dynamic and thought-provoking educational environment, allowing students to actively engage with AI concepts, explore their ethical and practical dimensions, and lay the foundation for a deeper, more comprehensive understanding of the subject matter.

There were a total of 61 and 64 students in the first and second semesters, respectively. This resulted in an average of approximately 31 students per tutorial session. A typical debate session comprises two teams: the supporting team and the opposing team, each consisting of 3 to 4 members. To ensure engagement from all students, the identities of the debaters are revealed only when the debate is about to begin. The flow of the activities and time allocated for each activity is illustrated in Fig. 1.

These activities are designed to unfold as follows:

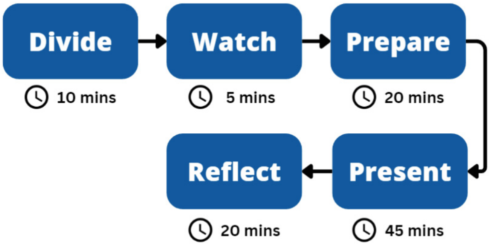

Fig. 1. The flow of the debate activity.

1. **Divide.** Students are divided into 6 groups, with 3 groups supporting the debate topic and the other 3 opposing it. Group assignments were randomly assigned by the instructor.
2. **Watch.** Each group will be asked to watch a 5-min video related to the debate topic. In the first semester, the topic was "AI Having Emotions Does More Good Than Harm" while in the second semester, the topic was "The Benefit of A Smart City Is Far Greater Than The Privacy Loss".
3. **Prepare.** After watching the video, each group is required to conduct research and compile points that either support or oppose the debate topic. At the end of this activity, each group is asked to name one debater from their team. An emcee and a timekeeper will also be appointed to ensure the smoothness of the debate session. The rest of the students will act as citizen jurors, deciding the winner of the debate at the end of the session.
4. **Present.** There are four rounds in the debate session. After the emcee opens the session and explains the rules and regulations, the first round begins, during which each group presents their opening statement. Following that, in the second round, each group can rebut the opposing group's statement and present their own case. In the third round, each group can pose a question to their opponents, who will have 30 s to respond. In the final round, both groups conclude their claims. Different speakers will deliver points in each round. If a group has only 3 members, one member will present in rounds 1 and 4. Each speaker will be allocated 2 to 3 min to present their statements.
5. **Reflect.** Following the debate's conclusion, the citizen jurors will cast their votes to determine which team they believe should win and who the best debater is. To ensure the confidentiality and smoothness of the voting session, Mentimeter, an interactive presentation tool was used. Subsequently, the instructor will take this opportunity to engage in a reflective session regarding the debate. It is acknowledged that not all points shared during the debate may be entirely accurate, and the instructor will identify and explain any inaccuracies. Additionally, students will be guided through a discussion of the topics they explored and shown how they can evaluate their comprehension as they learn the concepts presented in the debate within this course.

To facilitate the classroom debate, the classroom layout will be arranged with either 6 or 8 chairs placed at the front of the class, evenly divided between the supporting, and opposing teams. The emcee, responsible for moderating the debate, will be positioned at the lecturer's table and will stand when addressing the audience. The timekeeper, seated at the front row and facing the debaters, will provide timely reminders, signalling when one minute remains and when the allotted time has concluded. Meanwhile, the remaining students will be seated as the audience, facing the debaters. Fig. 2 shows an example of the classroom layout.

Fig. 2. Example of classroom layout during the debate activity.

3.2 Data Collection

Data collection was carried out through a survey at the end of the session. The survey was developed using a 7-points Likert scale where students will rate each statement as strongly disagree (1), disagree (2), slightly disagree (3), neutral (4), slightly agree (5), agree (6) and strongly agree (7). Based on these ratings, the mean and standard deviation were calculated for each of the questions. A higher mean score for a particular question suggests a more positive overall learning experience as perceived by the students. Meanwhile, the standard deviation score reflects the level of agreement among students in rating the mean score for each question. This allows for an in-depth insight of students' perceptions and the overall effectiveness of the classroom debate approach.

4 Results and Discussion

In the first semester, 35 respondents (57.4%) participated out of 61 students, while in the second semester, 47 respondents (73.4%) took part out of 64 students. Among the total of 82 respondents, 46 were male and 36 were female, with an average age of 21 years old at the time of their responses.

To evaluate the effectiveness of the classroom debate implementation, a survey encompassed of seven questions were handed out to the students. The initial six questions required students to rate their level of agreement using a 7-point Likert scale, while the final question was an optional open-ended question that allows the respondents to provide additional feedback or suggestions. For each question, the mean score and standard deviation were calculated. Overall, the responses from all respondents were positive.

Table 1. Findings for average mean and standard deviation for both semesters (N = 82)

Question	M	SD
Q1. I felt that I could achieve the goal of the activity	5.72	1.31
Q2. I know exactly what / how to response to the question asked	5.40	1.41
Q3. I felt excited to voice out my opinion on the topic	5.35	1.49
Q4. I was absorbed in the discussion that I don't realise the time	5.24	1.38
Q5. The activity helped me in understanding AI better	5.76	1.24
Q6. I prefer learning through this activity compared to traditional methods	6.21	1.12

Table 1 provides a detailed breakdown of all seven questions, each accompanied by its corresponding mean score and standard deviation.

Question 6, with a mean score of 6.21 ± 1.12 and the smallest standard deviation among all questions, stands out as a key indicator of the students' preferences. This high mean signifies a strong consensus among respondents, highlighting that a significant majority of them favor the classroom debate approach over traditional teaching methods when it comes to learning about AI. This sentiment is robustly supported by the qualitative feedback provided by students. For example, one student remarked, "A great method of teaching and learning! Hoping to always have these fun activities in all my studies. Never get bored though". This comment underscores the positive impact of the debate-based approach, emphasizing its engaging and enjoyable nature. Another student noted, "I enjoyed the game while learning AI. It encourages me to study". This feedback reinforces the idea that the classroom debates not only enhance learning but also motivate students to actively engage with the subject matter.

In contrast, question 4 has the lowest mean of 5.24 ± 1.38. This suggests that while respondents find the activity better than the traditional method, there is room for improvement to enhance students' engagement in the discussion. Question 3 displays the highest dispersion and the second lowest mean score of 5.35 ± 1.49. This implies that not all respondents were equally enthusiastic about voicing their opinions on the topic. This divergence might stem from various factors, including lack of confidence, fear of judgment, insecurity about language skills, or even anxiety. Thus, incorporating further initiatives is essential to encourage students to ex-press their thoughts openly.

When comparing the means for respondents in semester 1 and semester 2, there was not much difference, indicating consistent responses. A more detailed comparison is illustrated in Fig. 3. For all questions except question 6, semester 1 has a slightly higher mean compared to semester 2. However, in question 6, the difference is insignificant, with the mean for semester 2 being insignificantly higher. The consistent response suggests that the classroom debate approach is effective across different semesters. It also indicates that the method has a consistent impact on students' perceptions regardless of the specific class composition or semester.

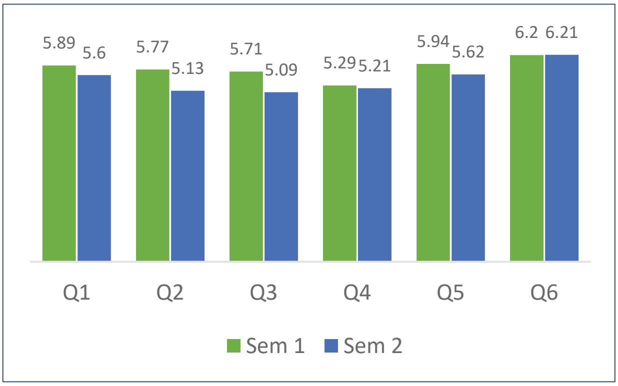

Fig. 3. Mean comparison between respondents from semester 1 and semester 2.

5 Conclusion

The implementation of the classroom debate approach during the initial week of the course has proven to be a highly effective strategy in encouraging students to formulate their initial perspectives on AI-related topics. This acts as a robust foundation for students to embark on the course and piques their curiosity about AI concepts, thereby cultivating their interest in further learning The activity's targeted focus on a specific topic imparts an unforgettable experience to students. Additionally, it nurtures essential skills vital for their academic and professional development. Student feedback has generally been positive, underlining the approach's effectiveness. However, it's important to note that opinions vary on certain aspects, reflecting the diversity of student experiences and expectations. Furthermore, the success of this implementation extends beyond the course itself. It can be applied as an effective ice-breaking session in other courses, fostering critical thinking skills while providing educators with valuable insights into students' prior knowledge of the subject matter. This approach not only enhances engagement but also ensures a more informed and tailored learning experience for students across various subjects.

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Immersive in Mixed Reality (MR) to Support 3D Geospatial in Training Military Decision Making

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Abstract. This research includes application of Mixed Reality (MR) technology, to support and optimized the learning process involved in decision-making process specifically in military field. This research was focused on usability factors that can help in learning decision-making process. Military operations are highly depending on area of operation (coordinate) on the map and Critical Success Factors (CSFs) that can help in making decision and train the military officer to make decision. The gap between operator's behavior and prototype system can be filled with the element of immersiveness of MR. The element of immersiveness of MR is one of the key factors that contribute towards Critical Success Factors (CSFs). Using Mixed Reality (MR) technology, the element of immersiveness can be applied efficiently in the prototype. Map of geospatial terrain is important as a weapon or a piece of survival equipment to the military officers. Maps of geospatial terrain is vital in military since military officers needs to map details as they found when navigate new places. Military will strategist using map in conventional way in the process of locating the position of opponent forces, planning variety of military operations, comprehending key features with distances, locations, heights and good selection of routes. Based on the facts, this research highlighted the application of 3D geospatial terrain and intelligent system since the immersive and visualization will be enhanced by MR. This research embarks on nature of training in military decision-making and capabilities of Mixed Reality (MR) technology by applying the Virtual Reality (VR) and hologram in order to enhance the effectiveness of Situational Awareness (SA) amongst training decision makers' and human-system immersiveness during brainstorming of Course of Actions (COAs) parameters. The crux of this research is to provide effective and efficient ways of comprehending the 3D Geospatial Map Terrain while applying the technology of Mixed Reality (MR) in the process of training the military decision-making.

Keywords: Mixed Reality (MR) · Usability in Interaction · Training Military Decision Making

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1 Research Background

The implementation of Mixed Reality (MR) technology is suitable for use in collaborative situations where the technology is able to help various users manipulate every existing information. Users can visualize, modify and develop ideas, important content and information with just the touch of a finger using Head-Mounted Display (HMD) and gesture (Uhl et.al., 2023). Through the implementation of Mixed Reality (MR) technology, the concept of visualization of the effects of war, can be applied into the content built by applying elements such as diagrams, graphics and illustrations appropriate to the military aspect, creating a system capable of displaying each effects on actions or Course of Actions (COAs) taken either through percentage displays neither in color-coded through constructed visualizations in 3D Geospatial implementation (Ullo et.al, 2019; Gasques et.al, 2021 & Tadlock et.al, 2022).

Thus, Commander (CO) and his sub-ordinates are able to visualize and anticipate each action with appropriate for each Course of Actions (COAs) taken. The Expectation Analysis Module component is identified to stimulate the effectiveness of each decision taken by the Commander (CO). The components developed in the study conducted, are in line with the current needs of the Commander (CO) and his sub-ordinates in training military decision-making. Moreover, the elements of efficiency and user satisfaction have been tested and verified by system usability testing. This usability testing includes: i. Effectiveness of system; ii. Efficiency of System; and iii. User Satisfaction. The visualization aspect in 3D Geospatial has implications for the study conducted. Such aspects are important to identify the features and character traits of data visualization that can truly optimize each piece of information, especially in a collaborative environment. Figure 1 shows training of decision-making cycle to support tactical decisions training.

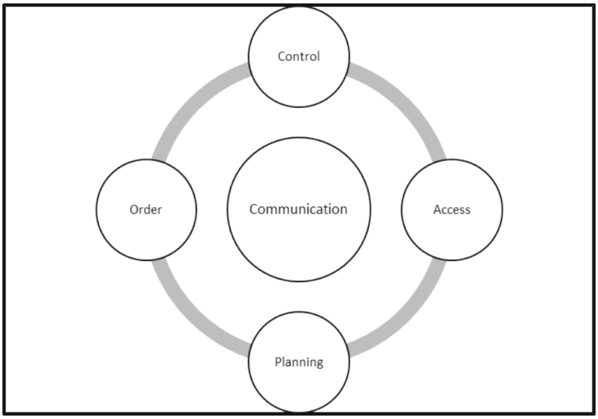

Fig. 1. Training of Decision-Making Cycles in Support of Tactical Decision

Based on Fig. 1, the control process involves Commander (CO) determining objectives as well as controlling the environment if there are any input changes in the ongoing operation. The control process is followed by an access process that involves additions and changes that are deemed necessary in the current context to implement the planning process for consistency in the planning made. The final process involves Commander (CO) instructing his subordinates if there are changes as well as monitoring that needs to be implemented. The life cycle process is an iterative or repetitive process that can be implemented. Therefore, in order to visualize the important details during decision making, the manipulation of 3D Geospatial may offer capabilities of zooming, panning, rotating, 360 view with x, y and z axis (Pavithra, Keerthi et.al, 2020) & (Kaplam, Cruit, Endsley et.al, 2021).

The 3-Dimensional (3D) map terrain can be implemented amongst military to understand the instruction given by the map and aware of the surrounding scenario. The (3D) object in map terrain should follow the physics rule which mean the object should have weight, effect and depth like physical object. This information will enhance the situational awareness (SA) of training in decision-making in order for them to move or locate any decided strategies such as scenario of army and supplies along a paved road than across a series of bush-covered hills and valleys. (LeRoux, 2010) & (Ahir, Govani, Shah et.al, 2020).

2 Research Objectives

This research embarks the following objectives:

- Analyse the Critical Success Factors (CSFs) in immersive of MR to support 3D Geospatial that contributing to the successful of COAs options during the training of military decision-making while implementing the Mixed Reality (MR) technology.
- Evaluate prototypes built (TACE) or the training of military decision-making application through usability testing based on four (4) constructs, namely attributes in MR medium, prototype effectiveness, prototype efficiency and prototype for user satisfaction.

3 Discusion and Findings

In this section, the discussion will be in data findings on the aspect of elements in immersiveness and usability of medium using MR technology. There are four (4) constructs have been tested using the prototype namely as Training for Military Decision Making (TACE).

3.1 Findings on Immersiveness Construct

The results of the study for the Mixed Reality (MR) medium components can be seen in Fig. 2. Based on Fig. 2, there were (61.1%) of respondents agreed and (11.2%) of respondents strongly agreed with the existence of one interaction in planning using MR medium. Respondents argued that Planning and Interaction One was still relevant because such interaction facilitated discussion sessions when instructions only needed to be given by the Commander (CO) without confusing his other sub-ordinates using the medium of MR. While, for communication aspect consists of (38.8%) respondents agreed and (55.6%) respondents were strongly agreed. For the aspect of 360o view/3D Geospatial, as many as (55.6%) respondents agreed and (38.8%) strongly agreed. As many as (66.7%) respondents mentioned agreed that multiple interaction may influence the factors of immersiveness in MR and (27.7%) respondents strongly agreed with this statement. The last aspect in attribute of immersiveness in MR was visualization whereby as many as (44.4%) mentioned as agreed and (33.4%) strongly agreed that MR may assist in terms of visualization.

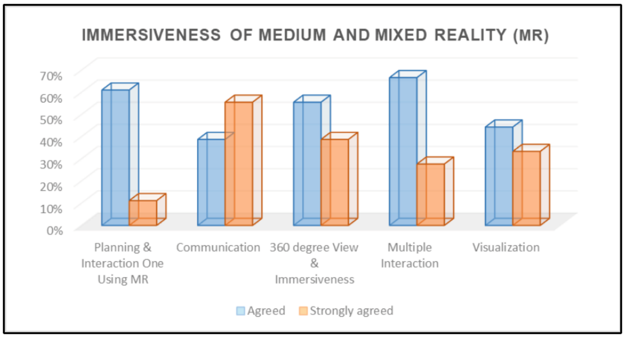

Fig. 2. Percentage of Immersiveness Mixed Reality (MR)

3.2 Usability Testing on Prototype (TACE) for Effectiveness, Efficiency and User Satisfaction Constructs

The findings of the research were obtained through usability testing based on a questionnaire instrument (User Assessment) on the prototype, version Alpha (TACE). The User Assessment Instrument contains three (3) parts, namely: Part I covers aspects of system effectiveness consisting of items EFFE 1-EFFE 12, Part II covers aspects of prototype efficiency consisting of items EFFI 1-EFFI 15 and Part III covers aspects of satisfaction users consisting of USAT 1-USAT 6. Table 1, shows the results of the findings and analysis in the form of mean the usability testing. Meanwhile, Fig. 3, 4 and 5, show the results of the research in the form of percentage (%) for testing the usability of the version Alpha prototype.

Table 1. Findings and Analysis of TACE Usability Test Version Alpha

Effectiveness Construct (EFFE 1-EFFE 12)	Average (Mean) Construct Efficiency (EFFI 1-EFFI 15)	User Satisfaction Construct (USAT 1-USAT 6)
4.333	4.000	4.333
4.000	4.167	3.722
4.167	4.056	4.222
4.389	4.056	4.500
4.389	3.944	4.389
4.778	4.000	4.500
4.389	4.111	
4.444	4.167	
3.944	4.278	
4.611	4.056	
3.778	4.278	
4.500	4.333	
	3.833	
	4.389	
	4.167	

Overall, based on Fig. 3, 4 and 5, it can be seen percentages for the three (3) constructs: i. effectiveness, ii. efficiency and iii. user satisfaction of the prototype version Alpha, show a percentage of over (50%) of respondents who strongly agreed and agreed. Therefore, it can be concluded that version Alpha prototype successfully achieved the component validation objective in the research objectives through its application into the prototype version Alpha (TACE).

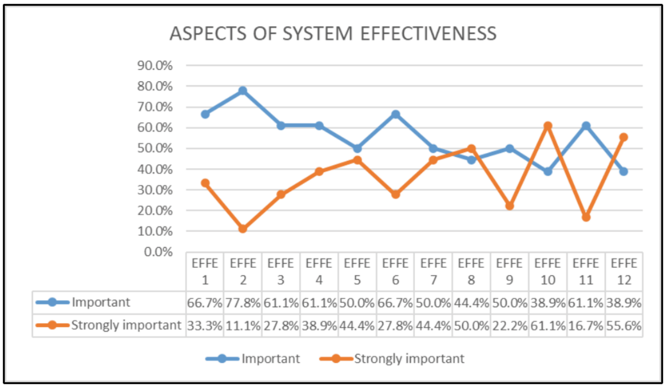

Fig. 3. Percentage (%) of TACE Effectiveness Construct Version Alpha

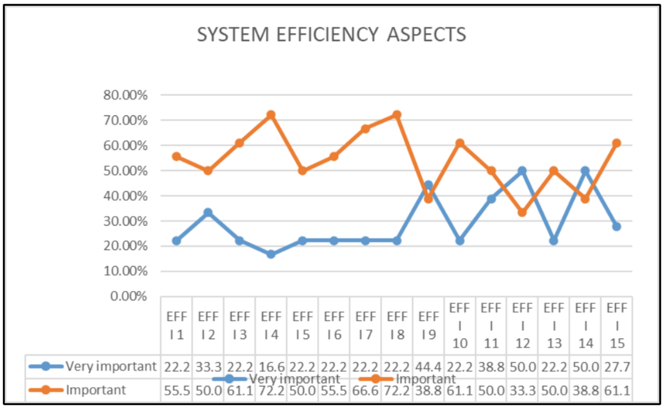

Fig. 4. Percentage (%) of TACE Efficiency Construct Version Alpha

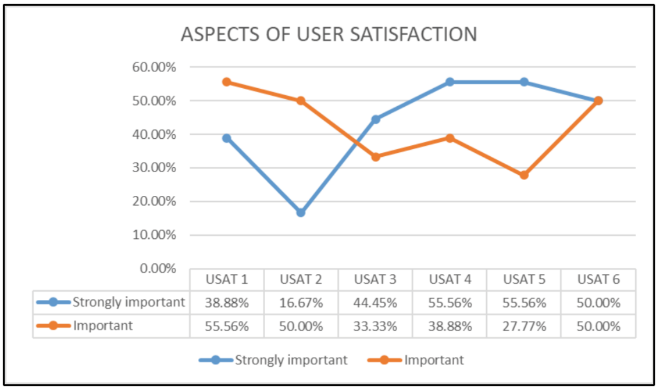

Fig. 5. Percentage (%) of TACE User Satisfaction Construct on Version Alpha

4 Conclusion

There are significant values for attributes in visualization data which is one of its attributes when used with MR medium, has proven to be an effective display for visual highlight for training of decision makers during discussion and mind proliferation sessions. All the findings of the research have been able to confirm the need for components and attributes of immersiveness in MR, to ensure its effectiveness and usability in the training of military decision-making by Commander (CO) and subordinates, through a collaborative environment, using Mixed Reality (MR) medium. The effectiveness of elements and features in Mixed Reality (MR) are analysed based on geospatial terrain. The training of decision-making process in a Command and Control (C2) environment is a process that involves many constraints, especially in terms of time, resources and information used. Management of information needs to be refined and improved from time to time to meet the need to make accurate military decisions. This study has used MR technology as a medium that can provide a collaborative environment to meet the needs of the Commander (CO) and his sub-ordinates when discussing and brainstorming to make effective military decisions.

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Implementing Community of Inquiry Framework in a Blended Learning: Evidence from an Engineering Course

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Abstract. Although the Community of Inquiry (CoI) framework is rarely implemented in blended learning of engineering courses, it is perceived as relevant for the design of these courses. The objective of this study is to investigate the effectiveness of implementing CoI when planning and delivering blended learning in an engineering course. The CoI was implemented using different indicators to depict social, cognitive, and teaching presence in blended learning. The assessment of the CoI implementation in the blended learning substantiated the presence of cognitive, social, and teaching during the blended learning course. The main challenge encountered during the implementation is the limited utilization of discussion forums by students. In conclusion, the outcomes of the study indicate that the deliberate use of the CoI framework has the potential to enhance blended learning in engineering courses.

Keywords: Community of Inquiry · Blended Learning · Social Presence · Cognitive Presence · Teaching Presence

1 Introduction

The field of education has seen a notable evolution in recent years due to the technical breakthroughs in recent years, the extensive integration of digital technology throughout the educational system, and the readily available internet connection [1]. Blended learning has brought about a fundamental transformation in the traditional methods of imparting knowledge to students [2]. Blended learning has been found to enhance the pace, ease, and efficiency of learning as compared to traditional instructional approaches reliant on chalkboard-based teaching methods [3]. Several experts have argued that conventional face-to-face engineering education is no longer sufficient to fulfil the practical learning objectives of students and the future engineering practice demands of engineering students [4–6]. Furthermore, as the engineering program undergoes reforms, the engineering profession is witnessing the emergence of a more diverse range of engineering services and business models. Consequently, engineering graduates are now expected

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to possess not only proficient engineering skills, but also a comprehensive understanding of the dynamics of the engineering profession. Additionally, engineering graduates are required to engage in continuous self-learning, develop cross-cultural engineering competencies, and acquire proficiency in data management, among other essential skills [7]. Nevertheless, the acquisition of these competences solely through conventional teaching methods appears to provide unsatisfactory results, leading to suboptimal learning experiences for students. Consequently, it becomes imperative to investigate novel pedagogical approaches in the realm of engineering education.

The use of a blended learning method facilitates the online accessibility of the theoretical components of the course content, hence decreasing the duration of in-person instruction [8]. Consequently, this leads to a decrease in the duration required for participants and faculty members to be away from the conventional classroom setting. Moreover, a decrease in the duration of courses provides teachers with the opportunity to provide a greater number of courses, hence expanding the pool of individuals they may educate over a given period. Subsequently, this facilitates an augmentation in income generation. The cost analysis studies revealed significant initial expenses associated with the creation of blended learning programs, encompassing expenditures on program developers, online assistance, continuous data administration, and web construction. However, the initial expenses associated with setting up were counterbalanced by substantial and continuous cost reductions for both learners and stakeholders through the implementation of a blended learning methodology. The aforementioned savings are to the reduction in teaching, catering, and facility costs resulting from the decreased requirement for in-person interactions. The aforementioned research has provided evidence to support the notion that a move towards blended learning may have a positive financial outcome. When combined with the corresponding educational course outcomes, this provides evidence of a treatment effect that favours the implementation of a blended learning method.

Despite the numerous advantages associated with blended learning methods, it is important to note that the field of engineering education lacks a sufficient number of studies and empirical research. Studies have shown that blended learning has the potential to enhance the development of certain attributes in students. The Community of Inquiry (CoI) framework, developed by Garrison, Anderson, and Archer [9], offers a valuable theoretical foundation for comprehending engagement and learning within the blended learning context. This framework centres on the creation of an online educational setting that cultivates critical thinking and active participation by emphasizing cognitive, social, and teaching presence. Over the course of thirty years, the CoI framework has gained significant recognition as a prominent educational framework utilized for elucidating and facilitating the development of efficient online learning [10, 11]. In this study the implementation of CoI in a Blended Learning engineering course is investigated.

2 Methodology

The researchers gathered data pertaining to the participants by administering a demographic questionnaire, and the CoI [12]. The demographic questionnaire was designed to gather information on several demographic factors, including age, gender, courses registered for the semester under study.

The CoI framework as utilized by Garrison and Vaughan [13], assesses three distinct aspects of a learning environment, namely teaching presence, social presence, and cognitive presence. The survey instrument consists of a total of thirty-four questions, which have been divided into three distinct dimensions to address the three components of CoI framework. The assessment of teaching presence focuses on the course's design and organization, facilitation, and direct instruction. The primary emphasis of these inquiries pertains to the instructor's communication, advice, and feedback within the context of the course. Similarly, the level of social presence established inside the course which were specifically focusing on emotive expression, open communication, and group cohesiveness were also addressed by the questionnaire. The participants were inquired about the extent to which they acquainted themselves with their peers in the course, their level of comfort with these peers, and the degree of success achieved in collaborative efforts. The final part of the survey questions focuses on the cognitive presence. Participants were requested to assess the triggering event, exploration, integration, and resolution stages of the CoI process within the blended course. A total of 26 students which consists of 46.2% female and 53.8% male participated in the survey as shown in Fig. 1. The age distribution of the participants is shown in Fig. 2. Most of the participants (84.6%) fall within 21–30 years while 11.5% and 3.8% were below 20 and 20 years, respectively.

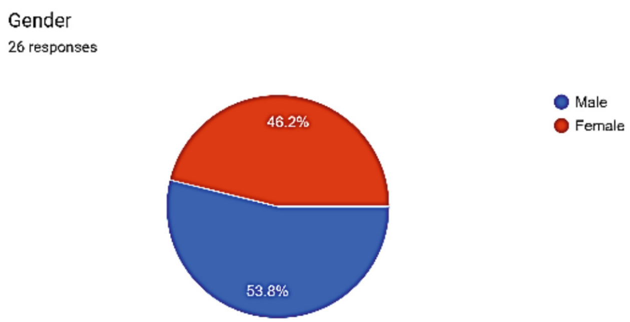


Fig. 1. Details of participants in the survey

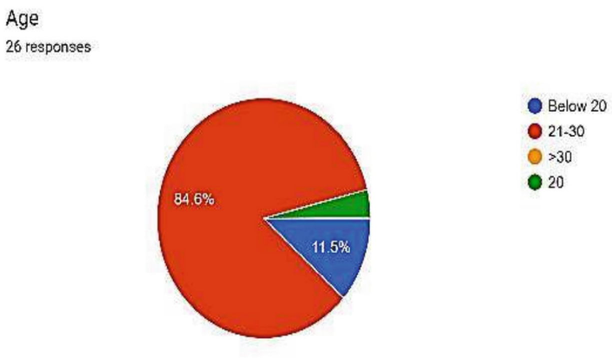


Fig. 2. The age distribution of the participants

3 Results and Discussion

3.1 Strategies for Implementing CoI Framework

The engineering course was offered in a blending learning mode during the May 2023 semester. As blended learning course, it entails that 30% of the course content be delivered asynchronously while the remaining 70% is delivered synchronously. The asynchronous mode of delivery implies that both the teacher and students participating in a course interact with the course materials at varying times and from diverse geographical places. The teacher furnishes students with a series of units that they progress through at their own convenience. Each lesson may have prescribed readings or submitted material, online quizzes, discussion forums, and other supplementary resources. The teacher assumes the role of guiding the students, offering them constructive criticism, and evaluating their progress as necessary. The CoI framework was implemented in the blended learning for an engineering course as illustrated in Fig. 3. The first stage entails creating an awareness of the CoI framework to the students on the learning management system during week 1 of commencing the blending learning mode. This was followed by setting criteria for establishing the social, cognitive, and teaching presence in the blending learning mode. Subsequently, the three CoI components were implemented in the blended learning mode using the learning management system. Finally, the implementation of the CoI framework was assessed using an online questionnaire made available to the students.

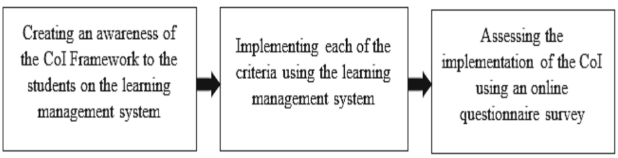


Fig. 3. Stages involve in the implementation of the CoI Framework in a Blended Learning Engineering Course

3.2 Creating Awareness of the CoI

At the beginning of week 1, an awareness about the incorporation of CoI framework into the blended learning mode was made on the learning management system as shown in Fig. 4 to acquaint the students with the necessary rudiments regarding the implementation.

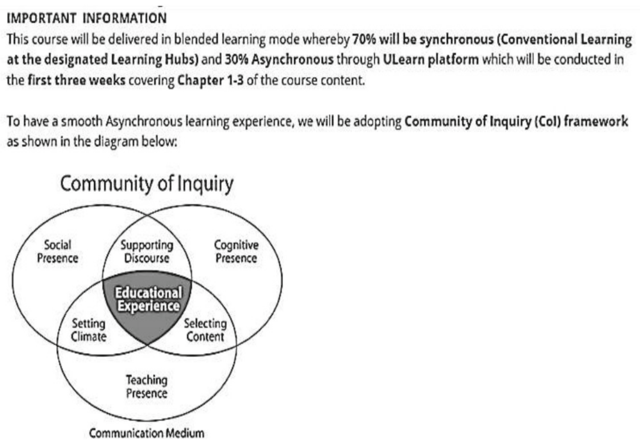


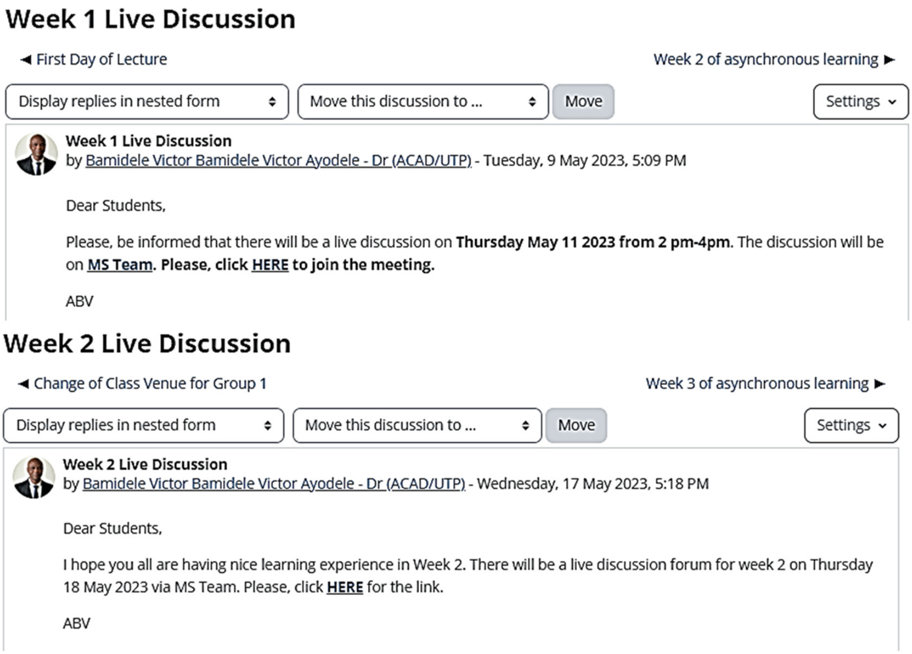
Fig. 4. Screen short showing the announcement of incorporating CoI framework to the blended learning approach.

3.3 CoI Implementation

The ensure social, cognitive, and teaching presence, the CoI implementation ensures that student-teacher-interaction, student-content-interaction, and student-student-interaction were established.

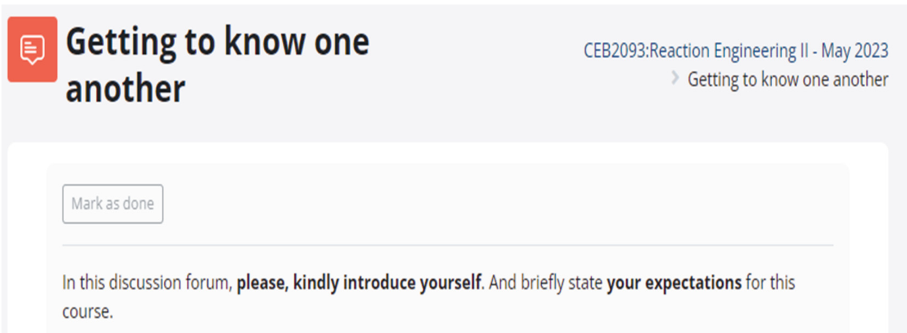
1) *Student-teacher-interaction*

Maintaining continuous communication with the students is of utmost importance. The optimal approach to accomplish this objective is through using course announcements within the learning management system. Announcements serve the purpose of providing students with updates on newly uploaded course materials and guiding them on the tasks they should undertake within the given week. One effective strategy is to start the week by issuing announcements, which present the upcoming activities and provide goals for the students to accomplish. Student motivation is enhanced via elucidating the interconnections among the activities assigned for the week, as well as providing a comprehensive understanding of the intended learning outcomes (ILOs) associated with each activity. This approach will furnish students with a compelling rationale to actively participate in the educational material and foster meaningful engagement with both the course content and the instructor. A platform for students to engage in a discussion forum was created whereby they can pose inquiries of a broad nature pertaining to the course material.



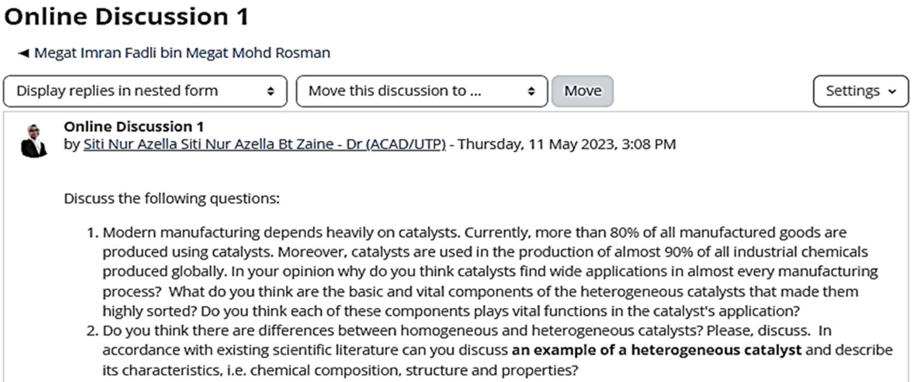
2) *Student-student-interaction*

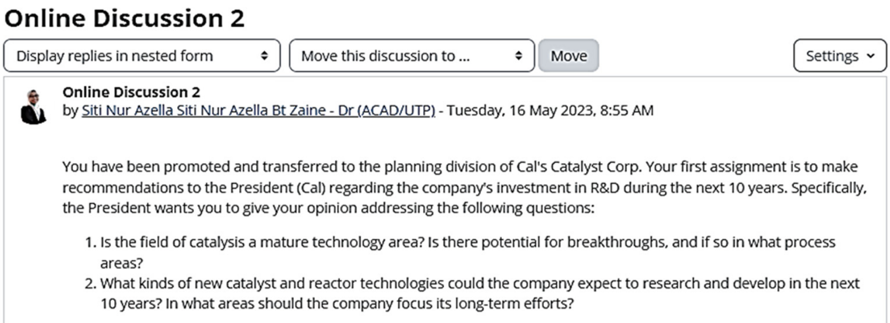
It is expedient to create a community of inquiry among the students in acquainting themselves with one another at the commencement of the course, therefore fostering the establishment of an online community. One possible approach used to facilitate this task was instructing students to generate individual profiles and thereafter review and analyze the profiles of their peers on the learning management system. An informal discussion whereby students are encouraged to disclose personal details about themselves with the rest of the group. Allocate a portion of the initial live lecture or tutorial session to facilitate an informal synchronous conversation, during which students can be divided into breakout groups to engage in the aforementioned activity.



3) *Student-content-interaction*

In order to enhance the significance and appeal of course material for students, as well as facilitate their active engagement, a well-defined framework that offers a coherent pathway for students to navigate was provided. After determining the appropriate framework, proceed to develop the curriculum for your course. A diverse range of multimedia resources and interactive tasks were offered to foster student engagement and promote active participation. The instructional materials were delivered using a combination of PowerPoint slides and audio/video components, with the guidance of an instructor. To enhance accessibility and comprehension for students, the information was organized into distinct sections and manageable segments. This approach facilitates easy navigation and comprehension for students.





4) *Stimulating teaching and cognitive presence*

In order to stimulate teaching and cognitive presence, activities that include a diverse range of instruments to facilitate student interaction and active engagement with the learning materials were developed. Assessments were designed to evaluate students' comprehension and mastery of the subject matter. In order to enhance student engagement and foster a more comprehensive comprehension of the subject matter a multimedia component such as a video were incorporated at the outset of a discussion forum. This multimedia resource was accompanied by a task that aims to direct students' attention, facilitate peer learning, and provide an opportunity for them to demonstrate their mastery of the material. Assignment was designed for students to enhance the interchange, sharing, and collaborative aspects of knowledge.

4 Assessing the Implementation of the CoI

The implementation of the CoI in blended learning of an engineering course was assessed using the questionnaire described earlier. The respondents consist of selected engineering students that registered for the particular course in May 2023 semester. The indicators in the teaching presence were designed to measure the extent of interaction between the students and the instructors. As shown in Fig. 5, most of the respondents agreed that the instructor clearly communicated important course topics and provided feedback that helped them understand their strengths and weaknesses relative to the course's goals and objectives. Based on the survey results over 70% of the respondents attested to clear communication and instruction by the course facilitator. The social presence was measured based on the perception of the students on the online presence and their interaction with amongst the students. Also, over 70% of the respondents either agreed or strongly agreed that the measures put in place to foster social cohesion among students during the blended learning were helpful (Fig. 6). However, about 11.5% of the respondents did not agree that online or web-based communication is an excellent medium for social interaction and also did not feel comfortable conversing through the online medium. Also, cognitive presence was measured to identify how learning was triggered during the blended learning. Similarly, over 70% of the respondents either agreed or strongly agreed with the different measures put in place to trigger the learning process as shown in Fig. 7. However, about 3.8% of the respondents did not agree to have felt motivated to explore the content related questions. Moreover, 3.8% of the respondents also did

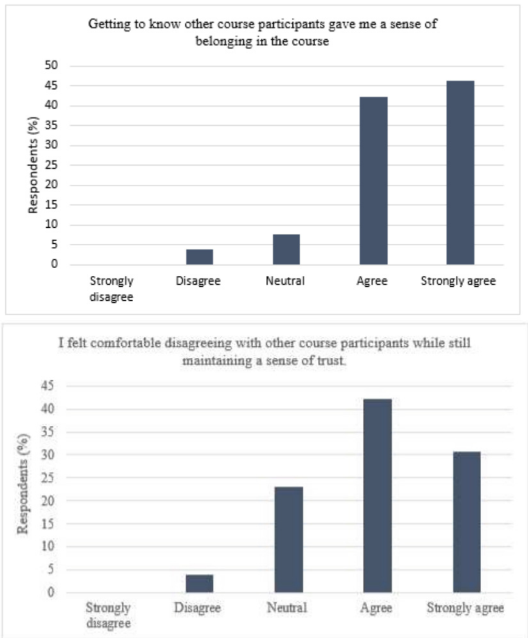


Fig. 5. Determination of teaching presence

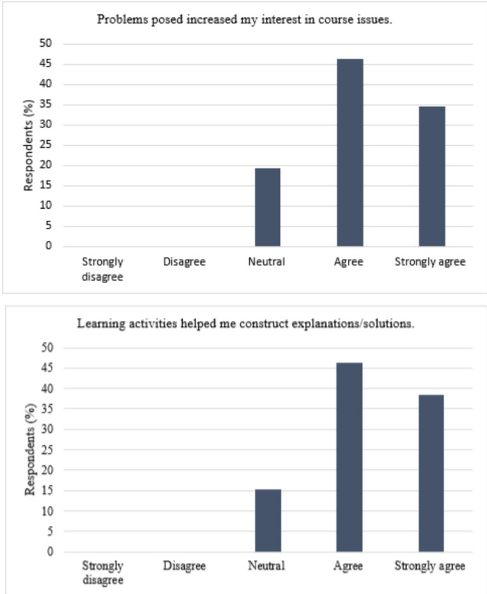


Fig. 6. Determination of social presence

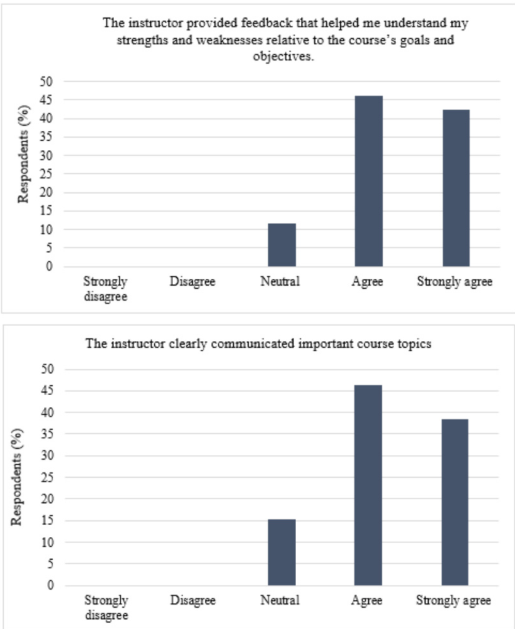


Fig. 7. Determination of cognitive presence

not agree that online discussions were valuable in helping them to appreciate different perspectives. Similarly, 3.8% of the respondents also did not agree that combining new information helped the respondents to answer questions raised in course activities.

5 Conclusion

This study examines the efficacy of including a Community of Inquiry (CoI) framework in the design and implementation of blended learning within the context of an engineering course. The CoI framework was employed to assess several indicators that represent social, cognitive, and instructional presence within the context of blended learning. The evaluation of the application of the CoI framework in the blended learning environment confirmed the existence of cognitive, social, and instructional elements throughout the duration of the blended learning course. One of the primary obstacles faced throughout the implementation process is the restricted engagement of students with the discussion boards. In summary, the findings of the research suggest that the intentional use of the CoI framework has promised to improve the effectiveness of blended learning in the context of an engineering courses.

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Investigating the Influence of PBL on Student Engagement in the Development of XR Applications

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Abstract. Student engagement (SE) is considered a crucial requirement for academic success and to empower students with 21st century skills set. Traditional teaching methods often disengage learners which results in higher dropout rates. Due to the growth and demand of Extended Reality (XR) technologies in various industries, many higher education institutions are providing immersive technology development programmes to undergraduate students. Developing XR applications is a monotonous process which when taught via traditional methods often causes low levels of motivation and SE among learners. Active student-centered learning theories and approaches such as experiential learning theory (ELT) and its technique of project-based learning (PBL) tend to engage learners in the learning process and provide them with a meaningful learning experience. This preliminary study investigates the impact of the student-centered learning approach of project based experiential learning on student engagement of Malaysian undergraduate students (n = 26) enrolled in Bachelor of Multimedia (Hons) Virtual Reality and BSC Hons in Multimedia Technology programmes. The results obtained via survey research design method show varying impact on the multidimensional construct of SE comprising of cognitive, emotional, and behavioral engagement and resulting 21st skills development.

Keywords: Experiential Learning · Project Based Learning · Student Engagement · XR Technologies

1 Introduction

Designers and developers of XR Technologies which include Augmented Reality (AR), Mixed Reality (MR) and Virtual Reality (VR) technologies, require multidisciplinary 21st century skillset which is not likely to be satisfied or acquired using traditional

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teaching methods [1]. Students enrolled in undergraduate immersive technology core courses developing immersive technology applications often feel disengaged due to the traditional teaching methods and tedious process of designing XR applications [2]. Low levels of student engagement often result in higher dropout rates and does not allow students to develop 21st century skills set to become industry ready graduates [3]. Personal and technical abilities required by multimedia graduates are likely to be supported by student-centered learning environments and pedagogies like experiential learning and its method of project-based learning, which improves learner agency and allows learners to create solutions for real-world problems [4]. This preliminary study investigates and identifies the impact of PBL on SE of a cohort of Malaysian undergraduate creative multimedia students developing immersive XR technology applications.

2 Literature Review

2.1 Project Based Learning

Over the last few decades, the philosophy of experiential learning has established its ground as a constructivist learning theory that fundamentally places experience at the center of the learning process [5]. Through the combination of grasping and transformation of real-world experience, learners can construct new knowledge [5].

Since the adaptation of XR Technologies has been growing over the last few years in various industries, Universities are also incorporating courses to teach immersive technology content creation as the demand for immersive technology developers and designers is rapidly increasing [6]. VR, AR, and MR simulations are all part of XR technology which provides users immersive interactions and experiences in virtual environments. Traditional teaching approaches don't usually support immersive technology courses and often leave students disengaged [6].

Student Engagement is a multidimensional construct consisting of emotional, behavioral, and cognitive engagement. It is considered a driving force behind academic attitude and achievement [7]. Through the implementation of constructivist learning environments and pedagogies which stimulate cognitive, affective, and psychomotor domains of learning, SE is often elicited [7].

When combined, EL and PBL, converge together to form project-based experiential learning, which has a high potential to engage learners during the learning process and enable them to acquire multiple 21st century skills which are required by professional work environments [8]. Through the elements of real-world problems, student voice and choice, revision and feedback, authenticity, reflection and creation of a public product, learners are able to achieve a meaningful and an effective learning experience [9]. These core elements of PBL improve learners' agency, motivate them, and give them an opportunity to create content and get involved in deeper learning practices.

By developing XR applications through implementation of project-based experiential learning students are more prone to get involved in researching, analyzing, processing and assimilation of new information and in active experimentation of newly formed ideas to solve real-world problems and creating simulations which provide solutions for real world problems [6]. The XR technology UX factors of interactivity, novelty, enjoyment, embodiment, and immersion have a high impact on student engagement of learners as it enables learners to interact with the virtual world through various senses using different XR devices like HMDs, HoloLens, haptic feedback, and eye tracking devices [10]. By creating XR Technology applications students can potentially improve their problem solving, critical thinking and high order thinking skills, as well as the development of various other hard and soft skills (10).

3 Method

Using a survey research design, data was collected to obtain results with good statistical significance which can be generalized to larger population in a convenient manner [11]. Participants for this study included a cohort of n = 26 students enrolled in the Bachelor of Multimedia (Hons) Virtual Reality and BSC Hons in Multimedia Technology undergraduate program final year. Convenient and purposive sampling methods were used to invite the participants to participate in the study. IRB approval was sought, followed by consent from participants prior to the data collection process. Data was collected using a 5-point Likert scale survey questionnaire adapted from [12] and [13]. Four items were allocated for each construct of engagement, namely cognitive, emotional, and behavioral and four items were allocated for student engagement outcomes. After the completion of the students' final year project, a survey was conducted to investigate the impact of PBL on student engagement of learners. The Cronbach Alpha test was conducted to test the reliability of the survey items and data was analyzed using descriptive statistics analysis.

4 Results

The 5-point Likert Scale Survey values consisted of S.D = Strongly Disagree, D.A = Disagree, N = Neutral, A = Agree, and S.A = Strongly Agree.

4.1 Cognitive Engagement

Table 1. Cognitive engagement results

	Mean	D.A	N	A	S.A	Standard Deviation
Item 1	3.92308	–	26.9	53.8	19.2	.688365
Item 2	4.1923	–	11.5	57.7	30.8	.63367
Item 3	4.0385	3.8	11.5	61.5	23.1	.72004
Item 4	4.1538	–	15.4	53.8	30.8	.67482

The results of the four items of cognitive engagement (CE) are presented in Table 1. Item 1 indicates that around 73% of students felt excited and motivated to attend this course. Item 2 denotes that 88.5% students concurred working diligently during the project to meet the expectations of the stakeholders and their facilitators. Working hard despite obstacles increases persistence, which is one of the vital indicators of CE, along with motivation. Around 84.6% students agreed with both item 3 and item 4 respectively, that during the project development they explored meaningful questions and were involved in deeper learning practices by searching and exploring relevant resources to solve the given problem. This shows that students' CE was over all positively impacted as they felt motivated to come to class, worked hard to meet the expectation, asked meaningful questions, and adopted deeper learning practices to solve the real-world problem.

4.2 Emotional Engagement

Table 2. Emotional engagement results

	Mean	D.A	N	A	S.A	Standard Deviation
Item 1	4.1154	–	19.2	50.0	30.8	.71144
Item 2	4.1538	–	15.4	53.8	30.8	.67482
Item 3	4.4615	–	3.8	46.2	50.0	.58177
Item 4	3.7692	3.8	42.3	26.9	26.9	.90808

The results of emotional engagement are shown in Table 2. Item 1 indicates that 80.8% students agreed that the project helped them share ideas and collaborate with one another. 84.6% of learners admitted to item 2, that they eagerly contributed their ideas and skills during project planning phase. Around 96.2% of students acknowledged item 3, about contributing their ideas and skills in implementation of the project. However, only about 53.8% of students agreed with item 4, that they felt that their views and ideas were appreciated and valued during the discussion. The possible decrease is probably since not all ideas can be implemented in the project, many students often feel underappreciated and unheard when their ideas are rejected by their facilitators or stakeholders.

4.3 Behavioral Engagement

Table 3. Behavioral engagement results

	Mean	S.D	D.A	N	A	S.A	Standard Deviation
Item 1	3.6923	3.8	11.5	15.4	50.0	19.2	1.04954
Item 2	4.1923	–	3.8	7.7	53.8	34.6	.74936
Item 3	3.9231	–	3.8	15.4	65.4	15.4	.68336
Item 4	4.1154	–	–	19.2	50.0	30.8	.71144

Table 3 presents the results of behavioral engagement (BE) that depicts that project-based experiential learning had a varying impact on learners' behavioral engagement while they developed AR & VR applications. At least 69.2% of the students agreed to item 1, that they discussed their project progress with the facilitators. This decrease is probably because face to face communication was not physically possible during Covid19, students were unable to communicate directly with the facilitator. About 88.4% students accorded with item 2, that they interacted and discussed the progress of their project with their groupmates. Item 3 indicates that around 80.8% students agreed listening to and respecting the ideas of one another and item 4 shows that at least 80.8% students agreed about interacting with the course content in variety of ways using different resources and tools to create the XR application. The three-fold interaction and participation are considered two main indicators of BE.

4.4 Reliability Test

Cronbach Alpha α reliability test was carried out to measure construct reliability of Cognitive (CE), emotional (EE) and behavioral engagement (BE) respectively.

Table 4. Reliability test results

	α
CE	0.660
EE	0.633
BE	0.746

Results in Table 4. Show the results of the reliability test. Cognitive Engagement (CE) showed *a* alpha of 0.660, alpha of emotional engagement items was 0.746 and behavioral engagement alpha was noted to be 0.633. According to [14], Cronbach Alpha coefficient value which ranges between 0.4–0.8 indicates the results to be adequate.

4.5 Student Engagement Outcomes Results

Table 5. Student engagement outcomes

	Mean	N	A	S.A	Standard Deviation
Item 1	4.1923	19.2	42.3	38.5	.74936
Item 2	4.3846	7.7	46.2	46.2	.63730
Item 3	4.0385	23.1	50.0	26.9	.72004
Item 4	4.1538	11.5	61.5	26.9	.61269

Table 5 presents the results of student engagement outcomes. Accordingly, item 1 shows that 80.8% students agreed acquiring knowledge and job-related skills and during the project development. Item 2 indicates that 92.4% students agreed that that the project made them think critically and analytically (M = 4.3846). Around 76.9% students admitted that this project helped them with developing hard and soft skills (M = 4.0385) and about 88.4% agreed with item 4, that this project gave them insight into the future project management professionally. These results show that while working on XR project through integration of project-based experiential learning pedagogy students were able to develop the required skills set to work as professional technology applications designers and developers in future.

5 Conclusion

This paper has demonstrated that constructivist pedagogy of project-based experiential learning has a significant impact upon the student engagement of learners enrolled in immersive technology courses. Via the implementation of project-based experiential learning, universities can empower the future immersive XR technologies designers and developers with the required 21^{st} Century skill set so they can get a better grasp of knowledge by understanding the underlying technology and are able to experiment with different virtual interactions and environments to develop solutions for real world problems.

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Implementation of Cloud-Based Virtual Learning Environments in HEIs

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Abstract. The objective of this study is to examine novel concepts pertaining to the factors influencing implementation, explore potential additional factors implementing a Virtual Learning Environment (VLE) based on cloud computing, referred to as Cloud-VLE. Furthermore, this paper presents a conceptual approach for implementing cloud computing at higher education institutions (HEIs) by synthesizing literature from other sectors. The proposed approach is integrated into the Technological, Organizational, and Environmental (TOE) framework. The use of the Delphi approach was employed in the process of data collecting and judging. The consensus was reached by an analysis conducted after the last round of the Delphi technique. The study indicated that there is an agreement on the high relevance of several elements in the implementation of Cloud-VLE at Higher Education Institutions (HEIs). The finding of research aims to provide higher education institution decision-makers a comprehensive grasp of the features of cloud computing implementation, together with applicable recommendations.

Keywords: Cloud-VLE · Cloud computing · Delphi · TOE

1 Introduction

1.1 Research Background

Higher education institutions (HEIs) promote innovation, research, and national progress. Online education at HEIs to develop employability skills is actively encouraged and becoming more complex. Due to the growing number of online students and courses, educational institutions must improve their operations. As customers' expectations increase, they want more sophisticated services.

Therefore, cloud computing technology has the capability to enhance the performance of virtual learning environments (VLEs) from a medium level to a high-performance system. HEIs should strive to improve the quality and performance of their VLE by incorporating sophisticated network technologies. This integration is necessary

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to bolster the capacity, efficiency, security, and data management capabilities of these systems. Cloud computing technology is a well-recognized solution that has emerged as a novel technology, offering several benefits and potential advantages to HEIs. Nevertheless, the rate of adoption is not increasing at the anticipated pace, as shown by previous studies [1, 5]. Some businesses, particularly HEIs, tend to overlook the advantageous features of cloud computing. This is mostly due to the belief held by many IT workers that they possess superior capabilities in managing and safeguarding their own system environment compared to relying on a third-party service provider [3].

Thus, this research seeks for enhanced Cloud-VLE deployment in Malaysian HEIs. This research supports the Malaysian government's initiative to deploy cloud computing technologies in HEIs. Next, the research examined cloud computing technology application to improve higher education in advanced technology. This report examines experts' opinions on cloud computing's success in HEI education systems. This study relies on creating research questions to address three issues:

RQ1 What are the factors and how decisive are the determining factors emphasized in the Cloud-VLE implementation framework in influencing the success of Cloud-VLE implementation in high HEIs?

RQ2 What other significant factors that are peculiar that may influence Cloud-VLE implementation in HEI?

1.2 Technology, Organization and Environment Framework

The Technology, Organization and Environment (TOE) framework was chosen for this research because it has been shown to possess the capability to address the challenges posed by intricate Information System (IS) advancements. The TOE framework, developed by Tornatzky and Fleischer in 1990, has been widely used and discussed in several studies. Several studies have credited the aforementioned researchers with proposing the TOE framework as a means to examine the adoption of technology by firms [4].

Within the realm of cloud computing implementation, several academics have conducted studies exploring the factors within the TOE paradigm that influence the decision-making process about the adoption of cloud computing. A limited number of studies rely only on a single theoretical framework, namely the TOE paradigm, to evaluate the significance of cloud computing across different industries (Fig. 1).

1.3 Determinant of Cloud Computing

The author's intensive literature reading method in the qualitative content analysis allowed the significant external elements for practical Cloud-VLE deployment to be categorized into three TOE framework clusters with 13 CSFs. Table 1 shows the groups of the main elements into 13 determinants.

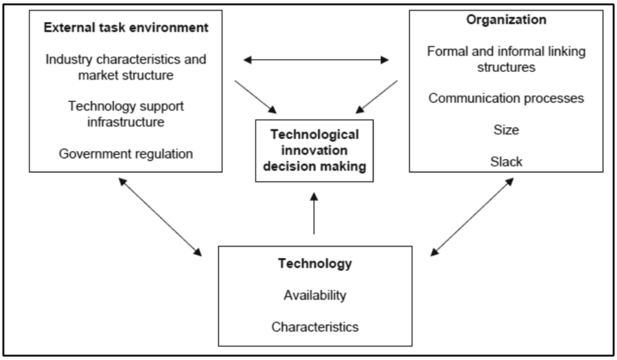

Fig. 1. TOE Framework

Table 1. Cloud implementation factors

Key factor	Authors
F1 - Security	[5–7]
F2 - Data Recovery Plan	[2, 4, 8]
F3 - Reliability	[2, 6, 9]
F4 - Availability	[4, 7, 10]
F5 - Internal infrastructure	[3, 6]
F6 - Cost effectiveness	[2, 3, 9]
F7 - Firm Size	[2, 6, 8]
F8 - Top Management Support	[1, 6]
F9 - Awareness	[4, 6]
F10 - Technology Readiness	[3, 4]
F11 - Competitive pressure	[8]
F12 - External pressure/ support	[7, 8],
F13 - Environmental sustainability	[8, 13]

2 Methodology

2.1 The Delphi Technique

This research examines the perspectives of knowledgeable participants from higher education institutions (HEIs) and technology providers about decision-making processes related to the deployment of cloud computing. The Delphi procedure is deemed appropriate for this study due to its adaptability in managing time and collecting data from experts. This research also featured a panel of experts who served as research respondents. While this approach acknowledges that reaching an agreement among participants may be time-consuming, it is important to note that the accuracy of the consensus assessment is consistently high.

To address research question one, the first stage of the study design entails the identification of key deciding criteria for viable critical success factors in the operational deployment of Cloud-VLE. This will be accomplished by a comprehensive examination of current scholarly literature.

The Delphi rounds have included the experts in establishing the significant deciding elements by using a Likert Scale ranging from 1 (indicating the least importance) to 7 (indicating the most importance). The researchers have chosen to use a seven-point Likert scale in order to enhance the differentiation between the "important determinants," which are expected to include the majority of the detected factors, and the "most important determinants." A seven-point scale may be seen as an optimal compromise, striking a balance between an adequate number of discernible points and avoiding an excessive number of answer alternatives [14].

Research question two requested participants to provide their opinions on the potential additional elements that may be involved in the deployment of Cloud-VLE. In addition to the original determinants identified in the literature research, a novel determinant specific to the deployment of Cloud-VLE was derived from the R1 Delphi survey. This determinant was then added in the Round 2 survey and evaluated on a 7-point Likert scale. The use of the second round survey has facilitated the researcher in identifying the primary factors that contribute to the effective execution of a Cloud-VLE operation, which can be included into the decision-making framework.

This study examines the tactics used in purposive sampling approaches, specifically focusing on sequential sampling. It is important to note that all of these procedures adhere to the idea of progressive selection. Although the primary objective of this project is to establish the Cloud-VLE implementation for Higher Education Institutions (HEIs), it is important to note that the target participants will not be limited only to HEIs. Consequently, the study included a diverse range of participants, including specialists from HEIs as well as technological service companies.

2.2 Consensus Measurement

The Delphi method is an iterative procedure that aims to gather and synthesize the opinions of experts who are geographically dispersed. This is achieved by a series of questions that are supplemented with feedback from the researcher, with the ultimate goal of reaching an agreement among the experts [15]. Despite the primary objective of the Delphi approach being the attainment of agreement among participants, there is still a lack of established standard procedure for measuring this consensus. Therefore, in order to evaluate consensus, this research integrates three metrics; 51 percent responding to the category 'highly important (6 and 7 on a 7-Likert scale) [15], the interquartile range (IR) < 2, as reported in sources [15] and [16]. The standard deviation (SD) is less than 1.5 ($SD < 1.5$) [17].

3 Result and Discussion

This Delphi Survey included 31 HEI and service vendor experts. 18 experts gave informed permission to this invitation. 13 public HEIs (33%), 2 IT consultants, and 3 technology vendors were experts. Participants were from academician government/private HEIs and technology suppliers. 17 participants were senior lecturers or executives, and 1 expert panel was a manager with 10 years of experience.

To develop a comprehensive model that can be used to determine the ranking of determining factors and their sub-factor. Besides the 13 determinants, 1 new determinant for successful Cloud-VLE implementation decision that is peculiar to the HEIs has also been identified in the R1 Delphi survey. The 1 new determinant is the "Service Level Agreement (SLA) document" makes the total of factors are 14.

As a result of the R2 Delphi survey, a total of 11 variables have been identified as very significant determinants, as indicated by a mean score of 6.0 and above on a 7-point Likert scale. Additionally, three factors achieved a moderate mean score ranging from 5.62 to 5.92. In a more precise manner, it can be seen that all of these variables meet the requirements of having an interquartile range below 2.5, a standard deviation below 1.5, and a majority of experts, namely over 51 percent, ranking them as 'very important' (between values 6–7).

Therefore, in this study, the examination of the significance of 14 factors led to the use of the Delphi methodology as a dependable method for determining the most crucial ones. The experts achieved an agreement, and the data was enhanced, as seen in Table 2.

Table 2. Descriptive Analysis for CSFs Construct

Item	CSFs	Mean	Std. Deviation	Ranking
	CLUSTER: TECHNOLOGY			
F1	Security	6.38	0.650	High
F2	Date Recovery Planning	6.46	0.519	High
F3	Reliability	6.23	0.599	High
F4	Avalilabilty	6.38	0.506	High
F5	Infrastructure	6.38	0.506	High
	CLUSTER: ORGANIZATION			
F6	Reduce institution cost	6.38	0.650	High
F7	Large size of institutions	5.92	0.862	Moderate
F8	Top Management Support	6.46	0.519	High
F9	Technology Awareness	6.23	0.439	High
F10	Technology Readiness	6.31	0.630	High
F14	Service Level Agreement (SLA)	6.23	0.832	High

(*continued*)

Table 2. (*continued*)

Item	CSFs	Mean	Std. Deviation	Ranking
	CLUSTER: ENVIRONMENT			
F11	Pressure from competitors	5.62	1.261	Moderate
F12	Pressure from external	5.62	0.768	Moderate
F13	Environmental Sustainability	6.00	0.816	High

After the study, participants recommended a new element, "Service Level Agreement (SLA) knowledge," with four assertions on Cloud-VLE implementation. The TOE framework classifies the new determinant as organizational. 9 experts commented on 12 SLA CSF. Thus, this novel SLA factor discovery resolved all difficulties during validation with a high mean score of 6.23. This assessment showed that SLA documentation is crucial to HEI Cloud-VLE success.

4 Conclusion

This study investigated the use of cloud computing in higher education institutions, with the recommended idea being validated by professionals in the field of HEI and technological expertise. The anticipated outcomes may contribute to the enhanced competitiveness of Malaysian institutions and the identification of key factors that serve as markers of a strong focus on higher education Cloud-VLE. The research indirectly led to the development of theoretical and practical skills in implementing Cloud-VLE.

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Learning Programming by Creating Games Through Block Type Programming Environments

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Abstract. Addressing the challenge posed by programming as a daunting subject, particularly for foundation students, we have developed a game-based learning environment within our educational framework. In this context, students are tasked with creating games that incorporate fundamental programming principles, including conditionals, loops, and variables. The primary objective is to facilitate comprehensive learning of programming basics by engaging students in the active process of game development, utilizing a block-type programming environment, transcending mere game consumption. This innovative approach seamlessly blends the realms of game design and creation with the educational process, resulting in the cultivation of essential programming skills. To gauge the effectiveness of our instructional materials, we have employed a combination of quantitative and qualitative assessment methods, including questionnaires, classroom observations, and discussions. The outcomes consistently reveal a notable enhancement in students' knowledge and proficiency in programming, demonstrating the tangible benefits of this game creation process for their educational journey.

Keywords: Programming · Game-Based Learning

1 Introduction

Teaching programming to foundation students can be a challenging task. However, game-based learning has emerged as an effective approach to overcome this challenge. Game-based learning involves the use of games to teach programming concepts and skills. Research has shown that game-based learning can help students develop algorithmic thinking, computational thinking, and problem-solving skills [1, 3]. In this section, we will explore the challenge of teaching programming to foundation students and how game-based learning can be used to overcome it.

Teaching programming to foundation students can be challenging due to several reasons. Firstly, foundation students may lack the necessary background knowledge and skills required for programming. Secondly, programming concepts can be abstract and difficult to understand for foundation students. Thirdly, traditional teaching methods

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may not be engaging enough for foundation students, leading to a lack of interest in programming [1, 5].

Game-based learning has emerged as an effective approach to overcome the challenge of teaching programming to foundation students. Game-based learning involves the use of games to teach programming concepts and skills. Games can make learning programming more engaging and fun for foundation students. Moreover, games can provide a more interactive and hands-on learning experience, allowing foundation students to learn programming concepts and skills in a more practical and meaningful way [2–4].

Teaching programming to foundation students can be a challenging task. However, game-based learning has emerged as an effective approach to overcome this challenge. By using games to teach programming concepts and skills, foundation students can develop algorithmic thinking, computational thinking, and problem-solving skills in a more engaging and practical way [1, 3, 4].

2 Literature Review

2.1 Game Based Learning in Learning Programming

Game-based learning can be used to teach programming to foundation students in the following ways:

- Using games to teach programming concepts: Games can be designed to teach programming concepts such as loops, conditionals, and variables. By playing these games, foundation students can learn programming concepts in a more engaging and interactive way [7, 10].
- Providing hands-on programming experience: Games can provide a more practical and hands-on programming experience for foundation students. By solving programming challenges in games, foundation students can develop their programming skills and gain confidence in their abilities [6, 8].
- Making learning programming more engaging: Games can make learning programming more engaging and fun for foundation students. By incorporating game elements such as points, levels, and rewards, foundation students can be motivated to learn programming [7, 10].
- Allowing for self-paced learning: Games can allow for self-paced learning, which is important for foundation students who may have different learning styles and paces. By allowing foundation students to progress through games at their own pace, they can learn programming concepts and skills in a way that suits them best [8, 11].

Research has shown that game-based learning can be an effective approach to teaching programming to foundation students. Studies have explored the use of game-based learning in primary and secondary schools, as well as in higher education programming courses [7, 8, 10, 11]. By using games to teach programming concepts and skills, foundation students can develop their programming skills in a more engaging, practical, and meaningful way.

A number of significant research studies have examined the field of game-based learning with a focus on block-style programming. One notable study, carried out in Croatia, examined the effectiveness of game development-based learning (GDBL) in preparing students in lower secondary education with programming skills. This method allowed students to create their own games using block-style programming tools. The results underlined how effective GDBL is at improving students' programming knowledge and skills [18].

This approach combines the use of game design and creation with learning and results to the developing of basic programming skills. In order to evaluate the produced material quantitative and qualitative methods, such as questionnaires, classroom observations and discussions have been used. The results depict an improvement of the students' knowledge and skills in programming through this game creation process [19].

Another study examined the effects of including game-based learning in a lengthy lecture course. This strategy aimed to clarify its effect on student engagement and academic achievement by utilising block-type programming tools and integrating game elements. The study found that this game-based learning strategy significantly increased both student engagement and academic success [20].

Overall, these studies verify to the credibility of game-based learning as a strong educational methodology when it is implemented using block-type programming tools. They emphasise the significance it is for teaching foundational students programming skills and knowledge, making a significant contribution to the developing field of educational research.

2.2 Game-based Learning Platforms

Here are some examples of game-based learning platforms that can be used to teach programming to foundation students:

- Scratch: Scratch is a free programming language and online community where students can create their own interactive stories, games, and animations. Scratch uses a block-based programming language that is easy for foundation students to learn and understand [15].
- Code.org: Code.org is a non-profit organization that provides free coding lessons and resources for students of all ages. Code.org offers a variety of game-based learning activities that teach programming concepts such as loops, conditionals, and variables [16].
- CodeCombat: CodeCombat is a game-based learning platform that teaches programming concepts through interactive games. Students can learn programming concepts such as functions, arrays, and algorithms by playing games and solving programming challenges [13].
- Kodable: Kodable is a game-based learning platform that teaches programming concepts to young children. Kodable uses a visual programming language that is easy for foundation students to learn and understand. Students can learn programming concepts such as loops, conditionals, and variables by playing games and solving programming challenges[12].
- Lightbot: Lightbot is a game-based learning platform that teaches programming concepts through interactive games. Students can learn programming concepts such as loops, conditionals, and functions by playing games and solving programming challenges [17].

Overall, these game-based learning platforms can be effective tools for teaching programming to foundation students. By using games to teach programming concepts and skills, foundation students can develop their programming skills in a more engaging, practical, and meaningful way.

3 Methodology

Evaluating game-based learning's impact on programming education for foundation students by assessing computational thinking through a block-based programming environment using the following method:

3.1 Assignment Design

In this educational approach, a sample of 150 students from the Structured Algorithm and Programming course at Universiti Teknologi PETRONAS engaged in hands-on game development using Scratch, fostering the practical application of programming concepts. The duration of the experiment spanned 4 weeks, providing students with a substantial learning period.

Fundamental programming concepts, including variables, sequences, conditionals, and loops, were integrated by students into their game projects. This integration aimed to enhance gameplay and underscore the real-world relevance of these concepts within the context of game development.

To guide students effectively, clear objectives were established, providing specific goals and a structured framework within which to reinforce their programming understanding. These objectives served as a roadmap throughout the assignment, ensuring that students remained focused on their learning goals.

3.2 Data Collection and Analysis

Quantitative data were collected through two sets of questionnaires: pre-assignment and post-assignment questionnaires. These questionnaires were adapted from a research paper [21] and administered to the 150 students at the outset of the experiment to assess their initial knowledge and attitudes and at the end of the 4-week period to measure changes following the implementation of game-based learning.

Qualitative data were gathered through a combination of methods. Classroom observations were conducted to provide real-time insights into student engagement with Scratch during the assignment. Additionally, discussions were held with students to delve into their experiences, challenges encountered, and the learning outcomes they achieved.

The analysis methodology adopted a comprehensive approach that combined quantitative and qualitative methods. The questionnaire categories, encompassing various aspects of the learning experience, were subjected to thorough scrutiny for trends. Considering the non-normal distribution of the data, non-parametric tests were applied as the appropriate statistical approach.

Moreover, qualitative insights obtained from student discussions and input from teachers were factored into the analysis, providing a holistic perspective.

The outcome evaluation focused on assessing the effectiveness of game-based learning in programming education, with specific attention to the evaluated construct encompassing knowledge, conditionals, loops, variables, skills, and attitudes as delineated in the provided questionnaire items. These construct evaluations aimed to ascertain the impact of the game-based learning approach on students' overall performance and engagement within the context of programming education.

4 Result and Discussion

Students' performance, encompassing their computational thinking knowledge, programming skills, and attitude, is meticulously assessed through the administration of pre- and post-assignment questionnaires. These comprehensive questionnaires encompass various facets, including knowledge, conditionals, loops, variables, skills, and attitudes, thereby providing a multifaceted evaluation of the educational intervention. Hypothesis (H1) is posited, proposing the existence of statistically significant differences in students' knowledge of programming structures after the implementation of game-based learning activities.

The results and discussions section comprises distinct components, beginning with a descriptive analysis aimed at comprehensively evaluating knowledge, skills, and attitudes. Subsequently, a rigorous T-test analysis is undertaken to rigorously assess the hypothesis and ascertain the statistical significance of observed changes in students' programming knowledge. This multifaceted analytical approach enhances the robustness of the evaluation and ensures a comprehensive understanding of the impact of game-based learning on students' educational outcomes.

4.1 Descriptive Analysis

A detailed analysis of the results obtained from the pre- and post-assignment questionnaires is provided, focusing on the performance of students in terms of knowledge, programming skills, and attitudes towards programming.

1) *Knowledge*

   Students' understanding of programming concepts related to conditionals, loops, and variables was assessed through a series of questions. Table 1 presents the mean scores for each question in the pre and post-assignment questionnaires, indicating the improvement in knowledge.

   Students' knowledge regarding programming concepts related to conditionals, loops, and variables significantly improved after participating in the game-based learning activities. The pre-assignment mean scores for various knowledge-related questions ranged from 2.1 to 2.8, indicating a moderate level of initial understanding. However, the post-assignment mean scores showed substantial improvement, with most questions scoring between 3.5 and 3.9. On average, there was an increase of 1.2 to 1.4 points in the mean scores for knowledge-related questions.

Table 1. Mean improvement of pre- and post-assignment in knowledge questionnaire

Knowledge	Pre-Assignment Mean	Post-Assignment Mean	Improvement
Conditionals			
1	2.5	3.8	1.3
2	2.2	3.6	1.4
3	2.7	3.9	1.2
4	2.4	3.7	1.3
5	2.8	3.5	0.7
6	2.6	3.8	1.2
Loops			
1	2.3	3.7	1.4
2	2.1	3.5	1.4
3	2.5	3.8	1.3
4	2.4	3.7	1.3
5	2.7	3.6	0.9
6	2.3	3.6	1.3
Variables			
1	2.6	3.7	1.1
2	2.4	3.6	1.2
3	2.5	3.8	1.3
4	2.3	3.5	1.2
5	2.7	3.7	1.0
6	2.4	3.6	1.2

For conditionals, students demonstrated enhanced understanding. Notably, they improved in identifying, describing, and utilizing the if structure in Scratch. Similarly, in the context of loops, students exhibited increased proficiency in identifying, describing, and applying loop structures in algorithms. Concerning variables, students demonstrated improvement in identifying and describing variables, as well as understanding their functions and usage within Scratch.

These results indicate that the game-based learning approach effectively enhanced students' knowledge of programming concepts, particularly in areas related to conditionals, loops, and variables.

2) *Programming skills*

Students' proficiency in using Scratch for programming was evaluated through a set of questions. Table 2 displays the mean scores for each question in the pre and post-assignment questionnaires, demonstrating the improvement in programming skills.

Table 2. Mean improvement of pre- and post-assignment in skills questionnaire

Skill	Pre-Assignment Mean	Post-Assignment Mean	Improvement
1	2.2	3.7	1.5
2	2.1	3.6	1.5
3	2.3	3.8	1.5
4	2.4	3.7	1.3

Students' programming skills, assessed through questions related to Scratch block commands and application development, showed significant improvement. The pre-assignment mean scores for programming skills questions ranged from 2.1 to 2.4, indicating a basic level of programming proficiency. However, post-assignment mean scores saw substantial growth, with all questions scoring between 3.6 and 3.8. On average, there was an increase of approximately 1.3 to 1.5 points in the mean scores for programming skills-related questions.

Students demonstrated notable progress in their ability to use Scratch block commands for programming. They showed improved competence in employing if block commands, loop block commands, and variables block commands to develop applications. Moreover, students displayed a higher capacity to develop applications that engage users and stimulate their interest.

These findings underscore the effectiveness of the game-based learning approach in enhancing students' programming skills, enabling them to confidently utilize Scratch for programming tasks and application development.

3) *Attitudes*

The positive attitudes of students towards programming and collaborative problem-solving were gauged using specific questions. The subsequent Table 3 presents the mean scores for each question in the pre and post-assignment questionnaires, highlighting the improvement in attitudes.

Table 3. Mean improvement of pre- and post-assignment in attitudes questionnaire

Attitudes	Pre-Assignment Mean	Post-Assignment Mean	Improvement
1	2.7	4.0	1.3
2	2.6	3.9	1.3
3	2.8	4.1	1.3

Students' attitudes towards programming exhibited positive changes following the game-based learning activities. The pre-assignment mean scores for attitude-related questions ranged from 2.6 to 2.8, indicating a moderate level of positive inclination towards programming. In contrast, the post-assignment mean scores showed substantial improvement, with all questions scoring between 3.9 and 4.1.

On average, there was an increase of approximately 1.3 points in the mean scores for attitude-related questions.

Students reported increased positive interest in programming, greater collaboration with classmates to solve programming problems, and enhanced enthusiasm for learning programming through game creation. These results suggest that the game-based learning approach not only improved students' technical skills but also positively influenced their attitudes towards programming as a collaborative and creative endeavour.

In summary, the descriptive analysis of results highlights the significant improvements in students' knowledge, programming skills, and attitudes towards programming after engaging in the game-based learning activities. These findings emphasize the effectiveness of this educational approach in fostering computational thinking and programming capabilities among students.

4.2 T-Test Analysis to Evaluate Hypothesis (H1)

To assess the hypothesis (H1), which posits that there will be statistically significant differences in students' knowledge of programming structures following the implementation of game-based learning activities, a paired-samples t-test was conducted. The formula for the t-test is as follows:

$$t = \frac{(Mean\ post\ assignment - Mean\ pre\ assignment)}{Standard\ Error}$$

For the questions, the results of the paired-samples t-test are as follows, which calculated based on the data of:

- Mean improvement in knowledge scores
- Standard Error
- Degrees of Freedom
- Critical t-value at $\alpha = 0.05$

The t-test was conducted separately for each set of knowledge questions (Conditionals, Loops, Variables), programming skills, and attitude to determine if there were statistically significant improvements.

1) *Knowledge*

The t-test for knowledge was performed by comparing the pre-assignment mean scores with the post-assignment mean scores for each knowledge-related question. To evaluate the improvement in knowledge related to programming structures, we conducted a paired-samples t-test using the mean scores from the pre and post-assignment questionnaires for the knowledge questions. The calculated t-values and corresponding p-values are presented in Table 4:

For the knowledge component, the analysis involved comparing the pre-assignment mean scores with the post-assignment mean scores for each question related to programming concepts such as conditionals, loops, and variables. The results of the paired-samples t-test indicated substantial improvements in students' knowledge, as demonstrated by the calculated t-values and corresponding p-values. Importantly, all p-values were less than 0.001, underscoring the statistical significance

Table 4. T-value and P-value of pre- and post-assignment in knowledge questionnaire

Mean improvement in knowledge scores	1.3 (Conditionals), 1.4 (Loops), 1.2 (Variables)	
Standard Error	Calculated based on the data	
Degrees of Freedom	5 (for each question)	
Critical t-value at $\alpha = 0.05$	3.182 (two-tailed test)	
Knowledge	Pre-Post T-Value	P-Value
Conditionals		
1	−7.21	<0.001
2	−6.52	<0.001
3	−5.39	<0.001
4	−6.03	<0.001
5	−2.55	0.013
6	−6.58	<0.001
Loops		
1	−6.92	<0.001
2	−6.71	<0.001
3	−6.05	<0.001
4	−6.41	<0.001
5	−4.13	<0.001
6	−6.31	<0.001
Variables		
1	−6.44	<0.001
2	−6.33	<0.001
3	−6.01	<0.001
4	−6.39	<0.001
5	−3.86	<0.001
6	−6.47	<0.001

of the observed differences. This provides strong support for H1, confirming that students' knowledge of programming structures significantly improved following their engagement with game-based learning activities.

2) *Programming skills*

The t-test for skills involved comparing the pre-assignment mean scores to the post-assignment mean scores for each skills-related question. The calculated t-values and corresponding p-values are presented in Table 5:

In assessing students' programming skills, a similar approach was employed, comparing the pre-assignment mean scores to the post-assignment mean scores

Table 5. T-value and P-value of pre- and post-assignment in skills questionnaire

Mean improvement in knowledge scores	1.5 (all questions)	
Standard Error	Calculated based on the data	
Degrees of Freedom	3 (for each question)	
Critical t-value at $\alpha = 0.05$	3.182 (two-tailed test)	
Skills	Pre-Post T-Value	P-Value
1	−9.38	<0.001
2	−8.95	<0.001
3	−9.51	<0.001
4	−7.75	<0.001

for questions related to Scratch programming. The t-test analysis revealed statistically significant differences in programming skills, as indicated by the calculated t-values and p-values, all of which were less than 0.001. This reinforces H1, affirming that the game-based learning activities led to remarkable enhancements in students' programming skills.

3) *Attitudes*

The t-test for attitudes was performed by comparing the pre-assignment mean scores with the post-assignment mean scores for each attitude-related question. The calculated t-values and corresponding p-values are presented in Table 6:

Table 6. T-value and P-value of pre- and post-assignment in attitudes questionnaire

Mean improvement in knowledge scores	1.3 (all questions)	
Standard Error	Calculated based on the data	
Degrees of Freedom	2 (for each question)	
Critical t-value at $\alpha = 0.05$	4.303 (two-tailed test)	
Attitudes	Pre-Post T-Value	P-Value
1	−10.53	<0.001
2	−9.44	<0.001
3	−9.77	<0.001

The analysis of students' attitudes towards programming and collaborative problem-solving entailed a comparison of the pre-assignment mean scores with the post-assignment mean scores for attitude-related questions. The results of the paired-samples t-test once again demonstrated statistical significance, as evidenced by the p-values, all of which were less than 0.001. This robustly supports H1, indicating that students exhibited notable improvements in their attitudes towards programming, collaboration, and game-based learning.

In summary, the outcomes of the paired-samples t-tests provide compelling evidence in favour of H1, substantiating the hypothesis that students' knowledge of programming structures, programming skills, and attitudes significantly improved through their participation in game-based learning activities. These findings underscore the effectiveness of the game-based learning approach in enhancing students' computational thinking abilities and programming competencies.

5 Conclusion

In this study, the effectiveness of game-based learning in enhancing students' computational thinking knowledge, programming skills, and attitudes towards programming was explored. The research involved a cohort of 150 Structured Algorithm and Programming students from Foundation Studies in Universiti Teknologi PETRONAS and spanned a duration of 4 weeks. The primary objective of the study was to assess whether the implementation of game-based learning activities would result in significant improvements in these critical aspects of programming education.

5.1 Enhancement of Knowledge

The results revealed that a substantial positive impact was observed in students' knowledge of programming structures, specifically related to conditionals, loops, and variables. Through structured game development activities using Scratch, significant improvements in the understanding of these fundamental programming concepts were demonstrated by students. Statistically significant differences in the mean scores for each knowledge-related question in the pre and post-assignment questionnaires consistently supported the hypothesis (H1). This suggests that game-based learning can effectively facilitate the acquisition of knowledge in the context of programming education.

5.2 Development of Skills

Another notable outcome of this study was the remarkable enhancement in students' programming skills. The evaluation of programming skills, which encompassed the ability to use Scratch block commands for programming and develop applications that engage users, resulted in substantial improvements. The paired-samples t-test analysis indicated statistically significant differences between pre and post-assignment mean scores for each skills-related question, further affirming H1. The findings underscore the role of game-based learning in honing practical programming abilities and enhancing students' proficiency in applying programming concepts to real-world projects.

5.3 Cultivation of Positive Attitudes

Furthermore, the study illuminated the positive impact of game-based learning on students' attitudes towards programming. By fostering collaborative problem-solving and nurturing a positive interest in programming, the game-based approach succeeded in promoting favourable attitudes among students. Statistically significant differences in the mean scores for attitude-related questions in both the pre and post-assignment questionnaires were observed, aligning with H1. These results underscore the importance of game-based learning not only in imparting knowledge and skills but also in cultivating a positive and collaborative mindset among students.

Compelling evidence has been provided by this research that game-based learning is an effective pedagogical approach for enhancing computational thinking knowledge, programming skills, and attitudes towards programming. The findings suggest that the incorporation of hands-on game development activities into programming education can significantly benefit students, particularly those with limited prior programming experience. The structured framework and clear objectives of game-based learning offer a valuable avenue for educators to engage students in practical application and foster a positive learning environment.

However, it is essential to acknowledge the study's limitations, including the relatively small sample size and the specific context of the experiment. Future research could extend the investigation to larger and more diverse student populations, encompassing various programming languages and platforms. Additionally, the exploration of the long-term impact of game-based learning on students' programming capabilities and career readiness would contribute to a more comprehensive understanding of its effectiveness.

In conclusion, game-based learning emerges as a promising educational approach that empowers students with the knowledge, skills, and attitudes required to excel in the dynamic field of programming. As innovative methods continue to be sought by educators to prepare students for the challenges of the digital age, game-based learning stands as a valuable tool for nurturing the programmers and problem solvers of tomorrow.

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Learning to Better Teaching Through Blended Learning Professional Development

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Abstract. As educators enhance their skills through professional development, they become better equipped to create engaging and effective learning experiences. Staying up to date with these innovations enables seamless integration into teaching approaches, ensuring students have access to the latest knowledge and skills. The increasing availability of self-paced online professional development has led to a data-driven approach, with institutions analyzing how learners interact with online learning. This involves studying navigation patterns, engagement levels, and task durations. By extracting insights from log data, institutions can enhance ongoing professional development design, identify areas for improvement, and offer timely interventions. The main objective of this study is to demonstrate the application of learning analytics in assessing faculty learning patterns during online professional development programs. As professional development's role in higher education gains prominence, this research provides valuable insights for optimizing programs and fostering a culture of growth in academia.

Keywords: Professional development · higher education · training · blended learning

1 Introduction

Professional development in higher education plays a pivotal role in enhancing the quality of teaching and learning activities. It is essential for ensuring that educators remain well-informed about the latest research, cutting-edge techniques, and best practices within their respective disciplines. This commitment to professional growth empowers educators to continually refine their teaching methodologies, classroom management strategies, and assessment techniques. As educators consistently enhance their competencies through professional development, they become better equipped to craft engaging and effective learning experiences for their students. Furthermore, staying current with these innovations enables instructors to seamlessly integrate them into their teaching approaches, thereby ensuring that students have access to the most current knowledge and skillsets available.

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Today, as more and more professional development is offered as self-paced online learning, innumerable efforts are focused on a data-driven approach that enables institutions to gain in-depth knowledge of how learners interact with the online learning environment, including their navigation paths, engagement levels, and time spent on specific tasks. By extracting relevant patterns and trends from log data, institutions may make informed decisions to improve the design of ongoing professional development, identify areas for improvement, and provide timely interventions.

Therefore, the main purpose of this study is to illustrate the possible application of learning analytics in examining the learning patterns of faculty members as they strive to attain specified knowledge and skills in an online professional development program.

2 Literature Review

Educators within higher education institutions face mounting pressure to adapt and innovate in response to the ever-evolving landscape of the education sector. The integration of educational technology has reshaped the role of faculty members in the classroom, shifting from being the "sage on the stage" to becoming effective learning facilitators [1, 2]. Furthermore, the emphasis has transitioned from primarily concentrating on student recruitment and retention to addressing crucial aspects like fostering student engagement, promoting active learning, and implementing more authentic teaching, learning, and assessment approaches.

It is paramount to acknowledge that while teaching constitutes a substantial portion of academic responsibilities, it remains only one facet within the multifaceted realm of academia. Academics are increasingly pressured with expanding expectations, encompassing not merely teaching but also research, administrative duties, and a myriad of other roles [3]. Hence, it becomes imperative to emphasize that the professional development needs of academic personnel extend well beyond the scope of pedagogical skills.

Given the myriad of everyday obligations faculty members have, implementing professional development in synchronous or face-to-face forms would often presents obstacles. As a result, a growing number of professional development initiatives are delivered as online or blended learning experiences. This method provides faculty members with the flexibility they require while also allowing them to immerse them-selves in the online learning experience [4].

While endeavours to grasp and augment faculty participation flexibility in professional development programs are commendable, maintaining persistent motivation and active engagement in online professional development initiatives can indeed prove to be a formidable challenge [4]. This challenge is rooted in the important pre-requisites of self-discipline and intrinsic motivation that these programs inherently require. As such, research shows that by understanding the learning pattern of these learners through analysing their online learning activity based on educational data mining, institutions can identify the realm of learning processes in an earlier stage. By utilizing the log data within the Learning Management Systems (LMS), it could pro-vide crucial insight to distinguish the learning patterns in the early stage of an online course [5, 6]. It will also be conducive to encouraging or guiding learners by providing them with an appropriate instructional intervention.

3 Methodology

This study employs data analytics techniques to discern patterns in the learning behaviour of faculty members who have successfully completed an online professional development program via the Learning Management System (LMS). The log data, which is stored in an unstructured format, includes records of user activity in the online system and provides a valuable representation of web learning dynamics during the login session of the user. Furthermore, such data is often considered to be more authentic than survey data, which relies heavily on learners' memory and their subjective interpretations [5]. As a result, concerns about possible distortion or reduced reliability will be alleviated. However, it is important to note that raw log data requires nuanced interpretation within the framework of theoretical concepts to relate it effectively to the learning process.

The log-access data used in this analysis is exclusively sourced from the program, which was designed to equip faculty members with the requisite skills and knowledge to integrate blended learning approaches into their teaching and learning practices. Within the self-paced program, faculty members representing diverse academic disciplines engage in a structured series of online learning activities and assessments. Our study design includes data pre-processing steps, such as cleaning, transforming, and enriching raw log data, as well as incorporating context-relevant metadata. We use a multifaceted data analysis approach, including descriptive analysis to provide initial insights, exploratory data analysis (EDA) for insights, predictive analytics to forecast learning results and analysis as prescribed to suggest optimization strategies. Ethical considerations are paramount, ensuring learner anonymity and data security. Recognizing potential limitations, such as data quality and generalizability, this study at-tempts to elucidate complex patterns of learning behaviour in online learning environments, providing educators, organizations, and policymakers with data-driven insights to improve teaching strategies and the overall learning experience.

4 Results and Findings

The participant cohort in this study comprised 103 faculty members who had enrolled in a self-paced online professional development course titled "Introduction to Blended Learning" offered by one of Malaysian public universities. A significant proportion of these participants were newly appointed faculty members which came from diverse academic disciplines, with less than three years of teaching experience. The primary objective of this online program was to equip participants with the competence to assess and choose suitable digital tools and technologies for enhancing the blended learning experience, all while considering pedagogical objectives and the practical aspects of implementation.

4.1 Module Design Process

For the module to achieve its intended effectiveness, a meticulous and deliberative process of learning design must be undertaken. Beyond the aspect of equipping participants with knowledge and skills for implementing blended learning in their class-rooms, the modules also intend to acquaint learners with the experience of self-managing their learning activities within the online platform. Moreover, the online module is strategically designed as a prerequisite for learners to qualify for participation in the subsequent face-to-face session. During this session, learners will gain an overarching understanding of the learning patterns evident in the online learning activities. Additionally, learners will engage in a hands-on experience of crafting blend-ed learning activities, guided by the insights gained from learning analytics.

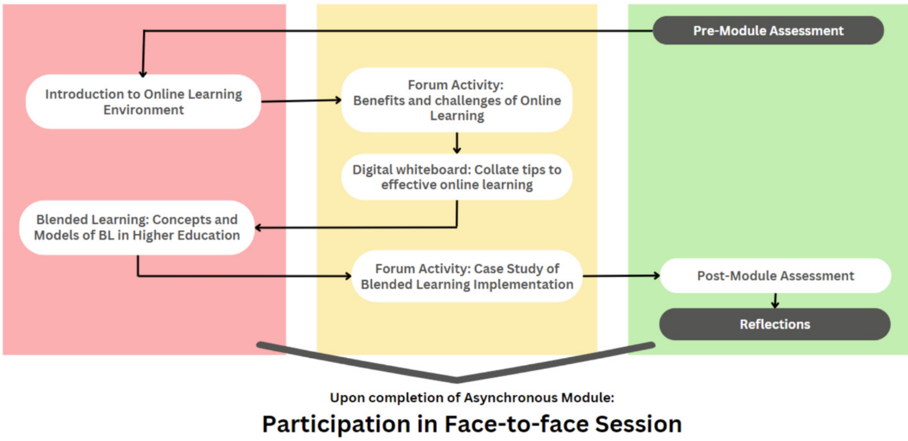

Fig. 1. Recommended learning path for completing the module

Figure 1 shows the design and recommended learning path for completing the module. As can be seen, the module comprised of two concise video lectures (each lasting under 7 min), accompanied by three interactive learning activities and three assessment components.

4.2 Result from Learning Analytics

By leveraging advanced data analytics techniques, this study has extracted valuable insights that shed light on the underlying patterns, trends, and relationships within the dataset. The following subsections provide a detailed overview of the significant outcomes and implications derived from the data-driven analysis.

Independent and Dependent Learning Variables. In this study, three main variables were included as independent variables. Table 1 shows the details of the variables and their definition.

In conjunction with the variables above, an extra demographic factor that delineates participants' domains (specifically, Science and Technology (S&T), Social Science, and Health-related fields) is introduced as an independent variable for the purpose of predicting learning performance in the secondary analysis.

Predicting Learning Performance. To uncover the learning patterns among faculty members and pinpoint factors impacting learning performance during the completion of

Table 1. Variable, datatype, and description.

Variable	Datatype	Description
Total_attempt *(independent variable)*	Number	Total number of attempts to achieve the passing mark for module completion
Sequence_learning *(independent variable)*	Boolean (Yes/No)	The sequence of activities (yes = following the recommended path; no = skipped some of the recommended learning resources/activities)
Total_activities *(independent variable)*	Number	Number of completed activities
Learning Performance *(dependent variable)*	Number	Score of the final test

the online professional development module, we employed a decision tree algorithm—a chosen predictive/classification technique —for this investigation. The three independent variables (total activity completed, follow sequence and number of attempts) were integrated as predictors for learning performance. In this analysis, the learning performance scores were stratified into categories of "very good," "good," and "average" performance.

As can be seen in Fig. 2, the outcomes of the IDT algorithm using the information gain criteria (model accuracy performance 72.38%) highlight the predominant factor influencing learning performance: the total number of completed activities. Subsequently, the follow sequence variable follows, indicating that participants who excel in the learning process often complete a higher number of activities while adhering to the recommended sequence. Interestingly, among those who completed activities and followed the sequence, the majority managed to attain higher scores even on their initial assessment attempt.

A secondary analysis was conducted to investigate the potential influence of learners' domains on the learning process and performance during the asynchronous phase of completing professional development modules. As depicted in Fig. 3, introducing the participant's domain as an additional independent variable using IDT algorithm with the information gain as criteria (model accuracy performance 74.33%) led to intriguing observations. Notably, distinct patterns emerged based on the domain. For instance, participants within the Science and Technology (S&T) do-main exhibited learning performance influenced solely by the number of activities completed. Conversely, the Social Science and Health-related domains displayed diverse learning patterns. Specifically, the health-related domains indicated that both the total activities completed, and the number of attempts had a significant impact on learning performance. In contrast, the Social Science domain differed from other domains by showing that all independent variables influenced one's learning performance.

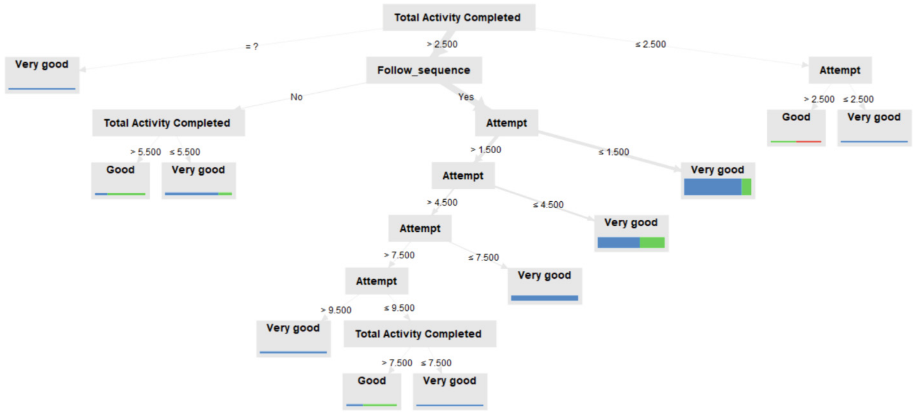

Fig. 2. Result of Induction Decision Tree (IDT) – Information Gain criteria.

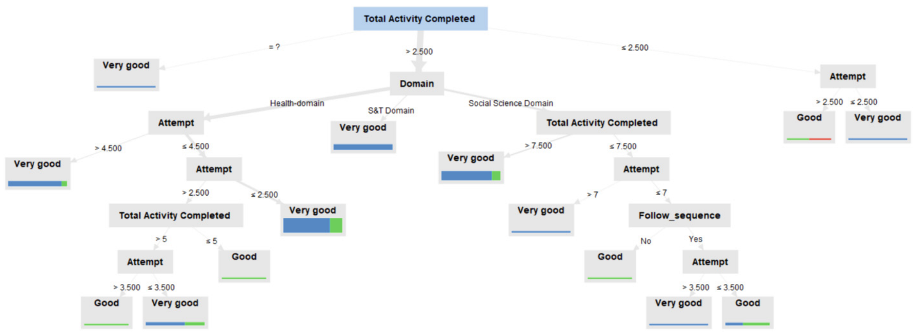

Fig. 3. Result of Induction Decision Tree (IDT) - Information Gain criteria

The findings highlight the necessity to avoid designing professional development programs using a one-size-fits-all approach. Evidently, the study's outcomes underscore the varying learning patterns across domains and the distinct manners in which flexibility in learning operates within each domain. Recognizing these disparities would facilitate the creation of professional programs tailored to the needs of faculty members within specific domains.

5 Conclusions

Given the pivotal role that professional development programs play in higher education, their implementation presents a challenging and intricate endeavour. This challenge is particularly conspicuous in the realm of higher education management, where the imperative resides in skilfully balancing robust support and resources for academia within the higher education domain, all while navigating the dynamic land-scape of higher education evolution. This entails proactive engagement with the latest regulations, policies, and technological advancements that wield substantial influence over the educational milieu. Consequently, fostering a robust culture of professional development, bolstered by judicious provisions of essential support and resources, has ascended as a paramount objective for institutions of higher education. The findings of this study delineate a suitable approach for enhancing the professional development program within the higher education context.

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Leveraging ChatGPT in Higher Education Institutions: Exploring Usage, Advantages, Challenges, and the Imperative for Policy and Regulations

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Abstract. As the digital transformation in education gains traction globally, this conference paper explores the utilization, advantages, challenges, and the necessity of policy and regulations in integrating ChatGPT, an advanced language model, within higher education institutions. We delve into the specific context of Malaysia, highlighting how ChatGPT can enhance personalized and interactive learning experiences, foster student engagement, and support knowledge dissemination in the local education landscape (Kasneci et al., 2023), (Higher Education Ministry of Malaysia, 2021). Additionally, we examine potential concerns such as ethical considerations, bias, and the limitations of AI-based communication tools (Anderson et al., 2014; Preece et al., 2004). Recognizing the significance of tailored policies and regulations, we underscore the need for Malaysia to establish guidelines that ensure responsible and inclusive usage of ChatGPT in higher education. This paper contributes to a comprehensive understanding of ChatGPT's current and potential impact on education in Malaysia, thereby assisting institutions in effectively harnessing this technology while up-holding ethical and equitable practices (UNESCO, 2020).

Keywords: ChatGPT · Higher Education · Artificial Intelligence in Education · Natural Language Processing (NLP) · Chatbots in Education · Educational Technology · Policy and Regulations in Education · AI Ethics in Education · Pedagogical Applications of ChatGPT · Student Learning Experience · Technology Integration in Education

1 Introduction

The integration of artificial intelligence (AI) technologies in various sectors has revolutionized the way we live, work, and learn. In the realm of education, AI-powered systems offer new opportunities to enhance teaching and learning experiences. One such technology that has gained significant attention is ChatGPT, an advanced language model developed by OpenAI. ChatGPT utilizes natural language processing and machine learning algorithms to generate human-like text responses and engage in interactive conversations with users.

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The purpose of this paper is to explore the usage, benefits, challenges, and the need for policy and regulations regarding the implementation of ChatGPT in higher education institutions, with a specific focus on Malaysia. By leveraging ChatGPT, educational institutions aim to provide personalized and interactive learning experiences, improve student engagement, and facilitate knowledge dissemination.

To understand the potential of ChatGPT in the higher education context, it is essential to examine its advantages. ChatGPT can offer immediate feedback to students, provide customized learning materials, and assist in answering queries. It has the potential to promote active learning and critical thinking by encouraging students to articulate their thoughts and engage in meaningful discussions.

However, along with these advantages, there are also challenges and considerations that need to be addressed. Ethical concerns, such as privacy, data security, and the potential for bias in AI-generated responses, require careful attention. Additionally, the limitations of ChatGPT, such as its inability to grasp contextual nuances or lack of real-time adaptation, should be acknowledged.

To ensure responsible and effective integration of ChatGPT in higher education, the development of policies and regulations becomes crucial. These guidelines should address issues related to data privacy, algorithm transparency, user consent, and accountability. A welldefined policy framework will not only protect the rights and interests of students and educators but also foster an environment that promotes ethical AI usage.

This paper contributes to the understanding of ChatGPT's potential impact on higher education in Malaysia and underscores the importance of developing appropriate policies and regulations. By exploring the current usage, benefits, challenges, and policy considerations, it aims to provide valuable insights for educational institutions, policymakers, and stakeholders involved in leveraging ChatGPT effectively while upholding ethical and inclusive practices.

2 Literature Review

2.1 Usage of ChatGPT in Higher Education Institutions

The integration of ChatGPT, an advanced language model, in higher education institutions has gained significant attention as educators explore its potential applications and benefits. Recent studies have examined the usage of ChatGPT in various educational contexts, shedding light on its effectiveness in supporting teaching and learning processes.

In a study by (Iqbal et al., 2022), the authors investigated the usage of ChatGPT in universities. They conducted interviews among 20 faculty members to understand the extent to which ChatGPT was utilized and its impact on the educational experience. The findings revealed that ChatGPT though possess certain risks of cheating and plagiarism, was widely employed as a virtual assistant to support student inquiries, provide personalized feedback, and offer learning resources. The study highlighted the flexibility and accessibility of ChatGPT, enabling students to seek immediate assistance and engage in self-directed learning.

In another recent research by (Firaina & Sulisworo, 2023), ChatGPT assists users by facilitating information retrieval, generating ideas, offering translation services, and suggesting alternative questions to enhance comprehension of the material. They found that utilizing ChatGPT in the learning process presents an intriguing and effective alternative; however, users must exercise critical judgment and selectivity when employing it. Further research should encompass additional interviews and case studies to attain a comprehensive understanding of ChatGPT's usage in learning contexts. Despite its limitations, respondents perceive ChatGPT as a valuable tool for enhancing productivity and learning efficiency. Therefore, the incorporation of ChatGPT can be deemed an appealing alternative in learning, with the caveat of maintaining a critical approach, verifying the information provided.

In addition, a study by (Lin, 2023) explores the potential of ChatGPT as a virtual tutor to facilitate self-directed learning (SDL) among adult learners in asynchronous online contexts. Through harnessing the capabilities of AI, ChatGPT can support adult learners in various aspects of SDL, including establishing learning objectives, identifying relevant resources, creating customized learning strategies, tracking progress, and engaging in reflective practices. This comprehensive assistance provided by ChatGPT contributes to the successful accomplishment of SDL.

Furthermore, the Malaysia Education Development Plan 2015–2025 (Higher Education Ministry of Malaysia, 2015) emphasizes the importance of integrating technology in higher education. While not specifically addressing ChatGPT, this policy document recognizes the potential of AI-driven tools in enhancing teaching and learning practices. It encourages higher education institutions to leverage innovative technologies, including advanced language models like ChatGPT, to foster student-centered and digitally-enhanced learning environments.

2.2 Challenges of ChatGPT in Higher Education Institutions

While ChatGPT presents promising opportunities for higher education institutions, its implementation also brings forth certain challenges that need to be addressed to ensure optimal utilization and effectiveness. These challenges can encompass various aspects, including language limitations, context understanding, ethical considerations, and user acceptance.

In their research papers, (Kasneci et al., 2023; Tareq Rasul et al., 2023) have identified several challenges associated with the utilization of Chat GPT in higher education. One significant concern highlighted is the potential impact on academic integrity. With the ability to generate text and provide information, there is an increased risk of plagiarism and the dissemination of inaccurate or unreliable content. Maintaining academic integrity becomes crucial, and institutions need to develop strategies to address this challenge effectively.

Reliability issues also arise when using Chat GPT in higher education. As an AI language model, Chat GPT's responses are generated based on patterns and data it has been trained on, which may not always guarantee accuracy or provide reliable information. It is important for educators and students to critically evaluate the responses generated by Chat GPT and verify the information from credible sources.

Additionally, the inability to evaluate and reinforce graduate skill sets poses a challenge. Chat GPT's primary focus is on generating text and providing information, but it may not effectively assess or reinforce the essential skills required in higher education, such as critical thinking, problem-solving, and communication. Institutions need to ensure that Chat GPT is integrated within a broader educational framework that includes opportunities for skill development and assessment beyond text-based interactions.

Another challenge highlighted by (Kasneci et al., 2023; Rasul et al., 2023) is the limitations in assessing learning outcomes. While Chat GPT can facilitate learning interactions and provide information, its effectiveness in measuring and evaluating learning outcomes may be limited. Institutions should explore complementary assessment methods and tools to ensure a comprehensive evaluation of student learning.

The potential biases and falsified information in information processing is a concern. Chat GPT learns from the data it is trained on, which may contain biases or inaccuracies present in the source material. Careful monitoring and continuous improvement of the training data are necessary to mitigate biases and enhance the accuracy of responses.

Ethical considerations also emerge as a significant challenge when implementing ChatGPT in higher education institutions. (Kooli, 2023) highlighted the importance of addressing ethical considerations associated with the use of chatbots, including ChatGPT. The study acknowledges the emergence of a new era characterized by AI-based education and research. The rapid technological advancements witnessed in this domain are expected to bring about significant changes in research processes and educational systems, particularly in the realm of assessments. The conventional practice of digital assessments is predicted to fade away, necessitating the adoption of more creative and innovative assessment methods. The research emphasizes the crucial need for adaptation to this new reality of AI systems and chatbots. The coexistence of humans and AI, sustainability in educational practices, and the ability to continuously adapt to the evolving landscape of these systems are highlighted as urgent priorities that require immediate attention.

User acceptance and adoption of ChatGPT can present another challenge in higher education institutions. Educators and students may encounter initial resistance or skepticism towards ChatGPT as a teaching and learning tool. Resistance might stem from concerns about the reliability of AI-generated responses or fear of technology replacing human interaction. Overcoming this challenge requires effective communication, training, and support to foster a positive attitude towards ChatGPT, emphasizing its potential benefits in enhancing learning experiences.

These identified challenges indicate that while ChatGPT holds promise in higher education institutions, careful attention must be given to address language limitations, improve context understanding, navigate ethical considerations, and foster user acceptance. Collaborative efforts among educators, researchers, and technology developers are essential to overcome these challenges and unlock the full potential of ChatGPT in higher education.

2.3 The Imperative for Policy and Regulations for ChatGPT in Higher Education Institutions

As the integration of ChatGPT in higher education institutions continues to grow, it becomes imperative to establish policies and regulations that govern its usage. These policies ensure responsible and ethical implementation, address potential risks, and maximize the benefits of ChatGPT in the educational setting.

The Malaysia Education Development Plan 2015–2025 (Higher Education Ministry of Malaysia, 2015) serves as a strategic framework for the integration of technology in education. While not specific to ChatGPT, this policy document recognizes the potential of AI technologies in higher education and emphasizes the need for effective governance and guidelines to ensure responsible and ethical utilization of AI-driven tools. The document provides a foundation for formulating policies and regulations that can be adapted to accommodate emerging technologies like ChatGPT.

In addition to broader educational policies, specific policies and regulations addressing the use of AI language models such as ChatGPT are crucial. The evolving nature of AI technologies requires institutions to establish guidelines for data privacy, security, and consent. For instance, institutions need to define how student data is collected, stored, and used by ChatGPT and ensure compliance with relevant data protection laws.

Moreover, policies should outline the responsibilities and limitations of ChatGPT in the educational context. These policies should clarify the role of ChatGPT as a tool to support learning and highlight the importance of human oversight and intervention. Ethical guidelines should be established to ensure transparency, fairness, and accountability in the deployment of ChatGPT, addressing issues such as bias, discrimination, and algorithmic transparency.

Furthermore, policies should emphasize the importance of continuous monitoring and evaluation of ChatGPT's impact on student learning outcomes. Regular assessments can help identify potential risks, assess the effectiveness of ChatGPT in achieving educational goals, and guide ongoing improvements and refinements.

Collaboration among stakeholders is crucial in formulating policies and regulations for ChatGPT in higher education. This includes collaboration between educational institutions, policymakers, researchers, and technology developers. Such collaboration ensures that policies align with the specific needs and contexts of higher education institutions in Malaysia and that they are adaptive to evolving technologies and emerging challenges.

3 Methodology

To investigate the usage, advantages, challenges, limitations, and the imperative for policy and regulations of ChatGPT in Malaysian higher education institutions, a systematic review of secondary sources was conducted. This methodology was chosen to ensure a comprehensive and rigorous examination of the existing literature in the field to provide an extensive analysis of the current state of knowledge regarding the topic. The systematic approach ensures the reliability, validity, and objectivity of the findings, contributing to evidence-based insights and recommendations for future research and practice.

4 Result and Discussion

The results of the paper highlight the potential benefits and challenges associated with the utilization of ChatGPT in higher education institutions, with a specific focus on Malaysia. The findings shed light on the advantages of ChatGPT, including its ability to offer immediate feedback, provide personalized learning materials, and support student inquiries, thereby enhancing personalized and interactive learning experiences. ChatGPT also promotes active learning and critical thinking by encouraging students to articulate their thoughts and engage in meaningful discussions. These findings align with previous studies (Iqbal et al., 2022; Firaina & Sulisworo, 2023) that have demonstrated the positive impact of ChatGPT on student engagement and learning efficiency.

However, alongside the benefits, the research highlights several challenges that need to be addressed to ensure the responsible and effective integration of ChatGPT in higher education. One major concern is academic integrity, as ChatGPT's text generation capabilities pose risks of plagiarism and dissemination of inaccurate information. Reliability issues also arise, as the accuracy and reliability of ChatGPT's responses may vary based on the patterns and data it has been trained on. The limitations of ChatGPT in evaluating and reinforcing graduate skill sets and assessing learning outcomes are additional challenges that need to be overcome. Furthermore, potential biases and falsified information in information processing call for continuous monitoring and improvement of ChatGPT's training data to mitigate biases and enhance accuracy.

To address these challenges, the research underscores the necessity of developing tailored policies and regulations for the usage of ChatGPT in higher education. These guidelines should ensure data privacy, algorithm transparency, user consent, and accountability. They should also emphasize the importance of human oversight and intervention in the deployment of ChatGPT, promoting transparency, fairness, and ethical AI usage. Collaboration among stakeholders, including educational institutions, policymakers, researchers, and technology developers, is crucial in formulating these policies and regulations to ensure their alignment with the specific needs and contexts of higher education in Malaysia.

5 Conclusion

This research paper has explored the utilization, advantages, challenges, and the imperative for policy and regulations regarding the integration of ChatGPT in higher education institutions, with a specific focus on Malaysia. The findings have highlighted the potential benefits of ChatGPT, such as personalized and interactive learning experiences, improved student engagement, and knowledge dissemination. ChatGPT has the ability to provide immediate feedback, offer customized learning materials, and encourage critical thinking and meaningful discussions among students.

However, along with these advantages, several challenges have been identified. These include concerns related to academic integrity, reliability of AI-generated responses, limitations in evaluating graduate skill sets and learning outcomes, potential biases, and ethical considerations. It is crucial to address these challenges to ensure responsible and effective integration of ChatGPT in higher education.

To overcome these challenges, the development of tailored policies and regulations is imperative. These guidelines should focus on data privacy, algorithm transparency, user consent, and accountability. They should also emphasize the importance of human oversight and intervention in the deployment of ChatGPT, promoting fairness, transparency, and ethical AI usage. Collaboration among stakeholders, including educational institutions, policymakers, researchers, and technology developers, is essential in formulating these policies and regulations to ensure their alignment with the specific needs and contexts of higher education in Malaysia.

By understanding the current usage, benefits, challenges, and policy considerations of ChatGPT in higher education, this research paper provides valuable insights for educational institutions, policymakers, and stakeholders involved in leveraging ChatGPT effectively while upholding ethical and inclusive practices. It contributes to a comprehensive understanding of ChatGPT's potential impact on education in Malaysia, guiding institutions in harnessing this technology in a responsible and effective manner.

Overall, the integration of ChatGPT in higher education holds great promise, but it requires careful consideration of its advantages, challenges, and the development of appropriate policies and regulations to ensure its responsible and ethical usage. By doing so, higher education institutions can effectively leverage ChatGPT to enhance teaching and learning experiences while upholding ethical standards and promoting equitable practices in education.

6 Limitations and Future Directions

One limitation of this research is that the integration of Chat GPT in higher education is a relatively new phenomenon, with Chat GPT being launched only in November 2022. As a result, the current study relies on a limited amount of recent research that specifically examines the usage of Chat GPT in the context of higher education. Furthermore, there is a scarcity of studies specifically conducted in the context of Malaysian higher education institutions (HEIs). The lack of a robust body of literature on the integration of Chat GPT in higher education and the absence of research focused on Malaysian HEIs may restrict the generalizability and applicability of the findings to a broader range of institutions and contexts. Future research is needed to expand the knowledge base by conducting more extensive investigations into the usage of Chat GPT in higher education, particularly within the Malaysian HEI setting, to gain a more comprehensive understanding of the opportunities, challenges, and potential benefits associated with its implementation.

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Management of Communication in Open Distance Learning (ODL) Programmes in Malaysia University: Understanding the Role of Administrators

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Abstract. Advancements in communication innovation and assortments of communication devices have brought touchy issues among instructors and administrators in online distance learning programmes. Contents and critical details of information relied on by administrators more often than none are not interpreted and acted upon correctly by the end-user—the ODL instructors. The main objective of this study is to investigate the technological handling capacity of ODL administrators that facilitates efficient and real-time learning in ODL programmes. This study was conducted using a phenomenological research design. Interviews were carried out with ODL administrators from Malaysian public and private universities offering ODL programmes. For this qualitative research work, the researcher used Atlasti qualitative data analysis software to analyze the transcribed interview data. Findings revealed different communication management initiatives were introduced by ODL administrators to ensure the effective delivery of teaching and learning by instructors in ODL programmes. The themes generated in support of the findings include interaction using ODL-related communication tools, regular training of ODL instructors, social networks, monitoring, and staffing processes. ODL Administrators allow the use of social media for learning but do not consider them as the official platform for teaching and communication. Findings also revealed disparate views on training for ODL instructors.

Keywords: Administrators · Instructors · Communication management · Distance learning

1 Introduction

The evolution of technology and digital communication tools has contributed to the shift of paradigms in managing distance learning communication systems. Online education instructors engaged in more dynamic interactive learning with technology [1–3]. Against

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the backdrop of communication dynamics and flexibility ushered into education by IT advancement, there are caveats to these dynamics as far as teaching and learning are concerned. For instance, irrespective of the medium or communication platform used by the management of educational institutions to relay messages to instructors, there must be a corresponding cognitive or behavioral change. This must in turn manifest in the classroom as part of the knowledge or character the student will acquire. Another caveat of concern is the avoidance of distorted information, misunderstanding, and miscommunication of facts (knowledge) that may permeate society via instructors and students. Many ODL administrators believe that every critical detail of information relayed to the instructor/lecturers is secured, well thought out, and explicitly stated [4]. However, as they hit the "*sent*" button on the communication platform and await the response from instructors with the hope that instructors/teachers have internalized the message, the teachers are confused because the ubiquitous nature of communication platforms makes the message diffuse with other messages plying the same platform. As such, the intended message is distorted and lost [4]. The pressure of work in ODL is heightened due to real or near-real-time communication and responses required. This made some ODL administrators in "*their own judgment*" believe in the deployment of multiple channels of communication without recourse to instructors who will eventually act on the information relayed for teaching. This only increases the likelihood that messages will be misinterpreted or misunderstood.

The intention of administrators is to help the instructors navigate through the online learning platforms, reach out to students—by uploading instructional content and being responsive to student needs. However, rather than serving as a catalyst for decoding and efficient utilization of the information relay by ODL administrators, the communication tools or platforms adopted create overload and exacerbate staff stressors. So, the central question that guides this study is how can ODL programme administrators manage communication to deliver learning without overwhelming the instructors. The United Nations Educational, Scientific and Cultural Organization (UNESCO) [5] defined the term open and distance learning (ODL) as teaching and learning that removes time and space from the learner with the aim of improving openness and flexibility in terms of access, curriculum, or other elements of a structure. The popular opinion on the use of ODL is that it describes communication in learning as not being constrained by time and space [6].

The number of higher education institutions that have launched the ODL teaching and learning mode in Malaysia has increased dramatically over the years. This increase necessitates the need to have communication platforms or tools that will support the quality of T&L in ODL programmes. In addition, the role of administrators/coordinators in handling or managing communication with instructors in ODL programmes is very germane. Presently, fourteen public and private higher learning institutions offer ODL programmes in Malaysia [7]. In addition, as of 2019, numerous numbers of students have enrolled in different ODL programmes in these institutions. The need to expand education via distance learning was given priority in the Tenth Malaysian Plan (2015–2025) under the Blue-Ocean Strategy. The current access to the cyber world in Malaysia currently stands at 96.8%—one of the highest penetration rates across Asia [8]. The ninth shift in the current MoHE policy stated that "up to 70% of programmes use blended learning models." There is expected to be a tremendous increase in ODL learners in Malaysia in the years to come.

However, the fact remains that distance learning programmes can only thrive in these higher institutions if communication that serves as the vehicle to convey learning is well managed. Maintaining quality pedagogy and efficient utilization of communication platforms in ODL are the major challenges to many higher institutions [9]. If instructors are successful, encourage engagement, manage course materials, and offer enough learning assistance through the communication medium, technology can improve students' learning in ODL [10]. All these expansions have widened the administrative and management functions of the University/Faculty.

The instructional support from instructors in distance education programmes had historically been undervalued. This is because the prevalent perception of faculty and department administrators of teaching and learning in ODL is that the instructor's role is mainly to grade or mark students' assignments that are completed at an appointed time [11]. As the need for quality materials that can improve learners' engagement in ODL increases, emphasis on and demand for the need for self-regulated learners becomes necessary. However, managers and administrators of ODL programmes in universities have largely not recognized that distance learning is a very different curriculum and pedagogical principles. They have not come to grips with the underpinning organizational requirements needed to implement and sustain quality distance learning [12].

Another setback in running ODL programmes is the myth pertaining to the coordination and management of student-teacher communication. According to [13], a lot of ODL administrators and leaders think that faculty members (full-time or part-time) with little or no training may simply add teaching ODL courses to their current burden. Some administrators think it's unnecessary to create modules that can help these instructors to easily teach the course material [12]. This supposition leads to subpar programme, ineffective use of communication tools like LMS, and dissatisfaction among students and instructors. As mentioned earlier, the purpose of this study is to investigate how administrators and coordinators enhance ODL instruction for effective learning.

2 Communication Management in Online Distance Learning Programme

To manage and sustain learner participation and interaction in distance education as argued by [1], communication must be managed effectively. Communication is the main factor in increasing learning success and the overall effectiveness of the ODL programme. Instructor and learner support will enable learners to connect to other information and retain information better and more effectively [14]. To manage communication in remote learning, it is necessary to coordinate both the technological instruments used to provide learning content and the instructional actions of the instructors [15]. In the context of this study, communication management specifically entails two parts: communication practices (managing content, and giving feedback on learning materials) and communication tools (managing learning via LMS, ALIM, CMS, blogs, googleMeet, Zoom, and email). When task requirements are in line with the communication medium, the capacity to transmit information and task performance is enhanced [16].

[17] contends that there is a lack of clarity regarding how courses should be organized and managed by instructors regarding course management in ODL. This is consistent with the [18] thesis that the lecturer's job frequently entails assisting students in using software and hardware interfaces. Management of technology to prevent it from becoming a barrier to communication, which can unavoidably impede learning, is therefore one of the responsibilities of the lecturer. To allow seamless integrated learning for the student, the instructor's job calls for skills in cross-functional teamwork [19]. The truth is that many distance learning instructors have not yet mastered the use of communication tools such as LMS, ALIM, CMS, blogs, GoogleMeet, Zoom, etc.

2.1 Leadership in the ODL Programme

There appears to be a paradigm shift in the management and administration of remote education as learners in ODL achieve their educational needs with minimal human interaction [20]. The demands of the contemporary educational environment are overwhelming school administrators and leaders. Even though, ODL continues to gain momentum with the aid of remote education technology platforms, some of the ODL administrators lack flexibility. Some are enmeshed in their outdated, restrictive, and expensive managerial practices. On the other hand, some ODL program leaders are too hasty to integrate innovative programs and practices into conventional academic environments [21]. Advocating a radical paradigm shift from the old to the "*new normal*" of ODL communication practices and tools often results in alienating rather than attracting faculty members [21]. [21] also emphasized that this *"thinking outside the box"* mentality creates resistance that is difficult to summon and inevitably preserves the status quo. Clear positive messages from administrators can go a long way toward making instructors who work at home feel more connected [22].

Investigation and review of the special and distinctive role needed for leadership in remote education were prompted by the crucial function it will play in the new globalized educational millennium. As a result, leadership in the context of distant learning is a pertinent subject for this study. Leaders and administrators in remote education are required to manage, facilitate, and coordinate instructional support communication practices [15]. To ensure the seamless transfer of pedagogical policies and the progressive shift to ODL contexts, leadership in ODL must address behavioral components such as faculty motivation, commitment, and satisfaction [21]. A higher education institution's management is required to create and carry out a development strategy for the institution [24]. As a result, the managers, coordinators Deans, directors, and department heads of various units are then given the chance to adopt or modify the strategic directions that best suit their needs [23].

In their argument, [24] claim that distance education leadership must understand the need to operate differently from traditional educational leadership. The leadership at ODL over the years has developed the idea of gaining a strong technological vision strong enough to replace conventional educational models. However, the development of the human capital (instructors), who can use this technology to achieve learning has not been given much-needed attention. This gap in [24] thesis, means that ODL leadership strategies have only captured one of the components needed by distance education leadership. Additionally, administrators' concern with purchasing technology without qualified instructors is unproductive, according to [25]. Only instructors who are competent in employing instructional technology can impart knowledge [20].

As a result, the model of leadership for distance education that this study proposes is based on both [21, 25] theses. That is a leader who can recognize the advantages, disadvantages, chances, and threats present in the mix of human and technical resources and strategically direct them to meet the learning goals. To build and offer remote education courses, leadership in the field must work to integrate instructional technology, learner interests, and faculty, administrator, and administrative experience [21].

2.2 The Roles of Distance Learning Administrators

Many administrators would admit that the shift to ODL has not only increased emotional tensions among faculty but has also brought to light the fragility of communication with them [22]. ODL administrators are individuals who are burdened with the responsibility of overseeing and coordinating all distance education activities [23]. They plan and make decisions about course materials, faculty recruitment and training, communication equipment, etc. ODL administrators' responsibilities also include coordinating and monitoring course delivery and all the processes and preparations involved in delivering the course to students [26]. Administrators of distance learning programmes must make sure that the technology available to instructors and the instructors themselves are competent in delivering the course material to students [1].

In summary, the literature reviewed to date indicates that only a handful of research papers mention issues related to communication management practices by instructors, leadership, and the role of administrators in distance education programs. Therefore, there is a need for more extensive and empirical studies on communication, leadership, and distance education.

2.3 Purpose of the Study

The main objective or purpose of this study is to investigate the technological handling capacity of ODL administrators that facilitates efficient and real-time learning in ODL programmes.

3 Method

Most of the studies on distance learning and technology have focused on statistical techniques [1]. While these approaches are noble, it is contended that studies on the use of communication technology in education, especially ODL, need more of an exploratory approach to provide a deep understanding of the phenomena. The qualitative research approach serves as an impetus for providing in-depth results. This study adopts a qualitative phenomenology method in order to gain a well-grounded understanding of the dynamic nature and meaning of the lived experience of leadership and administrators' role in managing communication between instructors and learners in distance learning in Malaysian ODL universities. Both public and private universities in Malaysia have expanded the scope of learning to accommodate ODL programmes in recent years. The fact that phenomenology is more particular about discovering and explaining people's lived experiences, the purposive sampling technique was deemed an appropriate method to tap data on the role of administrators in facilitating communication between instructors and learners. The rationale behind the choice of purposive sampling technique is to select individual (ODL administrators) that allows for equitable comparison based on research objectives and internal generalization. The researcher adopted a one-round data collection procedure using semi-structured interviews. Semi-structured interviews and design created a free-flowing, exploratory, inquisitive, and stimulating sequence for examining diverse interactive life realities in the context of research.

3.1 Participants

The interviews tap into understanding, awareness, and exposure to the current state of emerging communication technology platforms adoption in teaching and learning among higher education institutions in Malaysia. This enabled the researcher to obtain a broad view and test the applicability of the key administrators-instructors' interaction concepts: consistent training for ODL instructors, efficient monitoring of online communication, integration of social network sites (SNSs) into the learning platform, and effective recruitment procedure. During the interview, the primary query was "As the coordinator/administrator of ODL programmes, what do you do to ensure that the instructors use the communication tools to foster interaction among students?" This led to further challenging questions. All interviews were conducted with the ODL administrators, the ODL course owners, course managers; administrative officers; programmes coordinators, and heads of departments. All the interviews lasted for about 30 to 45 min. Table 1 contains a detailed summary of the interviewees' profiles.

Table 1. Participant profile

Interviewee profiles	Position	Institution	Age	Gender
Jafary	Head of department	MEDIU	>30	Male
Madam Shuh	ODL Administrative officer	MEDIU	>30	Female
Miss Far	ODL Administrative officer	MEDIU	>20	Female
Mr.Shazdocx	ODL Head of Exam & Records Department	MEDIU	>20	Male
Madam Onn	ODL course coordinator	OUM	> 30	Female
Jane e-Asia	ODL course coordinator	e-Asia	> 30	Female
John e-Asia	ODL course coordinator	e-Asia	>30	Female

(*continued*)

Table 1. (*continued*)

Interviewee profiles	Position	Institution	Age	Gender
Nur e-Asia	ODL course coordinator	e-Asia	>30	Female
Anita e-Asia	ODL course coordinator	e-Asia	>30	Female
Tan-	ODL course coordinator	Wawasan Open University	>30	Male
Khrusna	ODL course coordinator	Wawasan Open University	>30	Female
Madam Goh	ODL programme coordinator	Wawasan Open University	>40	Female

Note: Names in the table1 are pseudo-names; names of the participants are kept anonymous

3.2 Data Collection and Analysis

A thematic approach to data analysis was used in this study. Themes (patterns) that are significant to the phenomenon under study are found, explored, and reported using a thematic approach [27]. The procedure of thematic analysis involves six steps.

Phase 1: The concepts (administrators-instructors' interaction, consistent training for DL instructors, efficient monitoring of online communication, integration of social network sites (SNSs), and effective recruitment procedure) that were previously uncovered came from the literature. Using code titles, descriptions of what the codes are, and examples of how to recognize when the narrative pattern associated with each code happens, the meanings and characteristics of these conjectural codes have been recorded in simple words.

Phase 2: All transcribed interviews were imported into Atlasti version 9 data analysis software for initial coding and categorization. The reliability and validity analyses were subsequently ascertained. This is done to make sure the codes are valid and applicable to future raw data. Tests of trustworthiness and confirmability of the data were obtained to ensure that the data were both valid and reliable. This was done by sending the verbatim transcription of the interview data to the participants for review. After crosschecking, the replies from participants were used to confirm that the transcriptions were accurate. In addition, a preliminary coding process was carried out; an inter-rater validity technique was applied to validate the accuracy of the selected themes. Three intercoder/judges (colleagues) were consulted to rate preliminary generated codes. The result of the kappa inter-rater reliability test gives 78% reliability from three raters confirming the adequacy and consistency of the emerging themes. The reliability analysis's findings demonstrate that these concepts perform better than the benchmark of 70%. Proposed by [28].

Phase 3: All the transcribed data (12 interviews) were imported into Atlasti as document files. Atlasti was used to ensure an easy coding, categorization, and theme-generation process. The Software aided in applying codes to the unprocessed data. as well as connecting code from all interviewees (see Fig. 1).

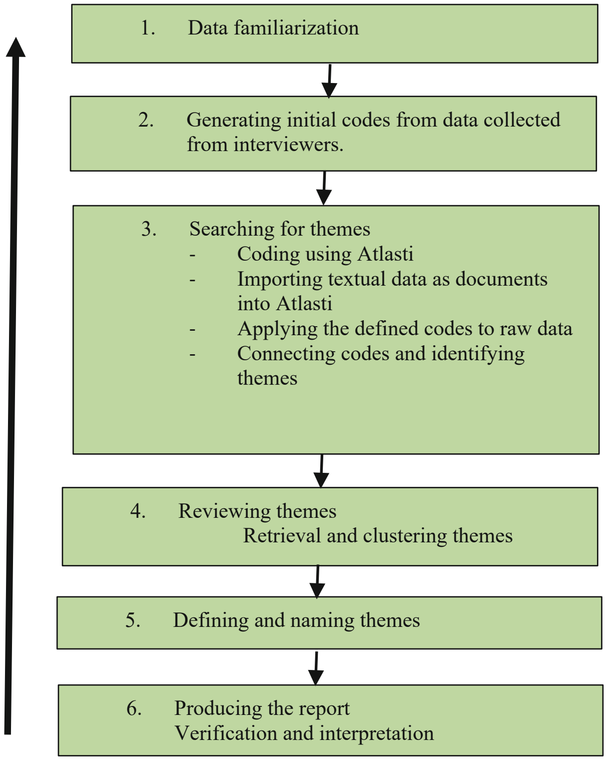

Fig. 1. Data analysis process

Phase 4: Data were retrieved from the Atlasti retrieval interface and clustered/mapped. It is understood that the confirmability and trustworthiness of code and theme extra validation in Phase 5 suggested extra reliability and validity checks in qualitative research, which is always a continuous process. This includes experts' judgment as mentioned in Phase 2 (i.e., giving the codes and quotes to a panel of experts/judges who compared the quotes against the codes and themes). Figure 1 shows how data were analyzed and validated.

Phase 5: Inter-rater reliability was conducted using percentage agreement on the initial codes. Selected judges rate the quotes or excerpts extracted from the transcribed verbatim responses of the participants in opposition to the emerging codes and motifs [29]. This approach was chosen because data codes were nominal and required the coders to make presence determinations.

The Scale

Over 75% of the code and theme derived from the interview data are reliable, according to the reliability study provided in Table 2. The reliability number exceeds the 70 percent standard recommended by [28], indicating that it is sufficient. Further analysis and interpretations were done on the codes and themes.

Table 2. Reliability analysis

Coding theme	Number of judges	Reliability – level of agreement		
		First judge	Second judge	Third judge
Administrator-instructor interaction	3	80%	75%	81%

4 Findings

The findings presented in Figs. 2, 3, 4, 5, and 6 depict the themes associated with the administrator-instructor interaction in ODL programmes and their supporting cases. [29] identified three methods of thematic analysis (data-driven approach, theory-driven approach, and hybrid approach); We adopted theory-driven and data-driven approaches because the concepts used in this study were derived from the existing Transactional Distance Learning Theory (TDLT) and literature. Themes were clustered conceptually based on the characteristics of the six concepts of TDLT. The information offered here is based on participant accounts, theories of distance learning, and pertinent literature.

4.1 Identification of Relevant Coding

Due to its complexity and originality, the results demonstrate that interactions between administrators and instructors in ODL programmes entailed several steps. The new ICT adopters and decision-makers in the educational activities of the future are ODL instructors, students, and higher education institutions. Therefore, there is a need to ensure that efforts to coordinate and manage pedagogy and administrative interaction among these three actors are identified and well supported. Identification of the need to leverage communication technology to coordinate administrative activities in this digital age is the key factor in this research. It made it possible for the emergence of other factors in this study. Interviews with the ODL administrators to explore how they perform administrative functions in a computer and internet learning environment generate variants of coding segments among the participants. Participant Anita's (a pseudo-name) interview has 28 coding segments on information related to computer-mediated learning and administrative functions, while Miss Far's (pseudo-name) interview generated only six segments towards the overall theme.

In addition, the central theme (administrative functions in a computer and internet-learning environment) helped to identify other internal codes that are peculiar to the study's discourse. The codes, corresponding participants, and frequency of occurrence are discussed. For instance, Anita and one time Mr. Shazdocx mentioned an effective recruitment procedure (ERP) four times. The administrators-instructors interaction code was reflected in the interviews of all the participants except the interview data of Madam Shuh. The code appears most frequently (five times) in Mr. Shazdocx's interview and Miss Far mentioned it just once. Another code that was generated from the interview is the Integration of social media. All the participants discussed this code. It appears more than once in the conversation with most of the participants. Monitoring communication efficiently is another important categorization that surfaced in the interview data. It appears 10 times in Goh's interview and just once in the conversation with Mr.Shazdocx. Training ODL Instructors is another unique categorization that emerged during the participants' explanation of the central theme. It appears twice in Jafary, Madam OM, Madam Shou, and Mr. Shazdocx's interviews. Content interaction code appears in an interview with Jafary, Tan, and Madam OM and Madam Shuh. In a nutshell, to understand how the central theme of the study is interlinked with other emergent codes, an effort was made to comprehend the circumstances that influenced the categorization process. Atlasti Code Mapping deep (see Fig. 2) was used to display deep insights about the interaction between the main theme and the sub-themes, and the corresponding participants.

Staffing Process
The participants mentioned the procedure they used in recruiting instructors for an online programme.

> *"Since internal or online professors work for us, we choose them based on their expertise in their fields and their qualifications, which is to say that we hire them based on their specialization academic qualifications. They won't have much difficulty preparing the lesson notes for the lecture notes because they are teaching the linked subjects." 19.*

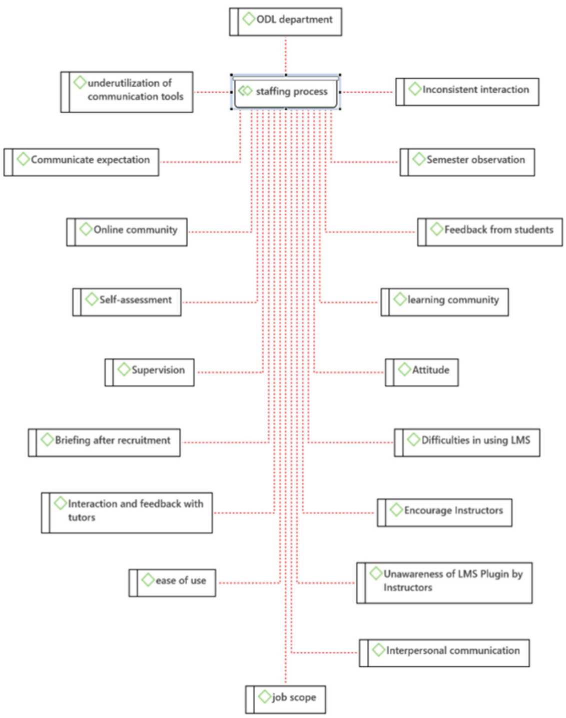

Fig. 2. Code mapping for theme: Staffing process

In recent studies [23] the recruitment and selection procedure for distance learning instructors does not consider any special criteria, because the administrators think that instructors are basically performing the same task as conventional learning instructors. They believe that the instructors' role is mainly to grade or mark students' assignments that are completed at the appointed time. This level of understanding undermines the unique nature of the distance learning environment—which is highly mediated by ICT. Distance learning administrators must recruit instructors who have competitive advantages in the use of ICT for ODL programmes [10].

Interaction Using ODL Communication Tools
The distance-learning administrators explain how they ensure interaction with the instructors. "Meetings are important to convey ideas and to enhance understanding between lecturers and administration". The ODL administrators considered interaction with ODL instructors to be an important and innovative step [15]. According to one of the administrators:

> *"I as the director will remind the lecturer" "I will ask for clarification of what's going on you are just very quiet for these two weeks" Normally they will tell us that's how we monitor*".

In practice, a question may be raised as to how administrators-instructors' interaction could leverage ICT to bring about consistent interaction in ODL programmes. Our analysis suggests that most administrators have identified this challenge and have begun to appreciate the uniqueness of ODL programmes by making use of the learning platform driven by ICT. They have become enthusiastic about the features of ICT that engage in continuous monitoring and engagement with instructors. For example, one administrator describes the innovative way they use in maintaining constant interaction with the instructors *"We have our online community for all our tutors, and we have our Mobile Support for Tutors"*. The finding suggests that ODL administrators rely heavily on communication tools—ICT to monitor and interact with the instructors. This indicates a paradigm shift in the administration and management of education activities from the conventional filing, memos, physical meetings, etc. to managing pedagogical activities in the *"cloud"*. One of the implications of this is that university administrators have realized that ODL activities are embedded in ICT tools, which require a different approach far from the conventional administrative procedures. Leadership in ODL must function differently from the conventional routine education activities and administrative processes. Atlasti Code Mapping technique for the theme is displayed in Fig. 3.

Themes related to engagement with the course content and the arrangement of the learning materials were developed from the analysis of the interview data in answer to the question concerning interaction with communication technologies. All participants agreed that keeping an eye on forum activity improves the relationship between teachers and students. One of the ways to improve student interaction in distance education is to ensure that forum discussion among students is thoroughly monitored. This is in line with the suggestions of [2], that the instructor's role is to ensure that learners can easily interact with learning materials using software and hardware interfaces. This is supported by administrators' comments. One of the administrators mentioned.

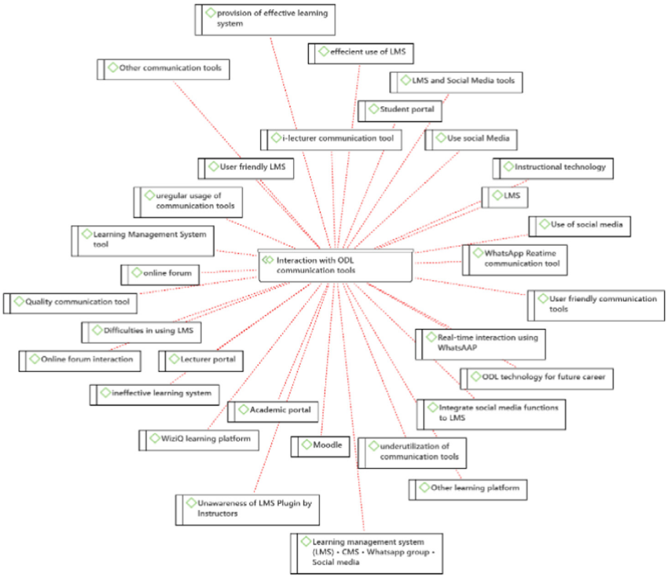

Fig. 3. Code mapping for theme: Interaction with ODL communication tools

"We have to make sure that what we call the basics of teaching and learning take place such as lecturer have to post a question for forum and students have to answer the forum".

Another administrator said

"The academic content of each subject is delivered by one or both of the following means: the first mean: which contains the text used in the course and presented in PDF format. The second means the subject lessons which are presented using an interactive format".

This theme is consistent with TDLT theory's fundamental principles, which place a strong emphasis on monitoring student and teacher engagement in online learning environments. The motif, however, appears to favor centralized communication.

Integration of social media

In most cases, the interaction between instructors and learners in ODL programmes can be done via other learning platforms that are relatively different from the ones approved by the management. This is what I refer to *"outsourced learning platform"* like the social network sites: WhatsApp, email, Twitter, personal phone calls, Facebook, Telegram, etc. This study reveals that the integration of social networks into the ODL platforms has made learning more interesting and in near real-time. All the administrators interviewed agreed that they allow the instructors to use other learning platforms apart from the one provided by the university. However, all the administrators acknowledged that learning done or conducted outside the official platforms is recognized but not documented as attendance for students and lecturers. The support provided by these learning platforms is counted as emerging ICT-mediated learning by the administrators. Nevertheless, these interests and assumptions have not led to greater alignment between the university learning platforms and the social network sites that have been used for learning. The study finds that alignment is difficult to achieve because of monitoring. For instance, one of the participants said,

"Yes the instructors can use Academic Portal, personal email, and other social networks like Facebook, WhatsApp Telegram Twitter, etc. But only the academic portal is officially recognized because of monitoring."

Insistence on the use of a university official learning platform has discouraged many instructors from expanding their capability in ODL to enjoy flexibility in teaching and learning. However, with the current situation of covid-19 pandemic, many school administrators and leaders are relaxing this policy. This is supported by previous studies. For example, [3, 31, 32] maintained that the major challenge in ODL programmes is quality pedagogy and efficient utilization of communication platforms. Atlasti Code Mapping technique for the Integration of Social Media themes is displayed in Fig. 4.

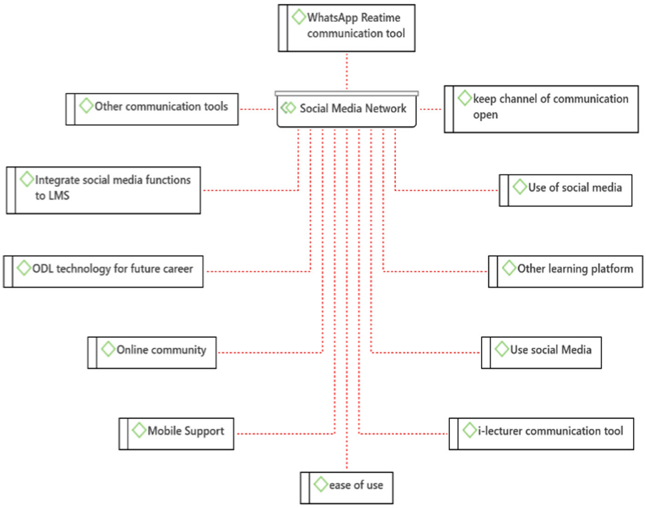

Fig. 4. Code mapping for theme: Social Media network

If instructors promote interaction, manage course contents, and provide sufficient learning support using a variety of communication media, learning will be more interesting [10, 30]. Hence, despite the potential benefit inherent in the use of emerging SNS platforms for learning, the long-term feasibility often remains uncertain because of the monitoring challenges faced by administrators and the higher institution integration process. However, one of the advantages of integrating SNSs in institutional learning platforms is that it serves as an innovative drive, especially when it is conducive and in line with the educational objectives and other stakeholders, such as learners, government, and industry. Therefore, alignment between learning platforms and SNS is important to realize the aspirations of both learners and the institutions of higher learning.

Monitoring ODL Learning Activities

Although the concepts and details of this subject may have already been included in the participants' verbal descriptions, they are now more clearly expressed at this level. [26] noted that the administrators' role in ODL programmes is to leverage technology to establish adequate and consistent monitoring of communication and interaction between instructors and learners. This is particularly true because a piece of technology is more valuable to users if it meets the necessary evaluation criteria. My evidence suggests that administrators' monitoring of teaching and learning varies among ODL programme providers. For instance, one of the participants mentioned

> *"Monitoring of online activities like assignments and forums"*. Another one said, *"All the activities of the online tutors are captured and tracked in our LMS"*.

One administrator said

> *"We monitor closely for example to pursue a semester, it is the responsibility of lecturers to upload the instructional design, assignment, and question forum and we monitor them from the first week of the semester"*.

Another instance

> *"In our LMS we can monitor privately by weekly by month......means how many hit ... we call hit When lecturer enters their LMS they must type in their username and password that we call hit. From that every week we can know how many hits for each lecturer and for students Also we can see how many hits from students meaning that whether they enter hit or not"*

Similarly, [26] emphasized that distance learning administrators must design ways to coordinate and supervise course offerings and all processes and preparation that are involved in the delivery of courses to the students. Efficient monitoring of teaching & learning activities requires the cooperative effort of the instructors, the administrators, and learners.

Effective monitoring includes the need for leaders to learn and reconfigure the new communication technology's adoption in the administration of education activities in higher learning institutions. One of the implications of this is that the participation of top management in the configuration of communication technology for teaching and learning will lead to the development of learning management systems that are distinctive and challenging for competitors to duplicate leading to competitive advantage. Atlasti Code Mapping technique for the theme monitoring ODL activities is displayed in Fig. 5.

Regular Training for ODL Instructors

The general observation is that higher education institutions' adoption of new ICT does not always result in the desired outcomes. This is particularly true because most of the instructors recruited to teach in ODL programmes have no prior or apriori experience. This leads to the underutilization of the features in most of the learning platforms. For example, one of the administrators said

Fig. 5. Code mapping for theme: Monitoring of ODL activities

"Students sometimes from few lecturers' inabilities to utilize this high tech fully"

Another administrator said,

"Having more structured activities online and training for instructors on the way to help learners to be self-managed learning, aside from the online forum discussions".

Lecturers need more training, especially those who are old (*technology-immigrants)* and not familiar with computer-based learning. Another administrator mentioned ongoing training from the IT department on how to use the system properly; most of the lecturers only have a basic knowledge of our system.

Training of ODL instructors on the use of ICT should be constantly negotiated as a process of aligning traditional and modern pedagogical approaches. This however depends on the ability of the key actors (administrators and instructors) to align their interests for efficient learning [13]. The finding suggests that updating instructors' teaching capability to use learning technology optimally is crucial. Atlasti Code Mapping technique for the theme of regular training for ODL instructor activities is displayed in Fig. 6.

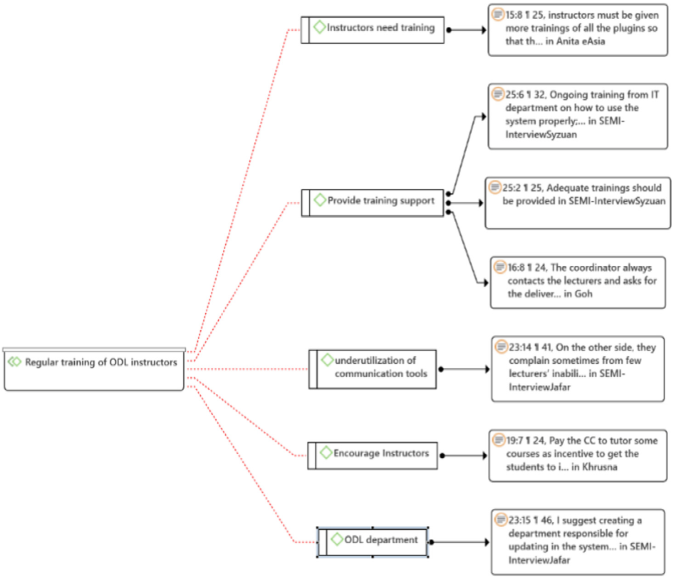

Fig. 6. Code Mapping for Theme: Regular Training for ODL Instructors

5 Conclusions and Implications

This study attempts to advance leadership and administrators' roles in distance learning research and practice by investigating the emergence of ICT in the management of education activities in ODL programmes. The findings demonstrate that ODL administrators leverage communication technology to monitor and coordinate the dynamic and interactive nature of teaching and learning activities in the ODL environment. The outcome of this study is the presented framework, which describes the adoption of the five communication management concepts: Effective Staffing procedure for ODL instructors, Interaction with ODL communication tools, Integration of Social Media Networks, Monitoring ODL activities, and Training ODL Instructors. These activities help to illustrate that the adoption of ICT in the education context is a dynamic, interactive, and ongoing process. This is particularly true because administrative and leadership functions in the ODL terrain have been influenced by numerous technological factors. As clarified in the preceding section, it is believed that the themes herein provide a useful analytical apparatus to demonstrate the unconventional and dynamic process involved in managing ODL programmes. As such, emphasis on the need to facilitate the positive interplay of key actors (technology, instructors, and learners) is articulated. This endeavor is a step towards developing new ways of examining and understanding the shift in leadership and administrator functions in the emerging "digital learning environment." The adoption of ICT in teaching and learning has moved from a simple information storage and retrieval process to involving various interactive and virtual cues that require new administrative procedures. The study affirms that the activities or functions of education administrators in the present digital age have been influenced by technology and a general change in the teaching & learning (T&L) landscape. Furthermore, the findings reveal that these changes, especially the innovative ones, are at the forefront of initiating and influencing technological development and adoption in education. Therefore, the study is useful to the leaders, school administrators, instructors, and system developers who are involved in the development of T&L platforms to understand how their knowledge, expectations, and interpretation of the T&L technology relate to the education stakeholder's interest. Administrators who are positively influenced by the adoption of ICT can use the findings of this study to make an estimation of possible values and interests of other stakeholders like instructors and learners attached to the teaching and learning process.

Studies that use qualitative research often face the challenge of limited sample size. This limitation calls for caution in the generalization of the findings. The findings of this study can be subjected to validation across a wider population using mixed methods approaches. Thus, future studies can use more data to allow for a more reliable generalization. Managing T&L in ODL is an ongoing action and ODL administrators do not rely on a single system, due to the constant demand for a flexible learning environment and technology advancement. Instead, they use other communication technology applications to accomplish their tasks.

This study did not focus on a specific type of T&L technology, as the aim is to propose a framework that can be applied in monitoring and managing communication between instructors and learners in ODL programmes. Though this may be considered a limitation, the themes proposed herein would provide a basis for developing a context-specific framework in the future. For instance, it can be modified to examine the integration of social networking (e.g., Facebook, Whatsapp page) into higher institution distance learning management systems.

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Multiple Users to Remote Access Teaching Platform

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Abstract. During the pandemic season, remote learning is preferred by most educational institutions to prevent rapid spread of the Covid-19 virus. Remote learning basically focuses more on theoretical type of learning more and certain institution does not have the facilities or could not afford Virtual Reality labs. When it comes to lab or hands on learning, mostly it would be done by using simulations. From these students would not be able to get a real-life experience in handling those hand on activities. Some learning institutes would ship portable components to the student's residence, but this method is not helpful since there are high chances where those components would be vandalized intentionally or unintentionally. In addition, distance learning does not give the proper access to group studies as students would be in different location while undergoing remote learning. Every project or task, mostly require student to complete individually while having remote learning, due to this there is no exchange or idea or any active learning among the students. This project is to develop a remote learning platform for students to get access of the CrowPi board from home and would be able to undergo interfacing activities and learning from home or wherever they are remotely, by having live camera access as well. To add on, multiple students can be able to access one board remotely so that students can even work in groups and exchange ideas and knowledge.

Keywords: Remote Learning · Virtual Reality · Distance Learning · CrowPi Board

1 Introduction

1.1 Background

The current situation of remote learning is limited to theoretical and simulated types of studies. This leaves a huge gap for interfaces or practical based learning or teaching methods. For practical work, there is a need for hands on type of work which would require components or teaching parts to be shipped to the student to carry out the related work. In addition, remote learning does not give the proper access to group studies as

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students would be in different location while undergoing remote learning. Every project or task, mostly require student to complete individually while having remote learning, due to this there is no exchange or idea or any active learning among the students.

1.2 Problem Statement

Three main identified problem statements will be solved through this study:

- Limited number of CrowPi boards available at UTP.
- No existing readily available platform for access to a single board computer for multiple users especially for interfacing projects.
- Difficulty in doing hands on interfacing activities in lab and as project work.

1.3 Objective and Scope of Study

The aim of this paper is to describe and discuss the development of a platform to remote access single CrowPi educational board for multiple users with live streaming of the board itself to monitor any changes of the electronic components on the board.

1.4 Tools

The software and platforms used are as follows.

- Operating System – Linux Raspberry Pi
- Learning Material Language – C Progamming Language
- Remote Access Platform (Student End) – Electron JS
- Remote Access Platform (CrowPi) – NodeJS
- Communication – Web Socket Protocol
- Web Cam Software – Mplayer

2 Literature Review

There are many benefits of remote learning especially during this pandemic era for students [2]. One of them is that students can access references from the internet during online classes that could enhance their learning process. They will be able to figure out how to use these resources on their own. Another benefit stated [2] is that for some students who must work to help support their families, they can have more flexibility in their studies.

Moving on, article from Dataprice [6] stated that any IT toolkit used to connect to, access, and control devices, resources, and data stored on a local network from a remote place is referred to as remote access technology. This is distinct from employing a cloud solution because it gives users access to an on-site environment rather than hosting data off-site in a shared environment and making it accessible online. For companies of all sizes that have not switched to a cloud-first approach or that need access to on-premises devices or resources, remote access is essential. Remote Desktop Services, Remote Access Software, and Virtual Private Networks are three of the most popular remote access technologies. The article pointed out that [6] RDS can be utilized on a local network to enable shared access to devices and resources, but for it to be a useful tool for remote working, companies must access RDS services online. This, however, is currently one of the most popular strategies used by cyber attackers to locate and access networks, making it riskier as the cybersecurity landscape changes.

In addition, for online teaching, this service enables students to execute tests and laboratory tasks remotely. In a remote laboratory environment, the same interaction with software and hardware can take place at a distance with the assistance of the remote infrastructure. This is a new layer that lies between the user and the lab apparatus.

This work is motivated by the aim to introduce a compact Raspberry Pi educational kit in the Structured Programming and Interfacing (SPI) course. The course involves teaching of C programming language and hardware-software interfacing in C. The CrowPi kit is designed for students to not only learn programming and basic computer science but also electronics through its integrated sensors (hardware). With remote access facility, students will be able to connect to the CrowPi system when they are physically far away.

Methods of learning are vital aspects to facilitate students in learning process especially on virtual platforms. Some people feel that studying in a group is more beneficial than individual learning while others probably have a different opinion. On virtual platforms, some difficulties are faced involving group-based activities especially involving hands on lab tasks like what we have in the SPI course. With a platform to remote access for multiple users, this problem can be resolved.

3 Methodology

Development of a remote access platform for multiple users. This platform has been designed based on room-based access system which is a platform where multiple users will get access to the same CrowPi Board.

As for the server end, the user can view and access the CrowPi board. This platform uses a web-based application, where it has a designated URL. In this server page, it requires the students to enter a room ID so that they can remotely access a CrowPi board.

There is also live camera access provided to the users using Mplayer to telecast the live camera feed. Before turning on the CrowPi board the external camera should be plugged in first.

3.1 System Architecture

(Figs. 1 and 2).

From the figure above it shows the system architecture. Remote Platform is basically the video communications of two machines and in this project, we have two ends of machine which is the client end and the server end. Since this project is mainly focusing on multiple users accessing a single CrowPi Board, this system architecture is designed in a way that a room will be created with a random generated room ID. Students with the same room ID will be able to access the same CrowPi Board.

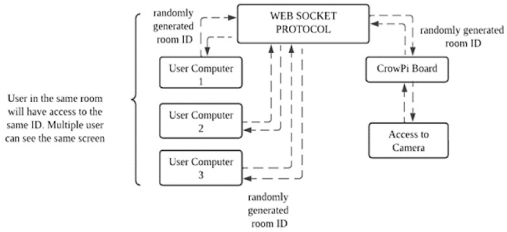

Fig. 1. Shows the system architecture

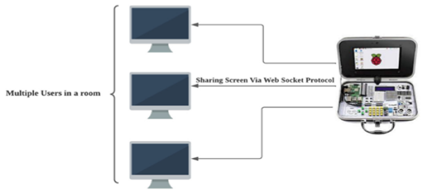

Fig. 2. Shows the visual representation of the system architecture

3.2 Flowchart

Student/User end. The flow of the system in the user ends goes in a way where once the user enters the application, they ought to enter the room ID. Students then, would be able to see the whole crowPi screen and would have the remote access automatically. Later on, user can enable the CrowPi external Camera to get the view of the hardware available (Fig. 3).

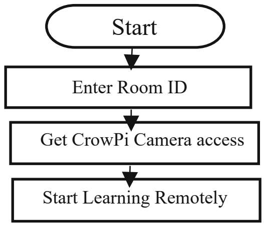

Fig. 3. Flowchart shows the User flow of the application

Server End (CrowPi). This flowchart is describing a process that starts with a user connecting to a device called a crowpi using a randomly generated ID. The process then waits for students to remotely access the crowpi and allows multiple students to enter the same room with the same room ID. Once a student has entered, they are able to use the remote desktop to access the crowpi (Fig. 4).

SDLC RAD Methodology. This part of the report had the outlines of the research strategy, the research method, data collection techniques and research limitations of the project. In the project the Software Development Life Cycle was used as the research

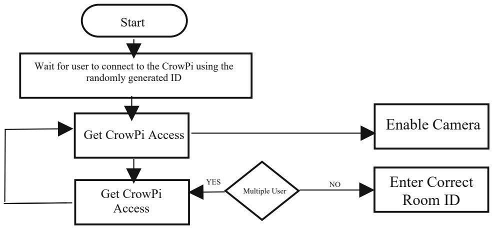

Fig. 4. Flowchart shows the flow for the user end

methodology. The Software Development Life Cycle (SDLC) is a framework that defies the tasks that must be completed at each stage of the software development process. The Software Development Life Cycle is the method for designing, developing, and testing high quality software that meets or exceeds user's expectations and is completed on time. The SDLC methodology if a method for developing high quality software that includes specified processes. To have a well-structured working method and to provide an efficient outcome, it is very important to have the most suitable methodology to run a project. In this project, as was mentioned I mainly used the SDLC method. The approach of this SDLC methodology mainly concentrates on the stage of software developing. The following steps will be used to ensure the workflow is smooth, efficient, and would be productive at the end of the project. The steps for the SDLC are as below:

3.3 Identifying the Current Problem

The first challenge is the limited number of CrowPi boards available at UTP. This poses a significant barrier for students and teachers who require access to these boards for hands-on activities in the lab or as part of their project work. The shortage of these devices limits the number of students who can work on interfacing projects simultaneously and can also impact the quality of their work. The second challenge is the lack of an existing readily available platform for accessing a single board computer for multiple users, especially for interfacing projects. This means that students and teachers must rely on physical access to the limited number of available devices, which can be time-consuming and inconvenient. The third challenge is the difficulty in doing hands-on interfacing activities in the lab and as project work. This can be due to various reasons such as a lack of familiarity with the hardware or software, limited access to resources, or insufficient support from instructors. These difficulties can lead to frustration among students and teachers, impacting their motivation and overall learning experience.

To identify the challenges, a need analysis was conducted by gathering information primarily from students and observations. From interviewing students, especially during the pandemic phase students find it difficult to cope with simulated hand on laboratory sessions and they were not able to visualize the real-life laboratory scenario. Next by observation, we have identified that the number of students in a course or lab session is more than the number of CrowPi Boards. Based on previous laboratory sessions, if students share on their laboratory item, they tend to get restless and frustrated when they were not allowed to bring back certain components from the lab. They get restless especially when they need to spend so much time physically in lab after the lab session to work on their projects.

3.4 Planning

In the context of developing a solution to the problem of limited access to single CrowPi for interfacing projects, the planning phase would involve determining the scope of the project, which includes identifying the target users, the features and functionalities required in the solution, and the timeline for completion. The target users for this project would be students who have enrolled in the Structured Programming Course.

Next phase of planning is by determining the project goals. The project goals would be to develop a platform that enables multiple users to access single CrowPi Board for interfacing projects, with features that enable remote access, collaboration, and a seamless user experience. The platform would aim to address the challenges identified in the problem identification phase, such as the limited availability of the CrowPi Boards, the lack of existing platforms, and the difficulties faced by students and teachers in doing hands-on interfacing activities. The platform would also be designed to provide a user-friendly interface that allows for easy navigation, efficient access to resources, and effective communication between users.

The third stage of planning is identifying the resources required for the project. The main resources required are from the software resources which would include the programming language framework and appropriate tool for the development and testing of the platform. The personnel resources required would include a developer with the knowledge of software development and enough knowledge in this field.

3.5 Designing

In the context of developing a solution to the problem of limited access to the CrowPi board for interfacing projects, the designing phase would involve the following steps. First is the user interface design for the web application. The user interface of the platform would be designed to provide a seamless user experience that is easy to navigate, and provides users with efficient access to resources. The user interface should be designed to allow for multiple users to access the platform simultaneously, and should be optimized for remote access and collaboration.

Next is the system design. The system design phase would involve designing the software architecture, selecting the programming languages, frameworks, and tools needed for development, and defining the system requirements. The software architecture would be designed to ensure the platform is scalable, reliable, and secure. The programming languages and frameworks would be selected based on their suitability for the platform's requirements. The system requirements would be defined to ensure that the platform meets the goals and scope of the project.

Moving on lastly to the integration design. The integration design would involve defining the integration requirements, selecting the necessary APIs, and designing the interfaces between the different components of the platform. The integration design would ensure that the platform is compatible with other systems and services and is able to integrate with them seamlessly.

3.6 Development

There are several development phases were involved. Firstly, is by implementing the User Interface. The user interface designed in the previous phase would be implemented using the chosen programming languages, frameworks, and tools. The user interface would be designed to provide a seamless user experience that is easy to navigate, and provides users with efficient access to resources. The user interface should be designed to allow for multiple users to access the platform simultaneously, and should be optimized for remote access and collaboration. The UI contains several functional buttons to generate random board access ID for the students to receive and access the board. Web application would display whether the remote access connection is successful or not.

The integration with other systems and services would be implemented on the integration requirement. For this project the integration used was the Web Socket Protocol to create the communication path between the user end and the machine end.

3.7 Testing

The developed platform would be tested to ensure that it meets the goals and scope of the project. Any errors or bugs found during testing would be fixed to ensure that the platform is functioning correctly. By simultaneously access the software with multiple entries. Testing out the camera functions, to see whether it supports two multiple users to access the same camera simultaneously.

3.8 Deploying

The first stage of deploying is by setting up the infrastructure. The necessary hardware and software infrastructure would be set up to host the platform. This includes setting up servers, configuring the necessary network protocols, and setting up the necessary software dependencies. In this project by setting up the infrastructure at the Computer Engineering lab, by identifying the suitable network topology which would be appropriate to support the system. Replacing all the ordinary machines in the Computer Engineering lab with the CrowPi Board.

Once the first stage deployment has been done, it should be tested in a staging environment to ensure that it is working correctly before opening it up for students. At this stage we should test the platform for scalability, reliability and security. Once the testing phase has been done, it would be deployed into a live production environment. Where students would be notified of the new platform and they would be provided with instruction on how to access and use it.

Lastly is the monitoring and maintenance, the new platform would be monitored to ensure that is functioning correctly. Any issues that arise should be addressed immediately to ensure that the platform is running optimally. Regular maintenance and updates would also be performed to ensure that the platform is up to date and secure.

SDLC have various software development life cycle models which were defined and designed to implement during the software developing process. There are a few models and each models follows a series of steps in its own unique way to ensure success in the process of software development. The SDLC model which will be used in this project is the RAD model, also known as the Rapid Application Development model. The RAD model is a process that involves no specific planning and prototyping. The software will be written in a fast paced and iterative manner. RAD focuses on developing soft wares based on requirements given. This process involves gathering and analyzing the requirements given. The RAD model distributes the analysis, design, and test phases into a series of short, iterative development cycle.

4 Impact Towards Teaching and Learning

The main objective of this project is to get multiple students to access the CrowPi Board remotely from wherever they are. Mainly so that they could work on practical programming remotely and at the same time the CrowPi board get vandalized. From this project what can be shown is that a each CrowPi board will generate a room and a room ID when the start share button is pressed. The room ID is a random generated key which will be generated newly every time the CrowPi share screen button is pressed. This is to ensure the security feature and to ensure that students do not simply get to access the board without any supervision. From this, students can experiment with basic source code which operates hardware components such as the LEDs, LCD screen, and the Seven Segment.

5 Result and Discussion

5.1 Result

Installation of Existing Platform – VNC. It was tested at the project's starting stage by installing a program named VNC. VNC stands for Virtual Network Computing. It is a cross-platform screen-sharing utility made for controlling a second machine remotely. In other words, a remote user can utilize a computer's screen, keyboard, and mouse from another device just like they were sitting directly in front of it. Client/server architecture is used by VNC. On the device you want to control from, a VNC viewer, or client, is installed, and a server component is installed on the distant computer. This could be a phone, a tablet, or another computer. A copy of the distant computer's screen is sent to the connected server and viewer via the server. The program enables keyboard and mouse commands to operate on the remote computer from a distance, so the connected user has complete control in addition to being able to see everything on the distant machine's screen.

VNC contains both a server end and a viewer end; the server end is a piece of computer hardware or software that provides capabilities to other applications, referred to as "clients." A server can provide services to one or more clients, such as resource or data exchange, under what is known as the client-server model. In this method, a single client can use several servers while a single server can service a few clients. A client (the viewer) will submit a request to a server, and the server will respond by submitting a response to the client. A computer with VNC Server software installed can be accessed and controlled from another device in a different location. The program enables the transmission of the device desktop to an additional device that has VNC

Viewer installed. When connected VNC Viewer users issue a request, they can then see the same thing as the user in front of the remote machine (with permission).

On the end of the viewer, is a piece of software that shows the content of a digital file on a screen. Use of Viewer to control nearby computers and mobile devices. Software called VNC Viewer enables remote access to and control of a computer from a computer, tablet, or smart phone. It is a graphical desktop sharing technology that enables mobile devices to remotely control the desktop of a computer running VNC Server. To provide you control over the computer you've accessed after you're connected, the system sends keyboard, mouse, and touch events to VNC Server.

Using VNC has advantages which are, it has a screen sharing feature, allows users to access another desktop remotely, file transferring features, file sharing features and simple interface.

At the other end, the disadvantage of using VNC is, multiple Students cannot assess a single remote desktop simultaneously unless a paid version is used. To get more feature, the VNC server needs to be purchased. VNC has a security risk because it is a powerful platform and has vulnerabilities exposed. The software lags when using low end personal computers where it uses excessive bandwidth (Fig. 5).

Fig. 5. Shows VNC is being set up at the personcal computer

Designed Platform (Integration with Client and Server). After considering and reviewing the pros and cons of VNC, it has been decided to develop a remote access platform which is user friendly and complies with the needs of the university. The platform designed has two ends like the VNC, we have the Server end and the Client end. The main purpose of this project is to have multiple students accessing a same CrowPi board. To fulfill this objective, this program has been designed based on room-based access system. A room-based platform is a medium where multiple users will get access to the same CrowPi Board. The user will get a designated Room ID provided by the Client end (CrowPi End). Once The correct ID is entered, the assigned user in a specific room will have access to a particular CrowPi Board. Below shows a simplified architecture on how this program works. The communication between the server and the client is used based on the Web-Socket-Protocol (Fig. 6).

As for the server end, this part is where the user can view and access the CrowPi board. This platform uses a web-based application, where it has a designated URL. This URL can be accessed in mobile phones and tablets as well, so that users do not require to download or install any application. In this server page, it required the students to enter a room ID so that they could remotely access a CrowPi board (Fig. 7).

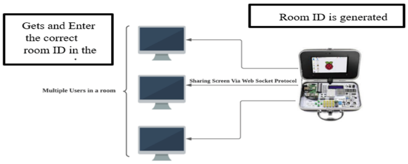

Fig. 6. Shows the visual representation of a room based system architecture

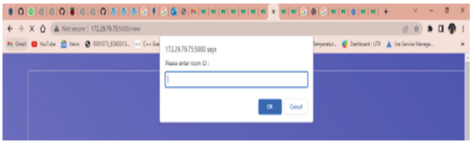

Fig. 7. Shows Web page for the user end, requesting the room ID of the CrowPi Board.

When the user does not enter a room ID or enter a wrong room ID the page will not redirect to the shared screen of the board. It will show an error message and the User would have to refresh the web page to key in the correct room ID (Fig. 8).

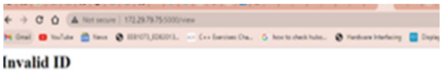

Fig. 8. Shows the web page did not redirect to the shared screen page since the room ID was invalid.

In addition, as was mentioned, the main part of this project is the CrowPi screen being shared to the personal desktop and would be able to edit and operate the CrowPi Board virtually. Since it a room-based program, where students will get specific room ID to access a certain CrowPi board (Figs. 9 and 10).

Fig. 9. Shows the CrowPi screen is being shared in the personal PC

For the CrowPi end, it is a desktop-based application where we have the start share icon entered and a randomly generated Room ID will be shown. The user shall receive the room ID and enter in their web page to gain the screen access. After the room ID is generated, the Start Share icon will change to Stop Share, so that the screen will no longer be accessed to the student unless a new session is started (Figs. 11, 12 and 13).

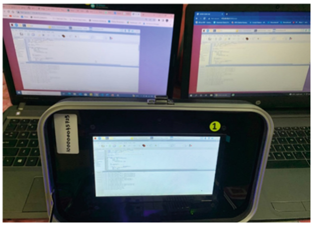

Fig. 10. Shows multiple students can access the CrowPi board.

Fig. 11. Shows the user interface of the CrowPi desktop application

Fig. 12. Shows the desktop application is displaying the randomly generated room ID and the stop screen icon.

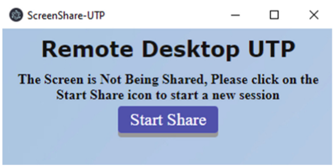

Fig. 13. Shows the message when the stop share button is clicked and requesting to restart the sharing session.

To sum up, Client (CrowPi end) will distribute a specific room ID when it starts to share. The room ID then will be entered by the user in the server URL, if the Room ID is correct the user will be able to remotely access the CrowPi board. The user will not be able to access the board when the stop share icon at the user end is entered. Below shows the actual snapshot of the flow of the software (Figs. 14 and 15).

5.2 Discussion

The main objective of this project is to get multiple students to access the CrowPi Board remotely from wherever they are. Mainly so that they could work on practical

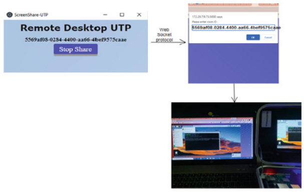

Fig. 14. Shows the summary of how the remote desktop program works.

Fig. 15. Shows the live feed camera access of the crowpi board where we can see the LCD screen, Seven Segment & LED, while the seven segment lights up.

programming remotely and at the same time the CrowPi board does not get vandalized. From this project what can be shown is that each CrowPi board will generate a room and a room ID when the start share button is pressed. The room ID is a random generated key which will be generated every time the CrowPi share screen button is pressed. This is a security feature and to ensure that students do not get to access the board without supervision to ensure that no one misuse the CrowPi board access. From this, students can experiment with basic source code which operates hardware components such as LEDs and Seven Segment display.

6 Conclusion and Recommendation

6.1 Conclusion

In summary, distance learning does not allow for group studies as students would be in different location. Every project task would require students to complete individually with no exchange of ideas or any active learning among the students. This work is to develop a remote learning platform for students to access the CrowPi board from home and be able to undergo interfacing activities and learning from remote locations, by having live camera access as well. To add on, multiple students can be able to access one board remotely so that students can even work groups and exchange ideas and knowledge. Students must be able to access every hardware component from the CrowPi together with their partners to have a discussion session or an active learning situation. By implementing this in the lab, students will have more hands-on practice on during distance learning mode.

6.2 Recommendation

- Permission Access, since it is a room-based concept, where anyone with the correct room ID can access the same CrowPi board.
- Web cam viewing can be done on a different server, for viewing the source code and the components.

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Novel Application of Mix Reality on Technical Training in Semiconductor Manufacturing

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Abstract. This paper presents the evolution of technical training operation with Mixed Reality (MR) application at semiconductor manufacturing environment. Pri-or to Covid-19, in-person training and seeding at other plants/supplier sites were the methods of knowledge transfer for machine and equipment troubleshooting training. Training operation was significantly slowed down and impacted due to travel restriction during Covid-19. Mixed Reality technology of smart glasses with 3D hologram and Heads-up display (HUD) user interface for training were then adopted and set as one of the blended learning methodologies in manufacturing on top of in person instructor-led, online web-based training, knowledge check, video demonstration library, real-time video classroom remote training. Result shown that, training effectiveness greatly improved with at least 3x hands-on opportunity with MR application. This paper aimed to generate discussion on the current state of setup for digital trans-formation, benefits to the organization and future development of immersive learning in 3 critical areas a) user interaction b) enablement of learning with digital twin c) navigation of multi-user collaboration.

Keywords: Human Computer Interaction (HCI) · Applied Computing – Interactive learning environments · Mix Reality · 3D User Interface

1 Introduction

Machine and equipment maintenance for semiconductor manufacturing operation are highly complex that involves 90–200 different types of equipment at production floor. The complexity of performing technical training on each of these areas in semiconductor manufacturing is attributed to the variance of each machinery, limited tool time for hands-on (since production needs to be halted to give way for technical training) and low tolerance of errors that could impact to production with time pressure. The competencies to master this equipment are mostly traditionally acquired from experience by years and buddy-system hands-on. Despite having in-person instructor on-site or buddy system, there was inconsistency observed in the knowledge transfer from trainer to trainee was detected that may resulted to impactful quality excursion issues. In addition, scalability and time to fully certified workforce was significantly longer with targeted small population i.e. limit to 4–6 trainees for a session due to training effectiveness at confined space and limited tool time available.

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During Covid-19 global pandemic, as travel restriction impede the training operation on-site, MR technology were beginning to apply with limited features in short time in response to pandemic situation such as real time video streaming with subject matter expert and offline self-learning videos were deployed to support 100% training remotely. Training effectiveness were subject to video quality, content quality, subject matter expert's availability from different time zone and real time feed-back on the hands-on practice.

Mixed Reality (MR) training delivery has significantly evolved and prove to be helpful in technical training for such complex task which tool time/hands-on is limited and trainer resource is scarce. The MR content delivery that consists of small chunks of specific tasks and steps were refined and deployed to increase the trainee's opportunity of hands-on practice. Instead of lengthy text-images spec or manual documentation, media rich i.e. 3D hologram object, heads-up display (HUD) and instructional designed content, trainees is able to learn in a combination of immersive virtual reality with real environment concurrently. The MR content development involved spec owner, supplier trainer, technical expert from module engineering, operation trainer, and peer trainer. In this work, the application of MR technology on technical training in semiconductor manufacturing environment that has significantly helped to improve the efficiency and quality of the technical training amid the travel restrictions imposed by the global pandemic of Covid-19. Furthermore, with the MR technology infused in technical training, it helps semiconductor manufacturing saved estimated 150,000 training operation hours annually.

2 Related Works

Many studies examinate AR/VR based training application in wide spectrum of medical and higher education. Application of AR/VR or Mixed Reality has increased with more smart-glasses device available in market. Result of VR learning has been shown significant positive in-terms of user's engagement [5] with avatar identity in the digital learning environment. Despite be in immersive virtual environment with avatar, absence of behavior clue physical form appearance doesn't not different of social interaction [4] in learning [1] where productivity is proven be similar between real and VR simulation [3]. MR that we want to discuss in this paper are the view of physical world with overlay of digital elements i.e.,3D hologram, GUI interface or HUD which you can interact. Application of MR in business were designed to help guide user on steps-by-steps training information blending into real-world and per-form the video-demonstration or 3D animation/assembly in front of the users. [6] MR with multi users collaborative learning can also be achieved with similar real time video call feature that users can doodle and take note in the mix-immersive environment [2].

3 Methodology

With MR being part of blended learning was implemented in semiconductor manufacturing, it is aimed to achieve self-learning pattern from reactive to proactive. Combining online training materials and opportunity of interaction in MR content on top of on-site training as blended learning approach, learning objective and content design were transforming towards digital immersive learning. Firstly, all blended learning setup is required to comply with the safety protocol mandated in manufacturing environment; Then, the MR content was designed and developed based on the equipment and operation standard operating procedure training delivery. Thirdly, a sample of 30 operation employees participated training with MR content deployed and completed within the defined training time.

3.1 Setup

Spec control, safety guideline control and module technology control were the prerequisite for operation and equipment technical training with MR technology. This setup is to ensure:

a) Training content referenced the governing spec procedure and pre-procedure setup that is standardized across factories.
b) Safety guidelines for environment, smart glasses device, toolkit and material handing were trained and applied during the blended learning -MR session.
c) MR 3D hologram training content, equipment maintenance or troubleshooting procedure were only accessed by competent operation or equipment specialists or targeted trainee with basic technical acumen to ensure training effectiveness.

3.2 Training Delivery

Conventional training delivery for operation training is est. 60 h and equipment training is est. 1040 h with 80% of time for physical hands-on with dedicated trainer on sight and 20% of reading spec documentation, online test/web-based training on theory. With the blended learning- MR implementation, theory delivery is with media rich content i.e. video, interactive content with HUD display, 3D animation demonstration and small chunk of specific steps-by-steps to guide trainee in accomplished task output to complement the conventional deliveries. [1] The spatial presence of HUD display on accurate hands-on learning content side by side between digital and real object.

3.3 Scope

Conventional training delivery for operation training is est. 60 h and equipment training is est. 1040 h with 80% of time for physical hands-on with dedicated trainer on sight and 20% of reading spec documentation, online test/web-based training on theory. With the blended learning- MR implementation, theory delivery is with media rich content i.e. video, interactive content with HUD display, 3D animation demonstration and small chunk of specific steps-by-steps to guide trainee in accomplished task output to complement the conventional deliveries. [1] The spatial presence of HUD display on accurate hands-on learning content side by side between digital and real object.

4 Result and Discussion

A comparison was made on the training TPT, user's frequency of hands-on before and after the implementation of MR content with the time constraint. Observation and feedbacks from trainees were discussed along with the potential future development of technical training.

4.1 Equipment Hands-On Practice

All 30 trainees who completed the training packages with MR content in addition to other blended learnings were able to perform 3x frequency of hands-on practice with time constraint measure as compared to conventional delivery. Trainer deployed learning sequence such as, first - reviewing MR content prior actual session (see Fig. 1), secondly -demonstration of the MR content in person with remote assist capability with all trainees and then let individual trainees to practice on their own.

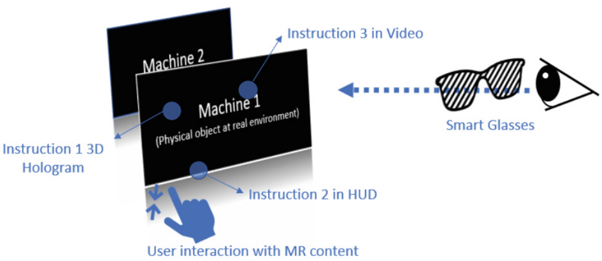

Fig. 1. An illustration of user's vision through smart glasses to view and interact MR content that overlay on physical machine at real environment.

With the same amount of training duration following Table 1, this approach eliminated trainer's repetitive teaching to individual and increase the frequency of trainee's practices. In depth discussion/questions were raised as more practices triggered thought process and details with strong engagement.

Equipment troubleshooting procedure is complex due to handling, materials, setup and system embedded configuration. All trainees who went through conventional documentation such as spec reading missing the details of visual and animation to articulate the details of what trainees need to acquire. With MR content, trainees were able to absorb the concepts and overview task procedures where 25 trainees strongly agreed that MR content is at ease to learn compared to plain text-image materials such as spec document.

4.2 Observation and Feedbacks

The overall MR application for the training package indicated significant spatial presence and engagement [5] as majority trainees (>75%) continuously stay curious to interact the 3D animated hologram object during training. Apply MR content require careful implementation. Thru our iterations, applying piecemeal MR content did not yield significant engagement but rather perceived as excessive used of learning tools and destructive to the overall learning experience as trainee will need to access the smart glasses in between and login to the MR content. In addition, feedbacks received from trainees who participated were positive in learning towards the immersive environment between digital and real world with 100% completion rate.

Table 1. Comparison of individual hands-on time before and after implementation of MR content.

Equipment Training Procedure Example	Before (mins)	After (mins)	Framework of deployment.
Module Introduction	10	30	a) Pre-work: Self-review MR Content b) Trainer refers documentation along with MR content. c) Trainer demonstrates procedure along with MR content. d) 4-6 Trainees perform hands-on practice with MR content. e) Open book quiz and knowledge check
Monthly PM Task	30	105	
Annual PM Task	30	85	

4.3 Discussions

From user interaction in terms of cybersickness or motion sickness, there is no strong evidence found during the use of MR application. However, the training was conducted in cleanroom environment where personal protection equipment such as safety goggles may impact the vision of the MR or causing slight discomfort due to the safety requirement imposed. Besides, current application of MR is towards personal 1 to 1 learning on the procedure with limited multi-users (>2 users) collaboration on interacting with hologram object concurrently. The benefits of collaborative learning remotely in group setting for MR maybe the future of development from smart glasses producing company. On the other hand, the uprising of digital twin may influence the enhancement of simulate equipment's capabilities with MR learning; trainees able to explore the digital twin-toolsets without fear of error. Furthermore, leveraging the advanced sensors and processing power of smart glasses on spatial mapping, hand tracking, eye tracking and location position in both physical and virtual spaces, great potential of learning feedback mechanism can be explored to further validate user's learning on the spot.

5 Conclusions and Future Work

Blended learning with the addition of MR application led to designing more effective training deployment especially for technical learning in manufacturing. With media-rich MR content in place, learning ability has significantly improved. In addition, the increase of hands-on practice cadence enabled trainee to master the equipment troubleshooting and operation. MR technology for learning has becomes the standard of learning in manufacturing here. For future development, it will greatly depend on the smart glasses technology advancement to support scalability i.e. multi-user collaborations and setup digital twin for technical training.

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Open-Book Final Examination: Do the Students Think it is Easier and Better for Them?

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Abstract. Assessment is always an important component in the teaching and learning process. The final examination is often carried out as a summative type of assessment to evaluate the student learning at the end of a course. Typically, final examination is conducted in a controlled environment 'close book' approach. The less common method is using the 'open book' approach. A study was conducted at Universiti Tenaga Nasional (UNITEN) to investigate the students' perception on open-book final examination, through a cross-sectional survey conducted among UNITEN students. The survey was conducted online between July 14, 2022, and August 8, 2022. Were number of respondents was 693 students, with 66.5% were male students, and 33.5% were female students. About half of the respondents think an open-book exam is easier (51.9% agree or strongly agree); and about two-thirds of the respondents think that they can get better results if the examination is conducted in open-book method (67.7% agree or strongly agree); and most of the respondents think that taking open-book examination is less stressful than closed-book examination (73.1% agree or strongly agree). Based on this survey, most students perceived that open-book examination is easier and better for them.

Keywords: open book examination · assessment · final examination

1 Introduction

One of the key components of learning is assessment. It is often said that assessment drives the learning process. Assessment is used to show how much has been achieved by the student. Typically, assessment is categorized into formative and summative assessment types. The summative assessment is often given as the final examination at the end of the semester. Two main approaches used for final examination are closed-book final examination (CBFE) and open-book final ex-aminations (OBFE). CBFE is observed to be more common especially in bachelor's degrees program in higher learning institutions.

Although there is no conclusive evidence of either CBFE or OBFE is objectively better in term of students results or performance [1, 2, 4], the general perception especially among students indicates that they would prefer taking open-book education. It was found that students perceived that taking OBFE would experience less anxiety and would perform better [3].

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In order to find out what students at Universiti Tenaga Nasional (UNITEN) think about OBFE, a survey was conducted at the end of the academic year 2021/2022. The survey was conducted anonymously online, and active UNITEN students were invited to participate. The main objective of the survey is to obtain students perception of OBFE and their preference.

It is expected that the findings from this survey will provide some insight into the students' perceptions of open book examination.

2 Background

2.1 A. Open-Book Assessment (OBA)

The shift to open-book assessment occurred drastically due to COVID-19 pandemic where all the teaching, learning and assessment activities were forced to be conducted online [5]. As the students would take the assessment from their home, conducting the same closed-book assessment approach, particularly final examination, was no longer suitable [6]. With these adjustments came the inherent challenges associated with open-book assessments, primarily because students were now situated in their homes, devoid of the controlled environments usually associated with traditional examination settings. This shift posed logistical is-sues, such as ensuring the integrity of the examination process and maintaining academic rigor. Moreover, educators faced the daunting task of redesigning assessment materials to ensure they remained effective in this new format, grappling with the need to create questions that tested critical thinking and application skills rather than mere rote memorization.

The move to open-book assessments during the pandemic brought some ad-vantages and disadvantages. On the positive side, these assessments foster a more realistic approach to real-world problem-solving, where students are encouraged to think critically, synthesize information, and utilize resources effectively, mirroring tasks they might encounter in their professional lives. However, this for-mat can present challenges in ensuring academic honesty. Without the controlled environment of a traditional examination room, the potential for academic misconduct increases, requiring institutions to utilize sophisticated monitoring software and honour codes. Additionally, while some students may thrive in this for-mat, others might struggle with time management and the ability to discern which resources are most pertinent, potentially leading to disparities in performance.

2.2 B. Open-Book Final Examination (OBFE)

OBFE is an assessment approach designed to in a way to allow students to bring learning materials or resources such as textbooks, notes, or printed slides into an examination environment. It can be categorized into three types:

(i) Conventional – the final exam is conducted in a room or exam hall, with students allowed to bring in selected resources or learning materials.
(ii) Take-home – students are given a set of questions and a limited period to complete it without assistance.

(iii) Computer-based – the final exam is conducted using a computer in physical venue. Students may be allowed access to online resources.

In OBFE, typically the instructor or the lecturer will decide the type of resources that students can bring into the exam. Normally it is either limited access – such as a specific textbook or a piece of paper containing notes, or unlimited access where the student is allowed to bring in any type and amounts of resources.

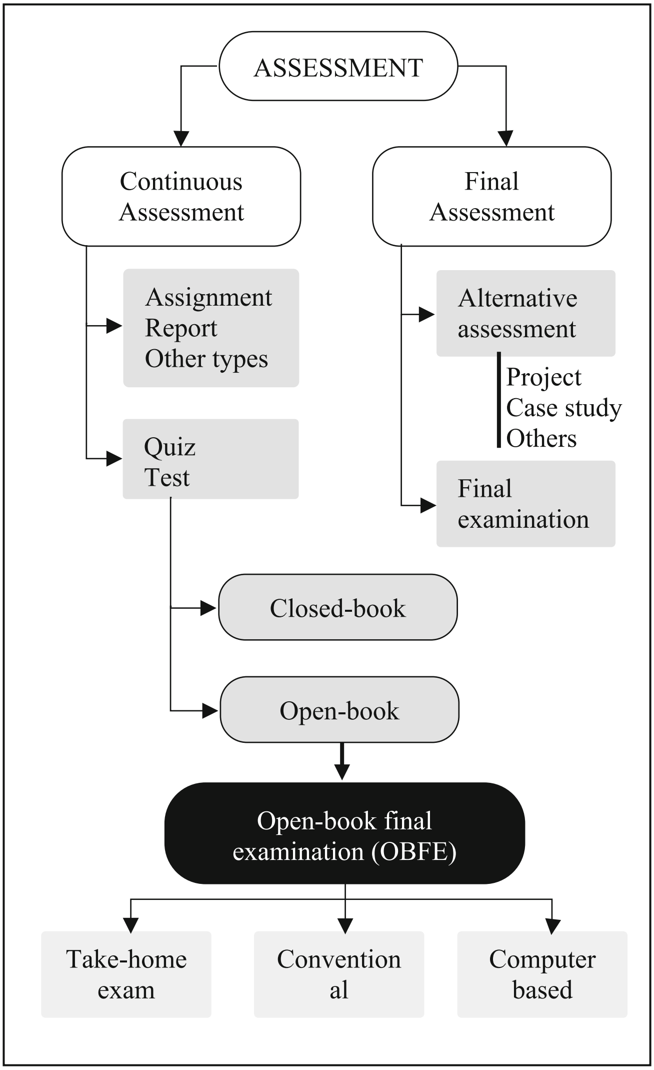

Fig. 1. Overview of typical assessment approaches.

Figure 1 shows an overview of typical assessment approaches. The focus in this study is on conventional type open book final examinations.

2.3 C. Implementation Challenges of OBFE

Designing and implementing OBFE may require additional thoughts and efforts especially if the lecturer is new in this area, as there are several challenges that they might face.

- The question needs to be very well designed in order to prevent the false perception that open book examination is easier than closed book examination.
- Often open-ended style would be more suitable to be asked in OBFE. Due to this, very clear marking guidelines and/or rubrics are required as the question might have multiple correct answers.
- Must consider the limitation of examination duration as typically students would require longer time in solving open-ended type questions.
- Suitability of the courses in conducting out the exam in open-book approach, based on the nature of the course. For example, OBFE may not be suitable for the courses that requires testing at lower cognitive domain.
- Grading or marking students answer may take longer time considering possibility of multiple correct answers, longer answer provided by the students and the legibility of the students handwriting.

3 Method

A descriptive cross-sectional survey was conducted online using Microsoft Forms between July 14, 2022, until August 8, 2022. The survey was opened to active UNITEN students during that time.

The survey questionnaire was developed by a team under UNITEN Teaching and Learning Centre (TLC). The survey consisted of two parts – Part I was on the demographic background of the students, and Part II was on the student's opinion and preference on open-book examination (as shown in Table 1).

In the first question, the students were asked whether they have experienced in taking open-book examination previously in UNITEN. This is a very important question to establish any prior experience that the students had, as this would affect the subsequent answers in the survey. The following question will be branching based on the answer. If the answer was "Yes", the students will be asked which type of exam they would prefer. If the answer was "No", the student will be asked which type they would choose, if they were given a choice.

At this preliminary stage of the study, descriptive statistics and frequency analysis approach was used to analyze the survey data. For Question 2, the answers are converted into the scale of 1 (strongly disagree) to 5 (strongly agree), for analysis.

Table 1. Survey Questions on Students' Preference on Open-book Examination

No	Question	Selection of answer
1	Do you have any experience in taking open-book exam in any subject at UNITEN?	• Yes • No • Not sure
1(a)	*(If the students answer Yes)* Which type of exam do you prefer?	• I prefer open-book exam; • I prefer closed-book exam; • No preference
1(b)	*(If the students answer No or Not sure)* If you are given a choice between open-book and closed-book exam	• I would choose open-book exam; • I would choose closed-book exam; • Either one is fine with me
2	What is your opinion on the following	
2(a)	I think open-book exam is easier than close-book exam	5-point bipolar Likert scale style 1: Strongly disagree (SD) 2: Disagree (D) 3: Neither disagree nor agree (N) 4: Agree (A) 5: Strongly agree (SA)
2(b)	I would get a better mark or grade if the exam is open book	
2(c)	Taking an open-book exam is less stressful than closed-book exam	

4 Results and Discussion

4.1 A. Background

In total there are 693 students who responded to this survey. About two-third of the respondents were male students (66.5%, n = 461), and another one-third were female students (33.3%, n = 2). The students are from all levels of academic pro-grams at UNITEN, with the majority being from bachelor's degree programs. Table 2 shows the detailed demographic characteristics of the respondents.

Table 2. Demographic Characteristics of the Respondents

Aspect	Characteristics	n (%)
Gender	Male	461 (66.52%)
	Female	232 (33.48%)
Level of study	Foundation	1 (0.14%)
	Diploma	74 (10.68%)
	Bachelor's degree	547 (78.93%)
	Postgraduate	71 (10.25%)

Table 3 shows the percentage breakdown of the respondents that have experience in taking open-book examinations in any course at UNITEN. Slightly more than half of the total respondents (53.59%) have taken an open-book examination before. More male students haven taken open-book examination (57.5%) compared to female students (45.3%).

Table 3. Percentage of respondents had experience taking open-book exam

Respondent (n)	% of respondents		
	Yes	*No*	*Not sure*
All (693)	53.39	40.26	6.35
Male (461)	57.48	36.23	6.29
Female (232)	45.26	48.28	6.47

4.2 B. Exam Type Preference

The respondents are divided into two groups – Group A included those who had experience taking open-book exam before, and Group B who responded "no" and "not sure" to the question on having experience in open-book exam.

In Group A, most respondents prefer open-book exams (79.5%), with slightly more male students prefer open-book exam (80.0%) compared to female students (78.1%). In Group B, most would choose an open-book exam if given a choice (70%), although it is lower by almost ten percent compared to Group A. It is observed that there is a significantly higher number of students who have no preference (25%) whether the exam is conducted in open- or closed-book. It is also observed that there are more male students in Group A (10.2%) prefer closed book examination compared to Group B (2.6%). Table 4 shows the detailed breakdown of the result.

Table 4. Exam type preference

Respondent (n)	% of respondents		
	Prefer open book	*Prefer closed book*	*No preference*
Group A			
All (370)	79.46	11.62	8.92
Male (265)	80.00	10.19	9.81
Female (105)	78.10	15.24	6.67
Group B			
All (323)	69.97	5.26	24.77
Male (196)	70.41	2.55	27.04
Female (127)	69.29	9.45	21.26

4.3 C. Descriptive Statistics Analysis

Table 5 shows the result from respondent on three sub-questions on open-book exam preference. The Cronbach's Alpha (α), which is used to measure the internal consistency, or the reliability based on the student's response to the Likert scale, was calculated for this set of question. The range of α value is between 0 to 1, where higher value would indicate that the questionnaire is more reliable. Typically, a value of 0.70 and above would indicate that it is acceptable. The α value calculated for Q2 was 0.79 indicating acceptable reliability for this survey.

Table 5. Students Opinion on Open Book Examination

Question	No of respondents				
	SD (1)	*D (2)*	*N (3)*	*A (4)*	*SA (5)*
Q2a: I think an open-book exam is easier than a closed-book exam	44	79	210	181	179
Q2b: I would get a better mark or grade if the exam is open-book	27	29	168	278	191
Q2c: Taking an open-book exam is less stressful than closed-book exam	25	53	108	265	242

Table 6 shows more detail analysis based on the breakdown of Group A and Group B. About half of the respondents think an open-book exam is easier (51.9% agree or strongly agree). More respondents in Group B (56.4%) think it is easier compared to Group A (48.1%).

About two-thirds of the respondents think that they can get better results if the examination is conducted in an open-book method (67.7% agree or strongly agree). A lot more respondents in Group B (71.8%) think that they will get better results, compared to Group A (64%).

Most of the respondents think that taking open-book examination is less stressful than closed-book examination (73.1% agree or strongly agree). About three-quarters of Group B respondents (75.5%) think it would be less stressful, while about 71% of Group A respondents have the same opinion as well.

From these results, it can be said that most students prefer open-book examinations, think it is easier for them, would make their result better as well as experiencing less stress.

Table 6. Descriptive and frequency analysis for Question 2

Respondent (n)	% of respondents				
	SD	*D*	*N*	*A*	*SA*
Q2a: I think an open-book exam is easier than a closed-book exam					
All (693)	6.35	11.40	30.30	26.12	25.83
Group A (370)	8.11	12.70	31.08	24.86	23.24
Group B (323)	4.33	9.91	29.41	27.55	28.79
Q2b: I would get a better mark or grade if the exam is open-book					
All (693)	3.90	4.18	24.24	40.12	27.56
Group A (370)	4.59	5.68	25.68	38.38	25.68
Group B (323)	3.10	2.48	22.60	42.11	29.72
Q2c: Taking an open-book exam is less stressful than closed-book exam					
All (693)	3.61	7.65	15.58	38.24	34.92
Group A (370)	3.51	9.46	15.95	38.65	32.43
Group B (323)	3.72	5.57	15.17	37.77	37.77

5 Conclusion

In this study, most of the students perceived that open-book examination is better for them, would be easier, and less stressful. Although this perception might not corelate with the actual ability to answer the question during the examination and the result, it would give the students more confidence prior to starting the exam.

This finding is only a descriptive and on-surface analysis of a cross-sectional study based on the respondent from active students at UNITEN during the time of the survey. Further study should be conducted to acquire more in-depth insights and correlation to the student's performance.

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Promoting Students' Autonomy in Listening Skills via Emerging Podcasts: An Investigation from Vietnamese Undergraduates

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Abstract. This paper investigates the utilization of Podcasts as a means to enhance students' learning autonomy and improve their listening skills, particularly in the context of English as a Second Language (ESL) learning. The study adopts a mixed-method approach, employing qualitative descriptive methods to explore students' learning autonomy and their perception of Podcast usage, and quantitative descriptive methods to assess improvements in students' listening scores. The participants consisted of first-year students enrolled in a General English Course at a private university in Vietnam. Data collection involved the use of questionnaires and tests. The findings indicate that students' learning autonomy exhibits positive advancements across various dimensions, including learner control, critical reflection, motivation, and information literacy. The integration of Podcasts also yields a slight but noticeable improvement in students' listening scores. Additionally, the study reveals a favorable perception among students towards the use of Podcasts as an additional learning resource for listening. The consistency in students' autonomy development holds promise for enhancing their overall comprehension abilities. This research contributes to the understanding of how Podcasts can effectively support language learners in their quest for greater autonomy and suggests the potential for continued utilization of Podcasts in fostering listening proficiency.

Keywords: Podcasts · learner autonomy · listening skills · students' perspectives

1 Introduction

The proliferation of digital audio production tools and online platforms has significantly eased the integration of audio content, particularly podcasts, into language education. In a review of podcast resources and technologies for second language education, Hegelheimer and O'Bryan [1] identified a noteworthy resource, ESLpod.com, which provides over 500 audio files that are freely accessible and organized by topic, specifically designed for English-language learners. Furthermore, a diverse range of podcasts are available that target academic listening skills, listening exam preparation, grammar instruction, and business English themes. Apart from serving as a classroom resource for listening activities, podcasts can also function as a repository of classroom lectures or conversations that can be accessed outside of the classroom to support independent

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learning [2]. In language learning, podcasts offer a range of benefits to learners, including access to authentic audio content, flexibility in usage, and topic-specific resources. Specifically, podcasts provide learners with the opportunity to access genuine language use, which can enhance their listening skills and comprehension of natural language patterns. Moreover, podcasts offer a convenient and portable means of accessing audio content, which can supplement classroom instruction and encourage autonomous learning. Additionally, the availability of topic-specific podcasts caters to learners' interests and needs, making language learning more engaging and relevant.

Listening skills play a pivotal role in second language acquisition or foreign language learning. Although reading, speaking, and writing skills are also essential for language development, listening is deemed the most critical skill for attaining language proficiency. Listening facilitates our comprehension of the world around us and is a fundamental aspect of effective communication [3]. As such, developing listening skills is vital to achieving communicative competence in a second language.

Podcasts in Academic Settings

As defined by O'Bryan and Hegelheimer [2], podcasts are online audio or video broadcasts that contain a Really Simple Syndication (RSS) feed, which enables users to subscribe to the podcast. Upon subscription, new episodes of the programme can be downloaded automatically to the user's device whenever updates are made available. According to Rosell-Aguilar's taxonomy (2007), one of the two primary applications for podcasting is the utilization of existing resources [4]. Within the realm of language acquisition, podcast resources can be classified into two primary categories. The initial category encompasses materials generated by individuals who are fluent in a particular language and intended for the benefit of other individuals who are also proficient in that language. Examples of such materials include news podcasts disseminated by broadcast media. The second category comprises pedagogical resources that are specifically tailored for language acquisition. These resources can be further classified into comprehensive language courses or supplementary materials that cater to targeted learners or individuals who are self-motivated. In the context of language learning, podcast materials can serve as a valuable supplementary resource for self-directed study. Classroom teachers are well-positioned to incorporate these materials into their instructional practises, thereby facilitating the delivery of information in the target language. This methodology offers learners supplementary chances to interact with genuine language resources and facilitates self-directed learning.

Podcasts have become a popular and valuable resource for language learners seeking to improve their listening proficiency outside the classroom. These online audio and video broadcasts are easily accessible, diverse, and extensive, providing learners with a range of topics and formats to suit their interests and needs. The subscription feature of podcasts allows learners to automatically download new episodes to their computer or portable media player, providing a flexible and portable means of accessing audio content. Several recent studies have highlighted the utility of podcasts for promoting autonomous second language (L2) listening. O'Bryan and Hegelheimer [2] suggest that podcasts can aid learners in practicing listening strategically in an L2, which can lead to improved proficiency. Furthermore, Rosell-Aguilar [4] notes that podcasts can facilitate learners' noticing of L2 lexis and grammar, as learners can hear these language features in authentic contexts. Additionally, Abdulrahman, et al. [5] highlight Podcasts offer a convenient option for listeners to select and listen to their desired content.

The utilisation of podcasts for self-directed listening has the potential to yield significant advantages. However, within the academic setting of Vietnam, their implementation remains limited. A plausible explanation for this phenomenon is that although learners may possess fundamental meta technical competencies to operate media players and search engines for podcast retrieval, they frequently lack the metatextual proficiencies required to proficiently structure their listening activities. The acquisition of metatextual skills encompasses an understanding of the organisation of written material and associated duties, as well as the utilisation of this comprehension in the fulfilment of tasks. Furthermore, despite the provision of metacognitive instruction by teachers in the classroom, learners may encounter difficulties in autonomously employing these strategies to proficiently utilise podcasts without prior explicit guidance. The present study endeavours to examine the efficacy of podcasts as a self-directed learning tool in enhancing students' listening abilities, while also delving into their attitudes towards the utilisation of podcasts. The following research questions serve as guides to those aims:

1. How do students' listening skills improve after using Podcasts as an autonomous learning tool?
2. How do students perceive the use of Podcasts in learning listening dependently?

2 Literature Review

2.1 Learner Autonomy in English Language Teaching

The concept of language autonomy (LA) has been a prominent topic in the field of English Language Teaching (ELT) for more than 40 years. It is widely recognised as a critical component of effective language learning [6] and a fundamental goal of English as a Foreign Language (EFL) education [7]. Holec's (1979) definition of LA as the capacity to take control of one's learning and maintain accountability for all decisions pertaining to learning has been widely cited in literature and serves as a starting point for more detailed exploration of the concept [8]. However, the notion of LA has evolved to include other important components beyond accountability and decision-making. For instance, the willingness and capability of learners have been recognized as essential factors that need to be addressed when developing LA [9, 10].

Research also highlights the significant impact of learners' perceptions of their roles and those of their teachers on their willingness and readiness for LA [11, 12]. Learners who view their professors as key characters in their learning process and expect to be told what to do, receive assistance, and have everything explained to them may be unprepared for autonomous learning. Conversely, learners who understand the roles that both instructors and students should play are more likely to be ready for independent study [10, 13]. Motivation is another crucial factor in the development of LA and research has demonstrated that it plays a significant role in learners' LA [14]. Therefore, investigating the degree of motivation and roles that learners perceive is essential to developing effective LA strategies.

Incorporating learners' authentic behaviours, whether they manifest in the classroom or beyond, is a crucial aspect of their self-directed learning practises [15, 16]. The objective of this research is to investigate the extent of motivation and the roles that learners perceive, as well as their autonomous learning behaviours. To sum up, the notion of Learning Analytics (LA) has undergone a transformation that extends beyond the domains of accountability and decision-making, encompassing the aspects of willingness and capability. Moreover, the perceptions of learners regarding their roles and those of their teachers are instrumental in fostering LA. Motivation is a crucial element in the advancement of autonomous learning (LA), and the effective formulation of LA strategies should take into account learners' authentic autonomous learning behaviours.

2.2 Instruction and Acquisition of English Listening Skills in the Vietnam Context

Listening comprehension is a critical aspect of language acquisition and education, yet it has been neglected in second language research, instruction, and evaluation [17, 18]. Listening, despite its importance, has been regarded as the most intricate and demanding language proficiency by educators and learners alike [19]. This is particularly true in Vietnamese secondary schools, where English listening skills have not received sufficient emphasis, resulting in ineffective teaching and limited development of this skill [20]. However, this issue is not confined to secondary schools, as universities and colleges in Vietnam, where English is not a major, also struggle to teach listening skills effectively. Due to the expectation of independent learning in higher education, the situation may be even more severe, despite the common phrase "teachers teach less, students learn more" [17].

Insufficient scholarly inquiry has been carried out regarding the autonomous efficacy of students and the means to enhance it in the milieu of tertiary language education institutions where English does not hold a prominent position [12, 17]. Previous studies have focused on teaching methods and difficulties in listening skills, rather than evaluating students' independent learning abilities. Therefore, it is crucial to investigate whether the directions provided by professors for independent study are adequate and whether students have the necessary capacity to study on their own.

To conclude, it can be stated that the ability to comprehend spoken language holds significant importance in the process of acquiring a language and in the field of education. The skill of critical thinking has been neglected in both secondary and higher education in Vietnam, leading to inadequate pedagogy and restricted growth in this area. The current body of literature pertaining to the enhancement of students' self-directed efficacy in the domain of language acquisition within tertiary institutions that do not prioritise English as a primary discipline is relatively scarce. Therefore, it is crucial to investigate and tackle these concerns in order to enhance language acquisition results in Vietnam.

2.3 Influential Factors of Autonomy Learning

The acquisition of learning autonomy is a pivotal component of self-directed learning, which empowers individuals to attain their objectives by means of self-governed decision-making. The multifaceted construct of learning autonomy is expounded upon by Everhard [21] and Murphy [22], who suggest that it can be shaped by both internal and external factors. The capacity to cultivate self-governance in the process of learning is subject to personal predispositions and fluctuates in accordance with diverse situations. Learning autonomy can be seen as a continuum, with different degrees of autonomy affected by internal and external factors. The first stage of this continuum involves total dependence on external influences, followed by a gradual reduction in external dependencies and the development of self-awareness through internal forces. The final stage is autonomy or independence, where learners rely solely on internal sources.

According to Cooker [23], the development of learning autonomy is influenced by various factors, particularly in the context of language learners. The components that constitute learning autonomy can be classified into seven distinct domains, namely learner control, metacognitive awareness, critical reflection, motivation, learning range, self-assurance, and information literacy. The aforementioned factors are instrumental in fostering the progressive maturation of learners' capacity to exercise autonomy in decision-making and assume accountability for their educational pursuits. Attaining the ultimate phase of learning autonomy, which is the autonomous stage, necessitates learners to satisfy all the facets of learning autonomy. In the early phases of the continuum, it is imperative to have external sources of support and intervention. As learners advance through the stages, their reliance on external assistance diminishes, culminating in a state of total self-sufficiency.

The study conducted by Douglass and Morris [24] aimed to examine the perceptions of students regarding the influence of three distinct factors, namely, student-controlled, faculty-controlled, and administration-controlled facilitators and barriers, on their self-directed learning. The researchers discovered that despite students' recognition of their own agency in the learning process, the influence of faculty and administrators remained a crucial factor in shaping their motivation and ability to learn. This underscores the significance of taking into account both intrinsic and extrinsic factors in fostering learner autonomy.

3 Methodology

3.1 Context and Participants

The study was carried out at a privately-owned technical institution situated in Ho Chi Minh City, Vietnam. This academic institution is among a limited number of universities in Vietnam that have provided General English Courses. Consequently, the university has mandated that first-year students across several disciplines, such as software engineering, information assurance, business, and graphic design, must enrol in English courses spanning from Level 1 to Level 6, which correspond to levels 1 through 6 of the CEFR (Common European Framework of Reference). The objective of this requirement is to ensure that students possess adequate English language proficiency to effectively engage with their academic pursuits at the institution. The primary objectives of courses ranging from level 1 to level 4 are centred on enhancing the listening and speaking proficiencies of students. Conversely, courses at level 5 and level 6 are primarily geared towards augmenting the reading and writing abilities of students. Upon completion of an English Placement Test, which is conducted by the English Language Department, students are assigned to classes that correspond to their placement exam results. The curriculum for each tier is disseminated over a period of seven weeks, with a requirement for students to be present in class for two sessions, which span one and a half hours each day, from Monday to Friday. The study centred on a cohort of 86 first-year students who were pursuing a degree in Software Engineering and had previously taken three General English courses. These students are currently enrolled in Level 4. The aforementioned students had successfully fulfilled the requirements of the initial three tiers of the curriculum, namely Levels 1, 2, and 3. Additionally, the participants indicated that they allocated an average of 3.2 h per week to extracurricular English language learning activities.

3.2 Instruments and Data Collection Procedures

The research was commenced by collecting primary data via the dissemination of an initial survey to 86 pupils who were enrolled in the General English Course at a privately-owned institution in Vietnam. The current study utilised a survey instrument adapted from Cooker's (2015) tool to assess the level of self-directed learning exhibited by students prior to the introduction of any interventions. The researcher supplemented the questionnaire by including Podcasts as additional listening materials and implemented treatment by assigning listening journals.

The investigator allocated to each student the duty of fulfilling a listening journal. Attendance in a weekly podcast session was compulsory for the students, with a prescribed maximum duration of 6 min per session. The students were granted the freedom to choose subjects that aroused their interest with the intention of engaging in active listening. This assignment covered the first half of the academic semester. The academic provided assessments of the students' journals and administered questionnaires to elicit the learners' reflections on the activities they had participated in. Towards the end of the academic semester, the students were excused from journal assignments and encouraged to continue engaging in such activities independently.

At the termination of the academic semester, the researcher obtained the listening journals of the students and performed a data analysis to evaluate the extent of self-directed learning demonstrated by the students. To assess the improvement of students' listening skills, two sets of listening assessments were administered to the students before and after the implementation of Podcast as supplementary instructional materials. The study employed test sets obtained from an online platform that was specifically developed to assess listening proficiency at different levels of the Common European Framework of Reference for Languages (CEF), ranging from A2 to C2. Each set consisted of 15 inquiries and was subjected to a time limit of 20 min. Upon obtaining the listening scores of students from pre and post-Podcast listening assessments, a questionnaire was dispensed to gather their perspectives on the implementation of Podcasts as auditory resources. The survey consisted of open-ended inquiries that aimed to explore the diverse perspectives of students on Podcasts, without limiting them to predetermined response options.

In this study, a systematic and academic approach was adopted to collect data and assess the impact of incorporating Podcasts as supplementary materials in the students' General English Course. The use of questionnaires, listening journal assignments, feedback provision, and pre/post-tests allowed for a comprehensive evaluation of the students' learning autonomy and improvement in their listening skills. Additionally, the inclusion of open-ended questions in the questionnaire aimed to capture the students' nuanced perceptions and experiences related to the use of Podcasts.

4 Results and Discussion

4.1 Students' Autonomy Improvement

The present study undertook an examination of the enhancement of students' autonomy by analysing their feedback across seven distinct categories that comprise the construct of learning autonomy. In general, the results suggest a favourable change in the perspectives of students towards the aforementioned categories, as evidenced by an upsurge in affirmative attitudes and a decline in unfavourable attitudes. The autonomy enhancement of the students is succinctly depicted in Fig. 1.

The findings depicted in Fig. 1 indicate that the enhancement of students' autonomy encompasses a multitude of dimensions, such as learner agency, metacognitive consciousness, critical contemplation, drive, breadth of learning, self-assurance, and proficiency in information literacy. The aforementioned factors collectively contribute to the augmentation of students' self-governance in the process of acquiring knowledge.

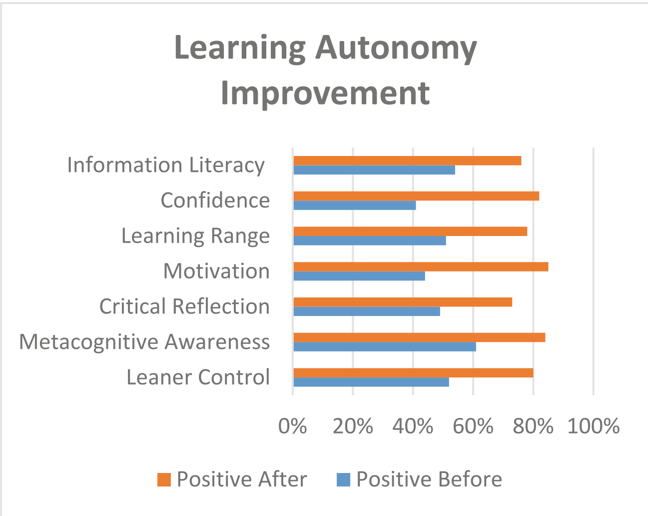

Fig. 1. Learning Autonomy Improvement

4.1.1 Learner Control

As depicted in Fig. 1, there has been a favourable enhancement in students' ability to regulate their English language learning, with specific emphasis on certain components. The initial noteworthy enhancement pertains to the aptitude of pupils to choose suitable resources for the acquisition of the English language. The enhancement can be ascribed to their availability of diverse computer applications and online platforms that facilitate the acquisition of English language skills. The incorporation of podcasts as an auditory tool serves a pivotal function in augmenting students' capacity to select appropriate learning materials.

Moreover, there has been an enhancement in the students' capacity to establish attainable goals. Students have the ability to concentrate on enhancing their listening skills and broadening their vocabulary in particular domains by selecting topics and accents that align with their personal preferences. The adaptation of learning materials and objectives can mitigate the stress that students may encounter during the learning process, ultimately fostering a more efficacious learning encounter. As a result, their capacity to effectively navigate their individual learning trajectory is augmented. The significance of learner control, as emphasized by Cooker [23], is a crucial factor in the potential benefits experienced by individuals learning a foreign language.

4.1.2 Metacognitive Awareness

Significant enhancements are observed in nearly all components within the realm of metacognitive awareness. The students have exhibited proficiency in justifying their selection of learning materials and identifying suitable learning methodologies. At the onset of the academic term, students underwent training to exercise autonomy in selecting Podcast videos based on their individual preferences, including but not limited to the subject matter, linguistic nuances, and the presence of transcribed materials. The provision of freedom of choice has facilitated the learners in assessing and deciding the appropriateness of the learning materials according to their unique requirements and speed, consequently resulting in advantageous outcomes from their choices.

Furthermore, it has been observed that students have demonstrated heightened self-assurance in their exploration of diverse methodologies and tactics aimed at improving their auditory comprehension abilities. As Cooker [23] has noted, an increased awareness of various language factors can act as a motivating force, resulting in heightened motivation and a sense of responsibility towards managing one's learning time. As a result, the level of metacognitive awareness exhibited by individuals is closely linked to their ability to regulate and direct their own learning.

Emphasising the significance of students' capacity to furnish justifications for their material preferences and their adeptness in choosing suitable tactics is instrumental in fostering metacognitive awareness and learner autonomy. The state of interconnectivity facilitates the capacity of students to make judicious choices regarding the materials they interact with, thereby enhancing their autonomy.

4.1.3 Critical Reflection

Regarding critical reflection, the students have demonstrated a generally favourable disposition towards the three components, albeit with some dissenting opinions on specific aspects. Differences exist among students' comprehension and contemplation of the functions of the educator and the student, along with the methodologies and contributions involved in the process of acquiring knowledge.

At the outset, a considerable number of students conveyed a feeling of inadequacy in the absence of explicit instructional assistance from their teachers. As the learners advanced, their dependence on the instructor during the learning procedure decreased, as they became capable of autonomously participating in listening practise through Podcasts. Furthermore, the students acquired an enhanced comprehension of their learning capabilities, which resulted in them taking on more accountability for their educational progression. It is noteworthy that students' critical reflection is closely linked to decision-making, which are pivotal components of collaborative autonomy, as noted by Cooker [23]. In the face of potential challenges, students' apprehensions are recognised and resolved through critical reflection, empowering them to make deliberate choices and take charge of their educational pursuits.

In addition, the level of critical reflection exhibited by students is a crucial factor in the development of learning behaviours that ultimately foster greater motivation for autonomy. Through the practise of critical reflection, students are inclined to cultivate a more profound comprehension of their individual learning processes and subsequently modify their strategies.

4.1.4 Motivation

The state of students' motivation can be assessed through their desire to learn, willingness to use the language, and active engagement in learning activities. According to the questionnaire administered, a majority of students reported an increased desire to learn English after utilizing Podcast on multiple occasions. They also displayed heightened enthusiasm and commitment in pursuing their language learning goals by independently continuing to watch Podcast videos even after the assigned tasks from the teacher were completed. Furthermore, the freedom and autonomy associated with listening to Podcast were perceived as effective for their learning, as they were no longer reliant on external pressure from the teacher. This shift in motivation can be characterized as a transition from predominantly extrinsic motivation derived from the teacher to predominantly intrinsic motivation originating from the students themselves. This shift carries positive implications for learners, as noted by Cooker [23], as it not only drives students to persist in language learning but also cultivates a desire to utilize the language in their daily lives or pursue further studies abroad. Overall, this transformation in motivation signifies a noteworthy advancement in students' engagement and commitment to language learning, ultimately fostering their intrinsic motivation and potential for long-term language use and growth.

4.1.5 Learning Range

The concept of learning range encompasses the flexibility in learning approaches and the breadth of learning content. In the context of this study, students have experienced an expansion of their learning range, primarily attributed to their increased enjoyment of learning English through methods that align with their personal interests. Consequently, the learning content has also become more diverse, as students not only select shorter duration videos but also engage with longer ones. Furthermore, many students actively engage in repeated activities with the videos to enhance their listening skills, while some prefer to challenge themselves by not using subtitles. This variety in learning activities not only presents a challenge but also generates interest among students.

The broadening of learning range is closely tied to learner control, as it enables students to exercise autonomy and reduces anxiety associated with the learning process. As noted by Cooker [23], an expanded learning range has a positive impact on learner control and motivation. In this context, students' ability to explore different learning methods and content not only enhances their control over their learning experience but also fuels their motivation to continue learning.

To summarize, students' learning range has expanded as a result of their increased enjoyment of English learning, leading them to pursue methods and content that align with their interests. This expansion is manifested in their engagement with both short and long videos and their willingness to engage in challenging activities to improve their listening skills. This broadening of learning range aligns with the concept of learner control and positively influences students' motivation and autonomy in the learning process.

4.1.6 Confidence

Prior to the implementation of Podcast as a supplement material, students exhibited a lack of confidence in actively seeking opportunities to use the English language. Additionally, they tended to harbor apprehensions about receiving negative feedback regarding their English skills, particularly in listening. However, following the integration of Podcasts into their learning experience, students' confidence has noticeably increased. They have become more at ease with the process of learning English and exhibit greater resilience in their efforts to improve their listening abilities. Moreover, they possess a heightened confidence in their future ability to use English proficiently, specifically in the domain of listening. This transformation aligns with what Cooker [23] refers to as "oozing confidence" (OC), characterized by a strong belief in one's competence and capacity to acquire and utilize the target language effectively. Furthermore, this enhanced confidence extends to the students' prospects of utilizing English in their future endeavors, including prospective job opportunities where English proficiency is valued.

4.1.7 Information Literacy

The category of information literacy within the realm of learning autonomy encompasses students' ability to effectively locate and navigate learning resources (Cooker, 2015). The utilization of Podcasts has undoubtedly enhanced students' capacity to select suitable sources for improving their listening skills and navigate them based on their specific needs and interests.

Moreover, students' information literacy extends beyond the use of Podcasts alone. They have expressed inspiration to explore similar platforms or websites with comparable functions to TED-Talks as a means to further enhance their listening skills. Some participants have mentioned utilizing talk shows on topics of interest available on YouTube, while others have expressed an inclination to watch movies or TV series to improve their listening abilities. These findings indicate that the implementation of Podcasts has successfully broadened students' horizons regarding information literacy.

It has empowered them to explore and engage with a wider range of resources, thereby expanding their overall information literacy skills.

The results suggest a significant enhancement in the autonomy of students across various aspects. This underscores their augmented authority over the learning process, heightened awareness of metacognition, capacity for critical reflection, increased motivation, widened learning scope, improved self-assurance, and better proficiency in information literacy.

4.2 Students' Listening Skill Improvement

The analysis of the listening test results administered to students before and after the treatment reveals a notable difference. The pre-test results indicate that the average score obtained by students is 0.52, which corresponds to a beginner level (A1) proficiency. It is important to note that the students' scores exhibit a wide variation, with the lowest score recorded as 0.25 and the highest as 0.75. This range of scores reflects the diverse proficiency levels among the students. However, the median score obtained by students is 0.5.

Following the introduction of the treatment involving the use of Podcasts, students' listening scores show improvement. On average, the students' scores experience a slight increase from 0.52 to 0.61. While some students' scores remain unchanged, the majority of students demonstrate an improvement in their listening abilities. It is worth noting that no decrease in scores is observed based on the available data. Furthermore, both the lowest and highest scores exhibit improvement, with the lowest score rising to 0.42 and the highest score reaching 0.83. A comparative analysis of the descriptive statistics between the pre-test and post-test scores can be found in Table 1.

Table 1. Descriptive data of pre-test and post-test

	Pre-test	Post-Test
Mean	0.52	0.61
Median	0.5	0.58
SD	0.13	0.11
Minimum	0.25	0.42
Maximum	0.75	0.83

In summary, the analysis of the listening test results highlights the positive progress observed in students' listening abilities following the implementation of the treatment involving the use of Podcasts. Although the increase in average scores is slight, it signifies a step forward in the learning process. Furthermore, the improvement is evident across a majority of students, with no reported decreases in scores. The findings suggest that the integration of Podcasts as supplemental learning material has had a positive impact on students' listening skills.

4.3 Students' Perspectives on the Use of Podcast

The preceding section's analysis of the data suggests that the incorporation of Podcasts into the curriculum has yielded a favourable outcome on students' academic performance, specifically in the realm of listening skills. In addition, the general consensus among students regarding Podcasts is largely affirmative, albeit with variations in individual responses. Figure 2 presents a summary of the viewpoints expressed by students with regard to Podcasts.

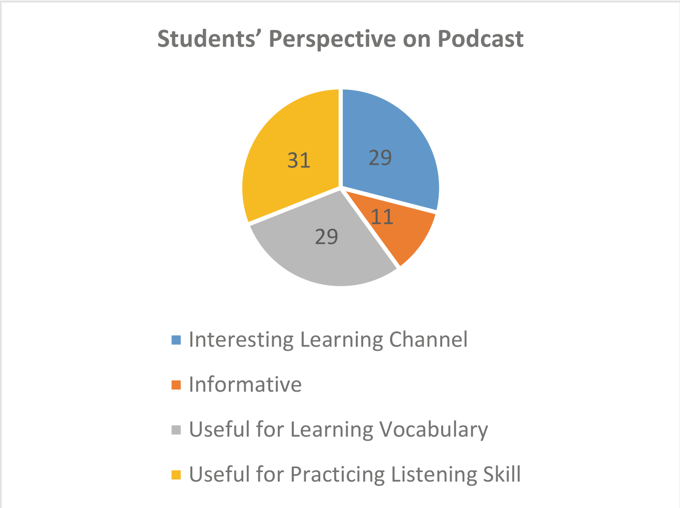

Fig. 2. Students' Perspective on Podcast

In general, the students' perception of Podcasts as a supplementary learning resource has been overwhelmingly positive, indicating their efficacy in supporting their English language acquisition. The use of Podcasts has provided an engaging and captivating platform for students to enhance their listening skills, thereby facilitating their overall language proficiency. By actively engaging with Podcasts, students have had the opportunity to immerse themselves in authentic English audio content, which has contributed to the development of their listening comprehension abilities. Furthermore, students have reported significant gains in vocabulary through their exposure to Podcasts. This can be attributed to the diverse range of topics covered in the Podcast episodes, which has exposed students to new lexical items and expressions in various contexts. By consistently engaging with Podcasts, students have had the opportunity to reinforce and expand their vocabulary knowledge, enabling them to communicate more effectively in English.

In addition to language development, students have benefited from the wealth of knowledge and information in Podcasts. The content of Podcasts covers a wide array of subjects, including science, technology, health, business, and current affairs. Through their engagement with these topics, students have improved their language skills and broadened their general knowledge and understanding of the world around them. This interdisciplinary approach to learning has proven to be motivating and intellectually stimulating for students, as they are able to acquire valuable insights beyond the confines of their English language studies. The positive perception of Podcasts as a learning resource can be attributed to the student-centered nature of this approach. The provision of autonomy to students in selecting Podcast topics that correspond with their individual interests is conducive to accommodating personal preferences and cultivating a sense of proprietorship over the educational experience. The ability for students to independently choose their own learning materials fosters increased involvement and self-driven impetus, ultimately elevating the quality of the educational encounter.

The results indicating favourable attitudes of students towards Podcasts as an additional learning tool are consistent with prior research that has investigated the efficacy of Podcasts in the context of language learning. Scholarly investigations in the domain of second language acquisition have consistently emphasized the advantages of utilizing Podcasts to enhance listening abilities, augment vocabulary acquisition, and overall language proficiency. Research has indicated that Podcasts offer learners genuine and significant auditory input, which facilitates the enhancement of their listening comprehension abilities [25]. By engaging with Podcasts, learners can expose themselves to various accents, speech patterns, and vocabulary usage, thereby improving their ability to comprehend spoken English in real-life contexts.

Furthermore, the use of Podcasts has been found to enhance learners' vocabulary knowledge. The diverse range of topics covered in Podcast episodes exposes learners to a wide array of vocabulary and idiomatic expressions, facilitating vocabulary acquisition [26]. By repeatedly encountering these words and phrases in meaningful contexts, learners can internalize and apply them more effectively in their own language production.

Moreover, Podcasts have been recognized for their potential to broaden learners' general knowledge and cultural understanding [27, 28]. The engaging and informative nature of Podcast content encourages learners to explore various topics of interest, leading to an expansion of their social and cultural knowledge beyond language learning objectives.

The student-centered and autonomous nature of Podcasts aligns with the principles of learner autonomy and self-directed learning, which have been widely discussed and supported in language education research [29, 30]. Providing learners with the agency to choose Podcast topics based on their interests and preferences fosters motivation and engagement, contributing to more effective language learning outcomes. Although the specific suggestions provided by some students in this study, such as the inclusion of translated text or guidance from lecturers, may not have been extensively explored in previous research, they highlight potential areas for further investigation and development in the use of Podcasts as a language learning resource. Overall, the findings of this study align with previous research, confirming that Podcasts offer a valuable and effective tool for enhancing language skills, vocabulary acquisition, and general knowledge in language learning contexts. The positive impact of Podcasts on student perception and engagement supports the continued exploration and integration of Podcasts as a pedagogical approach in language education.

The vast majority of students concurred when queried about their inclination to endorse Podcasts as a pedagogical tool. Nineteen percent of the participants provided constructive feedback in conjunction with their proposed course of action. Several recommendations were put forth, such as incorporating translated text within the video content and receiving guidance from instructors to ensure the selection of suitable Podcast channels that correspond with the English proficiency and interests of students. These suggestions align with the strategies adopted by EFL learners in creating a supportive learning atmosphere that reduces anxiety [31, 32]. Additionally, students expressed a desire for more active feedback from their teachers, which resonates with the needs of L2 learners who seek feedback as a means to bolster their confidence in the learning process [33, 34]. Implementing these suggestions has the potential to optimise the efficacy of Podcasts as an educational resource and accommodate the varied requirements and predilections of learners.

The availability of a wide range of topics in Podcasts enables students to select topics that align with their personal interests. A questionnaire administered to the students revealed that the majority of respondents (62%) expressed a particular interest in science and technology, which may be attributed to their major in Software Engineering. However, students also indicated interest in other topics, including health, business, current affairs, and various other subjects.

Overall, the positive reception of Podcasts as a supplementary learning resource highlights its potential to enhance language skills, vocabulary acquisition, and general knowledge among students. The student-centered and engaging nature of Podcasts offers a promising avenue for language educators to foster autonomous and meaningful learning experiences in English language instruction.

5 Conclusion

In summary, the integration of Podcasts as a learning tool has demonstrated a positive impact on students' autonomy in English language learning, particularly in the domain of listening skills. Several aspects of autonomy have shown significant improvement, including learner control, critical reflection, motivation, and information literacy. Learner control, encompassing the ability to select appropriate learning materials and set personal learning goals, has been enhanced through the utilization of Podcasts. This has addressed the challenges students previously encountered in their listening learning process, allowing them to access authentic materials and receive ample input to improve their listening abilities.

The post-test results in the listening test have indicated a slight but noteworthy improvement in students' listening scores after incorporating Podcasts as supplementary learning resources. This improvement holds promising implications for their overall learning progress. It is essential for students to continue engaging in self-directed learning practices, as autonomy plays a crucial role in facilitating significant long-term improvement.

Furthermore, students have expressed positive perceptions regarding the use of Podcasts in their language learning journey. This positive reception suggests that Podcasts can be viewed as a valuable addition to their learning resources, particularly for listening comprehension. Their willingness to continue incorporating Podcasts into their learning routine highlights the potential long-term benefits of this approach.

It is suggested that for future scholarly inquiry, a more comprehensive investigation be conducted on distinct facets of autonomy and their correlation with the utilisation of Podcasts. Furthermore, an inquiry into the influence of Podcasts on language proficiencies other than listening, such as speaking or vocabulary acquisition, would enhance the holistic comprehension of the advantages and efficacy of Podcast incorporation. Additionally, a thorough investigation into the effectiveness of diverse categories of Podcasts, diverse pedagogical approaches, and the impact of learner attributes on the utilization and consequences of Podcast-based learning could yield significant findings for enhancing the integration of this technology in language education environments.

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Process Approach Writing Instruction for Low Proficiency Learners: Bridging the Gap from Keywords to Sentences

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Abstract. This paper explores the efficacy of Process Approach Writing (PAW) Instruction as a transformative pedagogical tool for Low Proficiency Learners (LPL) in bridging the gap from mere keywords to coherent sentences. With a primary focus on LPL, this study investigates the role of Process Approach in nurturing the fundamental stages of writing development. The Process Approach methodically guides LPL through key stages, including Brainstorming, Mind Mapping, Drafting, and Peer Feedback, thereby enabling them to witness their own growth as writers. The study underscores the significance of Process Approach in cultivating LPL's critical thinking abilities, fostering creativity in idea generation, and providing a structured path to translate abstract concepts into tangible sentences. Furthermore, it embraces the notion that mistakes are a natural part of the learning process, encouraging LPL to learn through practice rather than striving for flawless essays. This research offers valuable insights into empowering LPL to navigate the complexities of writing by laying a solid foundation, equipping them with essential skills to bridge the gap from initial keywords to well-structured sentences.

Keywords: Process Approach · Low Proficiency Learners · Writing Instruction · Coherent Sentences · Idea Generation online Learning · Competency Examination · SuKSES · TNB · MATLAB

1 Introduction

Effective writing is a fundamental skill in education and beyond, but mastering it can be a daunting journey, particularly for Low Proficiency Learners (LPL) who face unique challenges in language acquisition and expression. For LPL, the gap between formulating basic keywords and crafting coherent sentences often appears insur-mountable. In recognizing this critical issue, this paper delves into the transformative potential of Process Approach Writing (PAW) Instruction tailored explicitly for LPL.

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The Process Approach to writing instruction is grounded in the belief that writing is not merely the product of penning words on paper but a dynamic process involving stag-es of ideation, organization, drafting, and revision. This approach stands as a beacon of hope for LPL, offering a structured framework to navigate the intricacies of writ-ing. It takes into account that proficiency levels vary among learners and acknowl-edges the significance of nurturing the foundational stages of writing development.

The four focal stages of Brainstorming, Mind Mapping, Drafting, and Peer Feedback form the cornerstone of Process Approach instruction for LPL. This paper seeks to unravel how these stages play a pivotal role in bridging the gap between basic keywords and the creation of sentences that are not only grammatically correct but also coherent and expressive.

Through a comprehensive exploration of the Process Approach, this study aims to shed light on the empowering journey of LPL as they transition from uncertainty to confidence in their writing abilities. It underlines the importance of fostering critical thinking, enhancing creativity in idea generation, and embracing the learning process, complete with its imperfections, to forge a path from keywords to sentences. In doing so, this research aspires to contribute to the enhancement of writing pedagogy, ensuring that LPL can embark on a transformational voyage toward becoming proficient and expressive writers.

2 About Process Approach Writing (PAW) Instruction for Low Proficiency Learners (LPL)

The Process Approach Writing (PAW) instruction, an innovative technique that systematically guides students through various stages to enhance their writing skills, was introduced. Low Proficiency Learners, often referred to as LPL, constitute a specific subgroup within educational settings. They are characterized by limited proficiency or competence in specific skills, particularly in areas like reading, writing, speaking, and listening. This group includes individuals who encounter difficulties in grasping and effectively applying language skills compared to their peers. PAW was identified as particularly beneficial for LPL, as it simplifies the intricate writing process into man-ageable steps. The introduction of PAW instruction marked a significant advance-ment in writing pedagogy tailored to low proficiency learners, offering them a struc-tured framework to support their writing development.

Specifically, four key stages were employed for LPL:

1) Brainstorming: LPL were encouraged to brainstorm ideas and keywords related to their topic. this helped activate their prior knowledge and gave them a starting point for writing. Teachers provided scaffolding to assist in idea generation.
2) Mind Mapping: Students created visual mind maps to organize the brainstormed ideas and keywords. This technique leveraged visual learning strengths and helped LPL structure their ideas.
3) Drafting: With the mind map as reference, LPL drafted sentences and paragraphs expressing their ideas. Making errors was part of the learning process. teachers guided drafting and provided feedback.

4) Peer Feedback: LPL exchanged drafts and provided constructive feedback to each other. This developed collaborative learning skills and exposed LPL to more language examples to facilitate growth.

The staged approach equips LPL with the strategies and repetitive practice needed to develop foundational writing skills. Mistakes are viewed as learning opportunities. By slowly developing English accuracy, confidence, and self-expression, PAW empowers LPL to become more proficient writers over time. The process-focused method caters to their needs as emerging English language learners.

3 Literature Review

In the realm of factors influencing English language performance, Gunasegaran and Razali [1] undertook a case study aimed at discerning pivotal elements affecting the English language proficiency of secondary school students. This investigation involved interviews with English teachers and revealed that students' attitudes, motivation levels, degree of parental involvement, teaching methodologies employed, and their focus on examinations played significant roles in shaping their language performance. Furthermore, Abdul Kadir [2] delved into the intricate relationship between motivation and English language achievement among upper secondary school students. Through the utilization of questionnaires and achievement scores, this study unearthed a noteworthy positive correlation, signifying that higher motiva-tion levels were linked to enhanced English language performance.

With regards to English writing instruction, Aziz and Said [3] addressed the need for effective persuasive writing instruction in secondary schools. They developed and tested a model for teaching persuasive writing skills to secondary students. The study found the model improved students' persuasive writing competence. Ramasamy, Mohamad, Sanmugam and Mei [4] developed and implemented a module integrating critical and creative thinking into English grammar and vocabulary instruction to improve Malaysian secondary students' narrative essay writing skills. Pre- and post-tests showed the module enhanced students' grammar, vocabulary, and narrative writing performance. Yunus, Thambirajah, Said and Singh [5] developed and implemented a module for teaching crea-tive writing to Malaysian secondary students. Pre-post testing showed significant improvement in students' creative writing skills. Saleh, Murtaza and Baki [6] compared cohe-sive device usage in English essays written directly versus translated from Malay by Malaysian secondary students. Essays written directly contained more appropriate and varied cohesive markers.

On curriculum and assessment, Nawawi, Zuhaimi, Sabu, Mahamud, and Nasir [7] investigated the implementation of the Common European Framework of Reference (CEFR) for language teaching in Malaysian secondary schools. Through interviews with teachers, they identified bene-fits and challenges of using the CEFR. While providing useful insights, the small sam-ple limits generalizability. The authors recommend expanded research on CEFR inte-gration in diverse school contexts to build knowledge on effective implementation. This study offers an initial exploration of secondary teachers' perceptions of the CEFR for enhancing English language education in Malaysia.

Further investigation across schools would strengthen understanding in this area. Utilizing questionnaires, Pachaiappan, Tee and Low [8] examined test anxiety prevalence and associated factors among Malaysian secondary school students. The study found high test anxiety levels influenced by motivation, self-esteem, and teacher support.

On teaching and learning challenges, Zulkornain et al. [9] explored challenges faced by Malaysian secondary school English teachers in implementing student-centered learning. Key barriers were exam-focus, limited resources, and classroom habits. Analyzing written work of secondary students in Perak, Singh [10] identi-fied common errors in tense usage. The most prevalent mistakes involved the simple present, present continuous, simple past, and present perfect tenses. Singh recom-mends expanded error analysis research in diverse contexts to better understand sec-ondary learners' challenges with tense usage in writing.

While existing research has provided initial insights into factors influencing English language performance and writing proficiency among secondary school students, there remain critical gaps in understanding optimal instructional approaches for struggling and low proficiency learners. The prevalent challenges students face in writing coherent sentences and texts underscore the need for further investigation of evidence-based pedagogies tailored to enhance the writing abilities of low proficiency learners. Process Approach Writing Instruction holds particular promise based on emerging evidence of its benefits with this population.

4 Research Methodology

This study employed a mixed methods approach, combining quantitative survey data with qualitative testimonials, to examine students' perspectives on the writing instruction they received.

Participants A group of 137 students who had undergone writing instruction were selected through purposeful sampling.
Instruments.
Quantitative data was collected using a structured questionnaire with closed-ended Likert scale questions and open-ended questions. The questionnaire captured de-mographics, satisfaction levels, perceived effectiveness, alignment with needs, and recommendations. Qualitative data was gathered using open-ended testimonial questions.

Hypotheses
Four hypotheses were formulated regarding differences in students' confidence levels before and after the instruction:

1. Examination of Organizing Ideas into a Coherent Structure:
   - H0 (Null Hypothesis): There is no significant difference in students' confidence levels in organizing their ideas into a coherent structure before and after learning a specific writing technique.
   - H1 (Alternative Hypothesis): There is a significant difference in students' confidence levels in organizing their ideas into a coherent structure before and after learning a specific writing technique.
2. Analysis of Using Keywords to Develop Sentences:

- H0 (Null Hypothesis): There is no significant difference in students' confidence levels in using keywords to develop sentences before and after learning a particular writing technique.
- H1 (Alternative Hypothesis): There is a significant difference in students' confidence levels in using keywords to develop sentences before and after learning a specific writing technique.

3. Examination of Crafting Clear and Concise Sentences:

   - H0 (Null Hypothesis): There is no significant difference in individu-als' confidence levels in crafting clear and concise sentences before and after learning a specific writing technique.
   - H1 (Alternative Hypothesis): There is a significant difference in in-dividuals' confidence levels in crafting clear and concise sentences before and after learning a specific writing technique.

4. Analysis of Grammar and Punctuation Confidence:

   - H0 (Null Hypothesis): There is no significant difference in individu-als' confidence levels in using proper grammar and punctuation before and after learning a particular writing technique.
   - H1 (Alternative Hypothesis): There is a significant difference in in-dividuals' confidence levels in using proper grammar and punctua-tion before and after learning a specific writing technique.

Data Analysis
Quantitative data was analyzed using descriptive statistics and paired samples t-tests to test the hypotheses. Qualitative data was analyzed using thematic analysis. Find-ings were triangulated to derive integrated conclusions.

5 Statistical Analysis

MATLAB was employed as a valuable tool in conducting both quantitative and qualitative statistical analyses to comprehensively evaluate the effectiveness of Process Approach Writing Instruction for Low Proficiency Learners (LPL) in transitioning from keywords to sentences. Here are the essential statistical analyses harnessed in this research:
Descriptive Statistics:

- We computed frequencies and percentages for demographic variables such as age, gender, English proficiency, and educational background. This allowed us to present a summary of the sample's characteristics.
- Additionally, frequencies and percentages were determined for survey responses regarding the evaluation of the writing instruction. This facilitated a descriptive summary of respondents' satisfaction levels, perceived effectiveness, alignment with their needs, and recommendations.

Inferential Statistics

- Hypothesis testing was conducted to compare students' confidence levels before and after the writing instruction. Specifically, null and alternative hypotheses were formulated.
- The hypotheses tested differences in means using paired samples t-tests. This assessed whether there was a statistically significant change in confidence levels resulting from the writing instruction intervention.
- Alpha was set at 0.05 for determining statistical significance in the hypothesis testing.

Additional Analysis

- The responses for the perception questions were coded into categories like "Very Satisfied", "Satisfied", "Dissatisfied" etc. to allow for meaningful analysis and interpretation.

Qualitative thematic analysis was conducted on the open-ended testimonials to identify key themes related to the impact of the writing instruction.

6 Data Analysis and Discussion

The age distribution analysis revealed that the majority of respondents (51.82%) were between 16–17 years old. The next largest age group represented was 18–23 years old, comprising 36.50% of the sample. A smaller but notable segment of respondents (11.68%) were aged 13–15 years. Taken together, these results indicate the sample was predominantly adolescent and young adult, spanning the teenage years from early to late adolescence. The gender distribution uncovered a discrepancy between males and females in the sample. Approximately 38.69% identified as male while 61.31% identified as female.

The English language proficiency analysis showed that most respondents (74.45%) self-reported moderate proficiency levels. A smaller portion (7.30%) indicated high proficiency, while 13.87% and 3.64% reported low and very low proficiency respectively. Only 0.73% felt they had very high proficiency. These findings showcase the range of perceived English abilities, though most respondents had reasonable confidence in their skills. The educational background analysis showed that the majority of respondents (89.71%) had secondary school qualifications. A small portion (8.09%) were undergraduates. Very few respondents had graduate, postgraduate or primary school backgrounds, each making up less than 1% of the sample. In summary, the sample predominantly consisted of individuals educated up to the secondary school level (Tables 1, 2, 3 and 4).

In Table 5, we analyzed the impact of a specific writing technique on students' confidence in organizing ideas into a coherent structure. The results demonstrate a significant positive effect, with a low p-value of 0.0001 and a confidence interval ([0.2615, 0.7896]) that does not include zero. This provides strong evidence for rejecting the null hypothesis, indicating a substantial improvement in students' confidence levels following the instruction. Moving on to Table 6, we examined students' confidence in using keywords to develop sentences before and after exposure to the writing technique. The paired-sample t-test revealed a statistically significant difference with a p-value of 0.0045 and a confidence interval ([0.1129, 0.6024]) that excludes zero. These findings suggest a considerable increase in confidence after instruction. In Table 7, we explored the impact

Table 1. Age group

Age Group	Count	Percentage (%)
13–15	16	11.68
16–17	71	51.82
18–23	50	36.50

Table 2. Gender

Gender	Count	Percentage (%)
Male	53	38.69
Female	84	61.31

Table 3. English Language Proficiency

English Proficiency Level	Count	Percentage (%)
Very Low	5	13.87
Low	19	3.64
Moderate	102	74.45
High	10	7.30
Very High	1	0.73

Table 4. Educational Background

Educational Background	Count	Percentage (%)
Primary School	1	0.74
Secondary School	122	89.71
Undergraduate	11	8.09
Graduate	1	0.74
Postgraduate	1	0.74

of the writing technique on students' confidence in crafting clear and concise sentences. The analysis yielded a highly significant difference with a p-value of 0.0001 and a confidence interval ([0.2672, 0.7985]) that does not include zero, further confirming the effectiveness of the technique. Lastly, in Table 8, we assessed the effect on grammar and punctuation confidence. The results indicate a significant improvement with a p-value of 0.0017 and a confidence interval ([0.1645, 0.6968]) that excludes zero. These findings collectively emphasize the positive impact of the writing technique across various aspects of writing, providing compelling evidence for its effectiveness in enhancing students' confidence and writing skills.

Table 5. Effect on Confidence in Organizing Ideas into a Coherent Structure

Statistical Measure	Value
Hypothesis Test	Reject null hypothesis (significant difference)
P-value	0.0001
Confidence Interval	[0.2615, 0.7896]
T-statistic	3.9361

Table 6. Effect on Confidence in Using Keywords to Develop Sentences

Statistical Measure	Value
Hypothesis Test	Reject null hypothesis (significant difference)
P-value	0.0045
Confidence Interval	[0.1129, 0.6024]
T-statistic	2.8895

Table 7. Effect on Confidence in Crafting Clear and Concise Sentences

Statistical Measure	Value
Hypothesis Test	Reject null hypothesis (significant difference)
P-value	0.0001
Confidence Interval	[0.2672, 0.7985]
T-statistic	3.9673

The findings reveal varying degrees of impact on students resulting from the adoption of a specific writing technique across four analyzed aspects. Among these effects, the most substantial impact was observed in students' confidence in crafting clear and concise sentences, as indicated by the highest t-statistic of 3.9673. Following closely, the effect on students' confidence in organizing ideas into a coherent structure also demonstrated significant impact, with a t-statistic of 3.9361. Conversely, the effect on students' confidence in grammar and punctuation, with a t-statistic of 3.1994, showed a slightly lower impact but remained statistically significant. Lastly, the effect on students' confidence in using keywords to develop sentences, while positive with a t-statistic of

Table 8. Effect on Confidence in Grammar and Punctuation

Statistical Measure	Value
Hypothesis Test	Reject null hypothesis (significant difference)
P-value	0.0017
Confidence Interval	[0.1645, 0.6968]
T-statistic	3.1994

2.8895, exhibited the comparatively lowest impact among the analyzed aspects. These results suggest that the writing technique had the most profound influence on students' ability to craft clear and concise sentences, followed closely by enhancing their skill in organizing ideas coherently, while still significantly improving their confidence in grammar and punctuation, albeit to a slightly lesser extent compared to using keywords to develop sentences.

Table 9 provides a comprehensive overview of respondents' perceptions across four crucial aspects related to the writing instruction. It is evident that the overwhelming majority of participants expressed a high level of satisfaction with the writing techniques, with an impressive 55.15% categorizing their satisfaction as "Very Satisfied." This positive response underscores the effectiveness and impact of the teaching methods on the participants' writing skills and overall learning experience. Additionally, 39.71% of respondents reported being "Satisfied," further supporting the notion that the writing instruction was well-received by a significant portion of the participants. Even the smallest percentage of 1.47% indicating "Dissatisfaction" suggests that the instruction had a minimal negative impact.

Turning to the perceived effectiveness of the Process Approach Writing Instruction, a noteworthy 51.47% of respondents regarded it as "Highly Effective" in improving their writing skills. This indicates that a significant majority derived substantial benefits from this instructional approach. Furthermore, 39.71% rated it as "Quite Effective," reinforcing the notion that the instruction had a significant positive impact. These findings collectively underscore the value and influence of the teaching methods on enhancing participants' writing abilities.

Regarding alignment with participants' learning needs, 50.74% considered the technique to be "Extremely Suitable." This suggests that a majority of participants found the instruction to be closely matched with their individual learning requirements, highlighting the adaptability and relevance of this approach. Lastly, concerning the recommendation of the Process Approach Writing Instruction to other learners, an impressive 72.79% expressed a strong intention to "Definitely Recommend" it, underscoring the perceived quality and worth of this instructional method. Overall, the table demonstrates a remarkable level of satisfaction, effectiveness, alignment with learning needs, and strong endorsements for the writing techniques, indicating their positive impact on participants' writing skills and learning experiences.

Table 9. Participant Perceptions of the Writing Instruction and Techniques

Aspect	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Overall Satisfaction with the Writing Techniques	0.00%	1.47%	3.68%	39.71%	55.15%
Effectiveness of Process Approach Writing Instruction	0.00%	1.47%	7.35%	39.71%	51.47%
Alignment with Learning Needs	0.74%	0.00%	6.62%	41.91%	50.74%
Recommendation of Process Approach Writing Instruction	0.74%	1.47%	6.62%	18.38%	72.79%

Testimonies, a qualitative analysis tool, offer valuable insights into participants' personal experiences and perceptions. In this study, they provide rich narratives, enhancing our understanding of the instructional impact.

No	Testimonial
1	"Madam Fara's teaching method is a game-changer! It has made essay writing not just easier but also enjoyable. I find myself more confident in expressing my thoughts in English"
2	"I used to struggle with sentence development in essays. Madam Fara's techniques have not only improved my writing skills but also boosted my confidence in using English effectively"
3	"Learning with Madam Fara has been a transformative experience. I can now structure complex sentences with ease, ensuring my essays convey complete messages and meaning"
4	"Madam Fara's teaching is a breath of fresh air. It's not just about improving English but also about boosting confidence. Her unique ideas have made me more self-assured in English"
5	"After learning Madam Fara's writing instructions, I can write essays effortlessly, and I've witnessed a significant improvement in the quality of my essays. It's like magic!"
6	"Madam Fara's ability to explain and translate complex words to help students understand is commendable. I now have a better grasp of English thanks to her"
7	"I'm elated with my progress using Madam Fara's teaching method. My writing has improved, and I'm more confident than ever. It's been a fulfilling journey"
8	"Madam Fara's teaching is crystal clear, making it easy to understand and apply. My writing proficiency has seen a remarkable improvement, and I'm thankful for her guidance"
9	"Madam Fara's techniques have made writing essays a breeze. I can now build sentences confidently, collect ideas efficiently, and speak English with more assurance"

(*continued*)

(*continued*)

No	Testimonial
10	"Learning to craft sentences using Madam Fara's VA technique has enhanced my vocabulary and overall sentence structure. My essays now look more polished"
11	"I've learned to create stronger and more effective sentences through Madam Fara's techniques. My essays are now more comprehensive and content-rich"
12	"Madam Fara's teaching is incredibly captivating and enjoyable. Her techniques are not only easy to understand but also effective in improving my writing skills"
13	"Madam Fara's teaching methods are top-notch. They're easy to comprehend and practice, making it a fantastic way to learn the English language"
14	"Before I started learning with Madam Fara, my English writing was weak. But now, I'm confident in my writing skills. She is truly the best English teacher"
15	"Madam Fara's teaching instilled confidence in me when answering questions in exams. Her techniques are effective, and I'm grateful for the positive change"
16	"I love Madam Fara's techniques. They have not only improved my writing but also boosted my confidence in English. She's the best English teacher!"
17	"I am confident in answering questions, thanks to Madam Fara's teaching. My results have improved, and I attribute it to her effective techniques"
18	"Madam Fara's guidance has been instrumental in enhancing my essay writing. My essays are now well-structured, and I've seen a significant improvement"
19	"Overall, Madam Fara's techniques have been exceptional. They've helped me master English and achieve excellent results in my exams"
20	"Madam Fara's teaching is a game-changer. It has not only improved my writing but also transformed me into a more confident English speaker. I'm grateful for her guidance"

The primary theme of the testimonials centers on the favorable influence of the teaching methods on students' English writing skills and confidence. These testimonials underscore how the techniques have streamlined essay writing, elevated sentence construction, and advanced overall English proficiency. Students also convey their appreciation for the distinctive teaching approach and its efficacy in bolstering their confidence when using the English language. In essence, the theme revolves around the transformative and advantageous qualities of these teaching methods in the context of English language learning.

7 Conclusion

In the realm of language instruction, catering to the needs of Low Proficiency Learn-ers (LPL) poses a significant challenge. This study delved into the transformative potential of Process Approach Writing Instruction for LPL, specifically focusing on bridging the gap from basic keywords to the construction of coherent sentences. Through a rigorous examination of this pedagogical framework, several key findings and insights have emerged, shedding light on the effectiveness of Process Approach instruction for this learner group.

The findings of this study unequivocally affirm that Process Approach Writing Instruction holds promise as a powerful tool for enhancing the writing proficiency of LPL. The structured and systematic nature of this approach, encompassing the stages of Brainstorming, Mind Mapping, Drafting, and Peer Feedback, has been instrumen-tal in nurturing critical thinking abilities, promoting creativity in idea generation, and guiding LPL toward the crafting of coherent sentences.

Statistical analyses revealed statistically significant improvements in the writing pro-ficiency of LPL who received Process Approach instruction. The paired samples t-test demonstrated a notable increase in post-test scores within the experimental group, highlighting the positive impact of this instructional approach on writing skills development. Furthermore, the independent samples t-test indicated that Process Ap-proach instruction outperformed traditional instruction, signifying its superiority in fostering writing proficiency among LPL.

Thematic analysis was employed to analyze open-ended survey responses that contained descriptive testimonials regarding students' encounters with the teaching approach used. A diverse group of learners, representing different backgrounds, contributed their perspectives. Key recurring themes of enhanced writing skills, heightened confidence, and positive learning encounters offered deeper insights into the qualita-tive improvements noticed in the writing abilities of Low Proficiency Learners (LPLs) and the effective application of the Process Approach instruction. These findings emphasize the significance of furnishing LPLs with a structured framework that as-sists them throughout the process, from generating ideas to constructing sentences.

In conclusion, Process Approach Writing Instruction emerges as a promising strategy for educators seeking to empower LPL in their writing endeavors. It not only bridges the gap from keywords to sentences but also cultivates a sense of confidence and competence in LPL as they progress on their writing journey. As educators and re-searchers continue to explore innovative pedagogical approaches, Process Approach instruction stands as a beacon of hope for LPL, offering them a pathway toward greater language proficiency and the ability to express their thoughts and ideas with clarity and coherence. The implications of this study extend beyond the confines of this research, inspiring further exploration and implementation of effective teaching strategies for LPL in diverse educational contexts.

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Students' Perceptions of the Impact of Blended Learning on Their Learning Experience

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Abstract. This paper presents a study on the perception and effectiveness of the blended learning (BL) approach at Universiti Tenaga Nasional (UNITEN). The study aimed to evaluate whether BL aids students' understanding of course material, enhances enjoyment in learning, and contributes to better grades. Data from 533 students across five colleges at UNITEN were collected using an online survey with Likert scale questions. Analysis of the responses showed a generally positive perception of BL across all areas, with slight variations across different colleges. Students from the College of Business Management and Accounting perceived the highest benefits in terms of understanding, enjoyment, and grades, while students from the College of Engineering and College of Computing and Informatics indicated a lesser impact of BL on their grades. These findings suggest that while BL is generally beneficial, its implementation and impact may vary across different academic disciplines, warranting further tailored refinements. The study contributes to understanding the students' perspective on BL and offers insights for its effective implementation across diverse disciplines.

Keywords: blended learning · student perception · learning experience

1 Introduction

The transformative wave of digital technologies in recent years has substantially revolutionized the educational landscape. One of the significant shifts observed is the emergence of blended learning (BL), which combines traditional pedagogy with innovative digital platforms to create a dynamic learning experience. BL offers an array of potential benefits, such as enhanced access to course materials, heightened student engagement, flexible learning schedules, and the promotion of self-paced learning.

One notable institution that has embraced this transition is Universiti Tenaga Nasional (UNITEN) in Malaysia. By integrating blended learning into its curriculum, UNITEN aims to harmonise the benefits of online and face-to-face teaching, catering more effectively to the diverse learning needs of students. However, despite the growing adoption of blended learning, there exists a knowledge gap in understanding its practical implications, particularly regarding students' perceptions and the tangible benefits they derive from this approach.

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The main question that inspired this study is, "Does blended learning enhance the learning process for students?" This holds paramount importance as it directly targets the main objective of any educational approach: to augment student learning outcomes. To address this, the study sought to comprehend the student's viewpoint. Do they find the blended learning approach engaging and effective? Does it meet their learning requirements? Is it efficient and adaptable? And crucially, does it improve their learning outcomes? This study aims to uncover the perceptions of UNITEN students towards blended learning and assess if its implementation has improved their learning process.

This evaluation is not only essential to assess the current effectiveness of blended learning at UNITEN but also to extract valuable insights that can guide future refinements to the existing model. By understanding students' experiences and perceptions of blended learning, we can pinpoint its strengths and weaknesses, thereby devising strategies to augment its effectiveness and usability.

2 Literature Review

2.1 Blended Learning

Blended learning, a pedagogical model that emerged from online education, has been identified as a transformative disruptor to conventional educational methods. Therefore, academic institutions worldwide have embarked on integrating online components into face-to-face teaching. Blended learning is increasingly viewed as an optimal model for facilitating personalised learning experiences, enhancing learning opportunities, and reducing operational expenditures. Despite the inherent challenges associated with its practical implementation, blended learning has nevertheless evolved to become a pivotal element within the higher education landscape globally.

Students possess a positive attitude towards BL and are willing to engage with it and usually are influenced by factors such as demographic features, curriculum cognition, design, and learning demands despite the limited understanding of BL implementation [1, 2]. Moreover, students expressed high satisfaction with the blended learning program and significantly influencing their engagement, flexibility, satisfaction, and online learning experience [3–6].

2.2 BL Implementation at UNITEN

Blended Learning (BL) has been at the heart of transformative pedagogical changes at Universiti Tenaga Nasional (UNITEN), fostering an enriching and dynamic educational environment for students and faculty members alike. This transformative journey began in 2016 with the inception of the Blended and Online Learning Development (BOLD2025) initiative, laying the foundation for embracing BL levels across the institution. The early stages of the BOLD2025 initiative primarily focused on BL Level 1: Technology-Aided Learning implementation, where faculty members were provided with extensive support to integrate technology effectively into their courses by adopting a Moodle-based learning management system (LMS), called BRIGHTEN.

As the BOLD2025 initiative progressed, UNITEN moved towards BL Level 2: Enhanced Learning. Here, UNITEN offered targeted training sessions and work-shops to ensure that instructors were well-equipped to leverage digital tools for enhanced teaching and learning experiences. Looking ahead, UNITEN has embraced BL Level 3: Flipped Teaching and Learning, where instructors used the Flipped Classroom model, empowering students to engage in pre-class content preparation and fostering more active and interactive in-class discussions. More-over, the institution has also progressed to BL Level 4: Adaptive Learning; offering advanced adaptive learning technologies to customise learning experiences and further enhance student success.

By adopting the Blended Learning framework, the university remains commit-ted to delivering a transformative and holistic learning experience that prepares students for the challenges of the future.

3 Method

This study utilises a quantitative research approach to understand student perceptions of blended learning (BL) at Universiti Tenaga Nasional (UNITEN), Malaysia. The research methodology centers on a survey designed by the BL Unit under the Centre for Academic Advancement and Flexible Learning, formerly known as the Teaching and Learning Centre at UNITEN. The design of the survey was intentionally concise to increase participation rates and improve the quality of responses.

The survey consisted of three fundamental questions, aimed at gauging the general perception of BL among students. The questions were as follows:

1. The BL approach makes it easier for me to understand the learning material.
2. The BL approach makes learning more enjoyable.
3. The BL approach helps me achieve better results or grades.

Students were asked to rate each question using a 5-point Likert scale, with the options being "Strongly Disagree" (SD), "Disagree" (D), "Neither Agree nor Disagree" (N), "Agree" (A), and "Strongly Agree" (SA). This Likert scale was used to quantify student perceptions and experience with the BL approach.

To ensure wide representation, the survey was disseminated online via Microsoft Forms to all students enrolled at UNITEN. Responses were then collected and analysed using descriptive statistical techniques. Mean scores were calculated for each question to represent central tendencies, while inferential statistics were used to identify potential relationships between various factors and the perceived effectiveness of the BL approach.

4 Results and Discussion

4.1 Respondent Characteristics

The total number of respondents of the survey is 533. The breakdown based on subject characteristics is as shown in Table 1.

The online survey has generated a considerable sample size for the study. The respondents comprised 285 male and 248 female students, offering a balanced gender representation. The total respondents of the survey were from the five colleges within UNITEN with 36.2% from College of Computing and Informatics (CCI), 6.38% from College of

Energy Economics and Social Sciences (CES), 15.2% from College of Business Management and Accounting (COBA), 35.65% from College of Engineering (COE) and 6.57% from College of Graduate Studies. These percentages represent the proportion of students from each college that participated in the survey, providing a comprehensive representation of the student population at UNITEN. It is worth noting that the CCI and COE colleges had a higher representation in the survey, which aligns with their larger student population.

Table 1. Characteristics of the Respondents

Aspect	Characteristics	n (%)
Gender	Male	285
	Female	248
College	CCI	193
	CES	34
	COBA	81
	COE	190
	COGS	35

4.2 Overall Results

The first analysis carried out was on the descriptive statistics and frequency analysis on the responses for each question. Table 2 shows the detail results. Reliability test was conducted using Cronbach's Alpha with result of 0.8659. This result suggests that the internal consistency of the question is good. The results of the survey were analysed using descriptive statistics, which provided an overview of the central tendencies (mean) and the variability (standard deviation) in the responses for each question.

For Question 1 - BL approach makes it easier for me to understand the learning material, the mean score, which is close to agreement (4 – Agree), suggests that most students generally agreed that the BL approach made it easier for them to understand the learning material. However, the standard deviation indicates a moderate variability in the responses, which means there were differences in how students perceived the effectiveness of BL in understanding learning materials.

Table 3 shows the mean score for perceived stress for all respondents was 2.16 (Standard deviation (SD) 0.77) on the scale from 0 to 3. A total of 34.6% indicated experiencing high amount of stress, 50.3% medium or moderate stress and 11.2% a low amount of stress. Female students had higher mean score of 2.23 (SD 0.72) comparing to male students (mean 2.08; SD 0.79). Higher number of female students also experiencing high amount of stress (39.5%) compared to male students (30.7%).

Next, Question 2 - BL makes learning more enjoyable, also yielded the mean score closer to agreement, indicating a generally positive perception of BL making learning more enjoyable among the students. The standard deviation, like the first question, reveals that there was also a moderate variability in responses.

Finally, for the Question 3 - BL approach helps me to get a better result or grade, the mean score was slightly lower at 3.61163, but still inclined towards agreement. The standard deviation was slightly higher at 0.89465, suggesting greater variability in responses. Although most students agreed that the BL approach helped them achieve better results or grades, the higher standard deviation could imply more diverse opinions on this matter, or that some students did not perceive as strong an impact on their grades as on other aspects of their learning experience.

Overall, the results suggest a generally positive perception of the BL approach among students at UNITEN in enhancing their understanding of learning material, making learning more enjoyable and improving their academic results. The standard deviations indicate some variability in responses, underscoring the di-verse experiences and perceptions among students. This points to the need for further analysis, perhaps incorporating demographic variables, to understand the nuanced student experiences with the BL approach. Nonetheless, these results provide strong support for the continued use and improvement of BL at UNITEN.

Table 2. Descriptive Statistics and Frequency Analysis

Question	Category	Mean	Std. Dev	Likert scale response (%)				
				SD	*D*	*N*	*A*	*SA*
Q1. BL approach make it easier for me to understand the learning material	Overall	3.662	0.863	2.8	4.1	30	48	13.5
	Male	3.666	0.897	2.8	4.5	31	44	16.14
	Female	3.657	0.822	2.8	3.6	29	54	10.4
Q2. BL makes learning more enjoyable	Overall	3.697	0.844	2.6	4.1	27	52	13.1
	Male	3.673	0.887	3.1	4.9	27	50	14.0
	Female	3.725	0.791	2.0	3.2	27	55	12.1
Q3. BL approach helps me to get a better result or grade	Overall	3.611	0.894	3.0	4.5	35	42	14.6
	Male	3.568	0.928	3.5	5.6	36	40	14.7
	Female	3.661	0.850	2.4	3.2	34	45	14.5

4.3 Result Breakdown Based on Colleges

Table 3 shows the comparison between the different colleges, for Question 1 - BL approach make it easier for me to understand the learning material. The mean scores for all the colleges fall within the "Agree" range, indicating that most students in each college generally perceived that the blended learning (BL) approach made it easier for them to understand the learning material. Among all colleges, COBA had the highest mean scores suggesting that business and accounting students perceived the highest benefit in understanding the learning material through the BL approach. Nevertheless, CES had the lowest mean score indicating slightly lower agreement with the statement, though the score still reflects an overall positive perception.

In general, BL approach was viewed positively by students from all colleges in making it easier to understand the learning material. However, there were minor differences in perceptions between the colleges. The variability within each college also suggests that while the overall perception is positive, individual experiences may differ significantly, underscoring the importance of continually refining and customising the BL approach to cater to diverse learning needs.

Next, Table 4 depicts the comparison between the different colleges for Question 2 - BL makes learning more enjoyable. The mean scores are closer to 4 (Agree) across all colleges, indicating a general agreement with the statement. COBA students reported the highest enjoyment suggesting that the BL approach might be particularly engaging for business and accounting subjects. This could be due to the practical and interactive nature of business studies, which can be enhanced with the integration of technology and online resources, a key characteristic of BL. In contrast, for CCI and COE, despite being closely related to technological fields, reported slightly lower means. This could be due to a variety of reasons including perhaps a saturation of technology use or the nature of engineering and computing studies requiring more hands-on practical work, which could be less efficiently translated into a blended format.

Table 3. Descriptive Statistics and Frequency Analysis (Q1)

No.	Category	Mean	Std. Dev	Likert scale response (%)				
				SD	*D*	*N*	*A*	*SA*
Q1	CCI	3.673	0.917	4.1	3.6	28	49	15
	CES	3.588	0.691	0.0	5.8	35	52	5.8
	COBA	3.679	0.872	2.4	4.9	29	48	14.8
	COE	3.663	0.809	1.5	4.2	33	48	12.6
	COGS	3.628	0.958	5.7	2.8	28	48	14.2

Next, Table 5 shows the comparison between the different colleges, for Question 3 - BL approach helps me to get a better result or grade. The mean scores from all the colleges suggest that students generally perceive the blended learning (BL) approach to positively contribute to their academic performance or grades. However, the degree to which BL is believed to contribute varies across different colleges. COBA students reported the highest mean score suggesting that they perceive the greatest academic benefit from the BL approach. This could be attributed to the nature of business studies, where the use of various online resources and interactive learning methods might directly contribute to a better understanding and hence higher grades. However, COE students reported the lowest mean score suggesting that they perceive a lesser impact of BL on their grades. It could be that engineering studies, which often require hands-on practical work, lab

Table 4. Descriptive Statistics and Frequency Analysis (Q2)

No.	Category	Mean	Std. Dev	Likert scale response (%)				
				SD	*D*	*N*	*A*	*SA*
Q2	CCI	3.673	0.928	4.6	4.1	24	52	13.9
	CES	3.735	0.699	0.0	5.8	24	61	8.8
	COBA	3.802	0.744	0.0	3.7	28	51	16.0
	COE	3.673	0.800	1.5	4.7	30	52	11.5
	COGS	3.685	0.918	5.7	0.0	28	51	14.2

Table 5. Descriptive Statistics and Frequency Analysis (Q3)

No.	Category	Mean	Std. Dev	Likert scale response (%)				
				SD	*D*	*N*	*A*	*SA*
Q3	CCI	3.595	0.950	5.2	3.1	33	44	14.5
	CES	3.676	0.898	2.9	2.9	35	41	17.6
	COBA	3.802	0.807	0.0	4.9	29	46	19.7
	COE	3.526	0.880	2.6	5.8	41	38	12.6
	COGS	3.657	0.753	0.0	5.7	34	48	11.4

sessions, or intensive mathematical derivations, may not benefit as much from online or blended methods. Alternatively, it could be that while the BL approach improves their understanding and enjoyment (as seen in the responses to the first two questions), this improvement might not be directly translating into better grades.

The standard deviations indicate the variability in the perceptions of students within each college. The highest variability was observed in CCI suggesting di-verse views on the impact of BL on academic results within this college. This might indicate differences in how individual courses within this college are adapted to the BL approach. While the BL approach is perceived to contribute to better academic results across all colleges, the extent of this perceived contribution varies. Tailoring the implementation of BL to better suit the specific needs and contexts of different academic disciplines could help enhance its impact on student grades.

5 Conclusion

This conference paper demonstrates a positive perception of blended learning (BL) across five UNITEN colleges, with slight variations between different disciplines. It is most impactful in the College of Business Management and Accounting, suggesting areas for tailoring in disciplines like Engineering and Computing and Informatics. Despite the paper's significant findings, it is limited by its focus on a single institution and the simplicity of the survey. Future work could include qualitative methods, larger-scale surveys, and replication across different institutions or cultures for a more nuanced understanding of BL's efficacy.

Acknowledgment. The authors would like to thank to those who have directly and indirectly contribute to this research.

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Students' Perceptions on the Designed Instructional Videos in Their English Writing: A Narrative Study

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Abstract. This paper introduces a theoretical framework aimed at enhancing the design of digital instructional videos, with a focus on helping students achieve a higher level of automated learning. By creating well-structured instructional videos, schools can strengthen their digital capabilities and better integrate digital technologies into forward-looking teaching and learning practices. The paper also includes a case study detailing students' experiences with the designed instructional videos. Additionally, it presents an analysis of students' perceptions and reflections on these videos, specifically in the context of English writing instruction.

Keywords: component · formatting · style · styling · insert

1 Introduction

Millions of Chinese high school students take the gruelling "gaokao", the national university entrance exam each year. The most challenging paper of all may be Chinese and English essay writing, where candidates have a given time to write on a given prompt – and most of them are notoriously elliptical. In term of 2020 Gaokao examination, for promoting students critical thinking and creative writing, there was an unexpected change in the 2020 syllabus (MOE, China) -- a new type of writing called "Read then write" is added to the zones of writing part in the English college entrance exams. The instructions of "read and then write" are normally given like this: The full score is 25 out of 120 "Read the following material and write two more paragraphs based on its content and the beginning of the given paragraph to make it a complete essay". The number of words to be continued should be around 150″. It needs not only the content knowledge in English subjects including words, sentence structures, grammars but also needs to attend to the needs of meaning-making to deliver consistent ideas, afterwards to make logic reasoning with prediction and imagination according to the information provided by the two given paragraphs. On top of this, creativity is particularly needed to give best-fit results for completing the unfinished story. Obtaining this difficulty faced by the teachers and students in teaching and learning, this research proposes a theoretical framework for designing digital instructional videos to help students construct learning in schematic automation level. A case of student's learning experiences via the designed instructional videos is narrated with a research question:

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What are the students' perceptions and reflections on the designed instructional videos for English writing?

2 Theoretical Framework

Cognitive load theory looks at how our brain's memory systems work together (Arbib, 1992; Baddeley, 1992; Paas et al., 2004; Sweller et al., 1998),. There are two types of memory involved: long-term memory, which can store lots of information in different ways, and working memory, which can only handle a limited amount of new information at once (Baddeley, 1992).. A "schema" is a big part of how we learn and remember things. It's like a mental framework that's stored in our long-term memory, and it helps us organize and understand new information. Think of it as a way to categorize information based on how we plan to use it. In this study, I consider working memory as our conscious mind. It has a limited capacity and time for holding information (Arbib, 1992).. Everything else we've learned and stored in long-term memory is hidden from our conscious mind until we need it. So, working memory is like the spotlight of our consciousness, and all other cognitive processes happen behind the scenes until they're needed (Guo, 2020; Chase & Simon, 1973).

In the process of making instructional videos, teachers play a crucial role in helping students access information stored in their long-term memory without conscious effort (Karpov & Haywood, 1998). This frees up their mental capacity to focus on current tasks and respond more quickly (Hui, 2012). Teacher mediation involves various methods of presenting well-organized content to students, making it easier for them to remember things automatically (Anderson, 2002). Think of it like a neatly arranged supermarket where customers can quickly find what they need, as opposed to a disorganized store where they spend more time searching for items. Similarly, when knowledge is presented in a disorganized way, it's harder for learners to recall it automatically, requiring them to use more mental effort (Kellogg, 2008). This extra effort can get in the way of higher-level thinking, reasoning, and problem-solving (Hartman, 1998). Figure 1 illustrates a visual framework we've developed to help teachers understand how long-term and working memory interact (Guo&Wang, 2022).

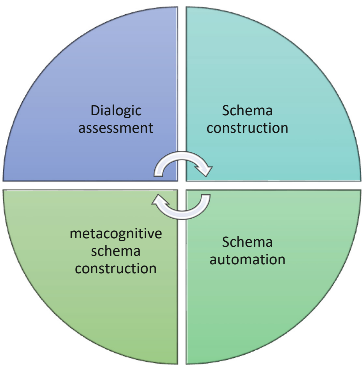

Fig. 1. Theoretical framework

3 Research Design

After the analysed the learning needs, I produced the videos supported the theoretical framework, then share the videos in a year 3 high school students' QQ group created by their teachers, the students requested to watch the videos and give feedback on the usefulness of videos on their understanding of read and the write wring. The feedback was gathered via their online post to the group message. The selected 'read and then write' instructions and given two paragraphs is in appendix A and the drawing for the instructional videos is in Appendix B. Both are attached.

A narrative Story: A Case of Ling

Read and then write is a newly emerging type of problem-solving Gaokao examination, which is the biggest concern for both the teachers and students. One of the students, Ling, reflected on the thinking journey of the writing after watching the designed videos; she then sent her reflection letter to me via the online group. The reflective letter is about the read and then write on a topic of "sister and brother are seedling with Pa" as mentioned in last section.

To: Beautiful big-eyed teacher

Since this is a continuation of a previous article, this method of combining graphics and text is very effective, but whether it can also be applied to other types of articles requires later experiments. Here, I just like to say about my thinking of this video class.

There are 7 paragraphs, more words, more plots and more plots to clarify the veins. It would be the best choice to draw out the content in chronological order and draw out it on paper. On the surface, putting the general background, characters, and events in front of you is helpful to conceive the next step of the plot. It is not difficult to find that Pa, Rebecca. Willison. River, seedlings, snake, clothes, dugout these repeated words appear the most frequently and have the largest length.

When I took the English test that day, I was confused, because of the limited time and lots of thinking about the last problem of the paper. However, today, after your drawing, I found that the story could only develop like this: use the heavy petticoat trapped the snake and ran away. This will not have a strange ending or even impossible to start.

The second issue is the life and death of snakes. When the teacher explained the test paper, he said: "Most of you say that the snake was killed... (It should have been said). The inertia is that snakes are killed, but when you think about it carefully, killing snakes is not a simple matter. After thinking about it, the mind of writing and thinking has changed from "how to escape to "how to kill snakes." But what you said today is "Western culture" ", to protect them, they just wake me up in the sun. We should have general thinking, reject blood and violence, I feel this. It can be applied to "catching thieves" and "being hurt by others without admitting violence" Click "Animals hurt people."

On this topic. Besides, Western clothing—"petticoat apron" is not well understood, and it is very disgusting during the exam, which is very messy. The basic word syntax of this verbal verb is important, but the treatment of the western cultural background cannot be taken lightly.

The last thing I learned is to grasp the minor characters in each picture, especially the details of the story. The simplest example one. If you write the children's intelligence *and bravery from the perspective of God at the end, it will be very abrupt, very cold and unreal. However, the secondary character Pa-the problem solver. Through his dad's merriment, the story will be complete in the structural layout (calling the heart before and after) and expressing the emotion appropriately. There is also the keyword "dip". A word has become the most critical part of the trailing edge problem.*

I will try to use this method to do a few articles to try drawing the flow. This will be a good method.

Name: Ling

The letter above indicates that Ling has offered a highly critical reflection on the video's design. Initially, she expressed strong agreement with the use of drawing as a valuable tool for problem-solving in this context. She then articulated why drawing was the most effective approach for addressing this particular problem, stating, "Given that there are 7 paragraphs with an abundance of text, numerous plot elements, and intricate details to elucidate, sketching the content in a sequential manner on paper seems like the optimal choice." This method aided her in untangling the intricate narrative and characters within the story.

Furthermore, the refection from Ling suggests that she closely aligned her thought processes with those presented in the video. She effectively engaged in cognitive apprenticeship by observing the researcher's guidance in the video. As she remarked, "I realized that the narrative could only progress in this manner," she confirmed that the reasoning behind the video's content resonated with her, eliminating extraneous information and allowing her to maintain a clear focus on the narrative flow.

In particular, she highlighted a common error made by most students, which involved a shift in their thinking from "how to escape" to "how to harm the snakes" when considering a problem. She not only recognized that a viable resolution might involve avoiding confrontation with the snake, but she also extended this concept to analogous situations such as dealing with a thief. Her perspective advocated for a holistic and non-violent approach, rejecting the notions of bloodshed and violence. This insight, she noted, could be applied to scenarios like "apprehending thieves" and "addressing harm caused by others without resorting to violence" in the context of "Animals hurting people."

She constructed a mental schema that encompassed various elements, effectively organizing them into a cohesive whole. As elucidated in the literature review in the preceding section, the size of the scheme would not take the capacity of work memory, the study suggests that atomicity is one of the most powerful ways to equip students to learn independently.

Furthermore, the research findings indicate that Ling perceived a limitation in her thinking due to the absence of an automated cognitive knowledge store. She placed particular importance on the automated retrieval of knowledge. To illustrate, Ling pointed out that terms like "petticoat apron" were not well-understood, leading to a sense of discomfort during exams. Additionally, she highlighted the significance of keywords, such as "dip." This study's conclusions imply that students struggle to engage in reasoning when they do not have a sufficient grasp of the text provided. This emphasizes the pivotal role that vocabulary comprehension plays in addressing the challenges associated with this issue (Anderson, 2002).

In addition, Ling raised a significant concern regarding the importance of understanding minor characters in each picture, particularly their roles and the nuances of the storyline. She provided a simple example to illustrate this point. If you depict children's intelligence and bravery from God's perspective at the end of a story, it would feel sudden, distant, and unrealistic. On the other hand, by focusing on a secondary character like Pa, who serves as a problem solver, and incorporating his father's joy into the narrative, the story gains a more coherent structural layout, with emotions expressed appropriately throughout. She stressed that this structural arrangement aided her thinking process, and the modeling aspect played a crucial role in shaping her thoughts. This progression, from construction to deduction and back to construction, enables students to develop a comprehensive mental framework or schema (Flavel, 1979).

Lastly, other students in the QQ group expressed a desire to reduce the video length. They acknowledged that the video content was clear, but they prefer videos no longer than 15 min. They cited time constraints due to busy schedules, including homework and daily classes, as the reason for this preference. For instance, Teacher Chen held a reflective session with students regarding the videos, where they praised the quality but suggested making future videos shorter. One student's comment captured the sentiment: "The videos are promising, but we're pressed for time." The video about the story of Rebecca, for example, ran for approximately 20 min. Consequently, students anticipate the creation of shorter videos in the future.

4 Conclusion

The feedback received from both Ling's reflective letter and the QQ group highlights the paramount significance of crafting educational videos that are both thorough and succinct while maintaining a well-organized structure. Embracing these insights can empower educators to forge more impactful learning experiences that are attuned to the specific demands and limitations faced by students. The suggested theoretical framework stands as a potent guiding instrument for educators and video creators involved in crafting instructional materials, whether in the realm of English writing or interdisciplinary subjects. This research offers invaluable insights into the intricate interplay between instructional design, cognitive processes, and the delivery of effective online education. In doing so, it lays the groundwork for further advancements and innovations in the ever-evolving field of education.

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Substitute Blended Learning (SBL) Implementation Framework: A UNITEN Experience

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Abstract. This article presents the Substitute Blended Learning (SBL) Implementation Framework and its successful application at Universiti Tenaga Nasional (UNITEN). The SBL framework supports the need to enhance teaching and learning practices through the integration of online course delivery while ensuring a student-centered and engaging learning experience. The framework offers a comprehensive SBL model that is adaptable to UNITEN's unique needs and to promote evidence-based practices for blended learning (BL). The application fills the gaps in the existing literature by providing a detailed account of the SBL implementation at UNITEN, as no prior similar work on SBL has been published. The SBL framework consists of 7 key steps, including conducting a thorough needs assessment, developing a comprehensive strategy, selecting appropriate tools and platforms, redesigning courses and curricula, providing faculty development programs, conducting pilot testing, refining the approach based on feedback, and finally, achieving full-scale implementation. Findings from the implementation reveal the successful integration of SBL into the pedagogical approach, enhancing flexibility, personalisation, and engagement for both lecturers and students. The SBL model also promotes effective learning outcomes by encouraging higher or-der thinking skills and fostering a deeper understanding of course content. This article contributes valuable insights and practical guidelines for institutions seeking to implement SBL strategies effectively, thus advancing the adoption of digital technology in higher education.

Keywords: —substitute blended learning · framework · blended learning

1 Introduction

1.1 Background

The rise of technology in various aspects of life, including education, has sparked the evolution of traditional teaching methods toward inclusive and adaptable systems. One such approach is Substitute Blended Learning (SBL), blending face-to-face instruction with online learning. With digital technologies permeating educational institutions, the

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potential to enhance learning outcomes through technology has become increasingly compelling. This paper documents the successful implementation of SBL at Universiti Tenaga Nasional (UNITEN), one of Malaysia's leading universities.

Blended Learning (BL) combines in-person classroom teaching with online learning, empowering learners to control their learning journey's time, place, and pace. BL takes various forms, including blended learning support and substitute blended learning. While blended learning support integrates digital technology to supplement traditional teaching, Substitute Blended Learning (SBL) replaces a portion of face-to-face instruction with online learning activities. By embracing BL in taught courses, UNITEN gains numerous advantages. Learners and instructors benefit from increased flexibility, personalised learning experiences, and enhanced student engagement through interactive online platforms. BL fosters higher-order thinking skills and deeper understanding of course content, leading to a more effective learning and improved learning outcomes.

1.2 Substitute Blended Learning (SBL)

Substitute Blended Learning (SBL) is a progressive approach to education, where learning and instruction are transitioning towards structured online learning, en-compassing 30% to 80% of the student learning time (SLT) in the form of lectures, tutorials, or practical sessions. As part of the Malaysia Education Blueprint 2015–2025 (Higher Education) 9th Shift - Globalised Online Learning [1], the Ministry of Higher Education aims to promote global quality standards, equitable access, and increased educational opportunities for all learners. It encourages higher education institutions to adopt online learning as an integral component, with a target of 70% of courses implementing BL by 2025, solidifying online learning and BL as fundamental aspects of the curriculum structure.

Figure 1 shows the defining characteristic of SBL lies in its formula 40:40:20, which allocates online components within the range of 30% to 80% of SLT [2]. This formula breaks down into three key elements: 40% for learning content, 40% for learning activities, and 20% for learning assessment. Each of these elements bears a direct relationship with the learning outcomes of the respective courses, ensuring a balanced and impactful educational experience. The integra-tion of these components in a cohesive manner fosters a robust and engaging learning environment, empowering students to achieve academic excellence.

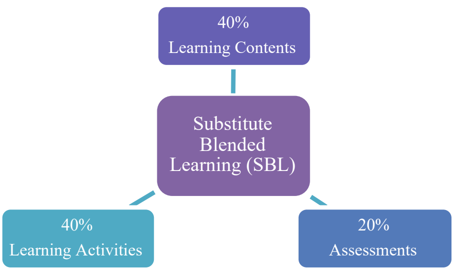

Fig. 1. SBL Characteristics for The Online Components.

1.3 Blended Learning at UNITEN

UNITEN's journey towards blended learning has been a continuous and evolving one, as depicted in Fig. 2. It began in 2016 [3] with the institution recognising the potential benefits of combining digital technology with traditional teaching methods. Pilot courses were introduced, successfully integrating face-to-face instruction with online activities, setting the stage for broader adoption of blended learning strategies throughout the university. In 2019, UNITEN took its commitment to blended learning further by launching the 'Blended Learning Agents' program. This initiative identified faculty members with exceptional enthusiasm and potential for blended learning methodologies. The selected individuals underwent extensive training in blended learning strategies and became mentors within their faculties, guiding and supporting their colleagues' transition from traditional teaching to blended learning.

In July 2022, UNITEN took on an ambitious project to implement Substitute Blended Learning (SBL) across the institution. Building upon the groundwork laid by pilot courses and Blended Learning Agents, UNITEN underwent stages of SBL implementation, including developing a comprehensive strategy, preparing academic guidelines, conducting faculty development programs, redesigning curricula, and conducting pilot tests. By early October 2023, UNITEN will have achieved a significant milestone with the full roll-out of SBL across all courses and programs. This marks the culmination of years of planning, testing, and refining the approach to cater to the diverse needs of UNITEN's student population. The institution's journey towards blended learning has been strategic and deliberate, with consistent efforts to evolve teaching and learning practices, ensuring an enriched and engaging learning experience for all students.

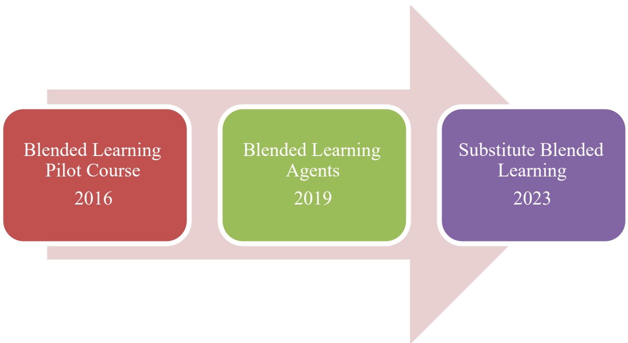

Fig. 2. The UNITEN Blended Learning Key Milestones.

2 UNITEN Substitute Blended Learning (SBL) Implementation Framework

Despite the potential benefits of SBL, its implementation is not without challeng-es. The shift from traditional teaching methods to SBL necessitates a fundamental change in the pedagogical approach, which can be daunting for many educators. Additionally, issues such as digital literacy, access to technology, and student engagement in an online environment pose significant obstacles. Given the diver-sity of its student population and its commitment to quality education, UNITEN faces the challenge of developing and implementing an effective SBL framework that suits its unique context.

2.1 Needs Assessment and Resource Evaluation

To implement SBL effectively, UNITEN undertook a thorough needs assessment to understand the specific requirements and challenges faced by its students and faculty. This evaluation also considered the existing resources and infrastructure to identify any necessary upgrades or investments. Leveraging its prior experience with BL since 2016 and the Blended Learning Agents program initiated in 2019, UNITEN had a solid foundation for the SBL transition. Analysing these existing practices allowed UNITEN to identify successful approaches, areas for improvement, and potential gaps, enabling the refinement of the SBL strategy to cater to the university's unique needs (Fig. 3).

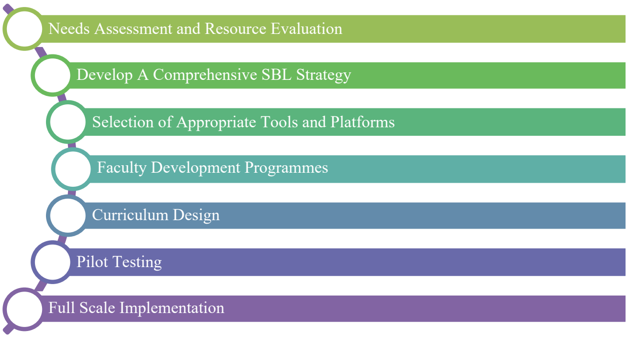

Fig. 3. The UNITEN Substitute Blended Learning (SBL) Implementation Framework

2.2 Develop a Comprehensive SBL Strategy

With UNITEN's unique needs and resources in mind, the next step in SBL implementation was developing a comprehensive strategy. This strategy carefully balanced online and traditional instruction, considering the needs assessment results, curriculum requirements, and the capacities of both academics and students. It combined synchronous and asynchronous learning methods, enabling real-time interaction and flexible access to educational content. The strategy also emphasized collaborative and interactive learning techniques, such as project-based learning and peer assessments, to ensure student engagement and foster a strong sense of community in the blended learning environment.

2.3 Selection of Appropriate Tools and Platforms

To facilitate SBL, UNITEN carefully selected an array of tools and platforms, with a robust Moodle-based Learning Management System (LMS) called BRIGHTEN at its core. BRIGHTEN allows academics to manage and deliver educational content, track student performance, and foster communication among students. Consideration was given to ease of use, scalability, flexibility, compatibility with other tools, and a comprehensive set of features for course management, assessment, and communication. In addition to the LMS, various tools were integrated into the SBL model to support diverse teaching and learning activities. For instance, MS Teams was used for video conferencing, enabling synchronous interactions and replicating the traditional classroom setting, with live lectures, presentations, and discussions between lecturers and students.

2.4 Faculty Development Programmes

To ensure a smooth and effective transition to SBL, UNITEN focused on Faculty Development Programs (FDPs) and roadshows. Faculty members were provided with a comprehensive guideline outlining the key principles, selected tools, and strategies for implementing SBL in their courses. Workshops and webinars were conducted, with experts in SBL sharing their knowledge and offering practical tips for implementation. Additionally, roadshows held across different colleges demonstrated the application and potential of SBL in an interactive setting, al-lowing faculty members to see how SBL would work in their specific contexts and gain a better understanding of the new model.

2.5 Curriculum Design

The SBL implementation involved redesigning existing courses and curricula to optimise student learning and engagement. It was more than just transferring course materials online; it was a thoughtful process of reimagining how each course could blend traditional and online instruction. Online learning modules were created, including digitized readings, video lectures, and interactive presentations, allowing students to access and review them at their own pace for a personalized learning experience. Interactive assignments like discussion forums, project-based tasks, and peer-review assignments were introduced to promote active learning and critical thinking. The assessment methods were also re-thought, incorporating online quizzes, virtual presentations, and collaborative projects to assess students' understanding and skills development.

2.6 Pilot Testing

Before implementing SBL across UNITEN, a pilot testing phase was conducted to assess its effectiveness and identify areas of improvement. Suitable pilot courses were selected based on factors such as course content, instructor readiness, and student diversity. These pilot courses ran the SBL model for at least one semester, allowing sufficient time to gather meaningful data and observe its impact on student learning and engagement. The insights gained from this phase informed the subsequent full-scale implementation, ensuring it was evidence-based and tailored to UNITEN's specific context. The pilot testing phase was a critical step in the successful implementation of the SBL model at UNITEN.

2.7 Full Scale Implementation

Following the successful completion of the pilot testing phase, UNITEN will embark on the full-scale implementation of the SBL approach. The insights and les-sons learned from the pilot testing phase informed this broader rollout in Semester 1, 2023/2024, ensuring that the SBL model was fine-tuned to meet the unique needs of UNITEN's students and academics. This phase shall be seeing the SBL being applied to up to 60% of the overall offered courses. This is a significant increase from the pilot phase and marks a pivotal moment in UNITEN's journey towards a comprehensive BL environment. An essential aspect of this stage is to maintain clear and regular communication with all stakeholders. This is crucial to ensure that students, academics, and other members of the UNITEN community were kept abreast of the progress of the SBL implementation and any changes that it entailed.

3 Conclusion

The successful implementation of SBL at UNITEN represents a significant milestone in the university's digital transformation. The phased approach, from needs assessment to full-scale implementation and continuous improvement, highlights the importance of strategic planning, stakeholder engagement, and iterative refinement in integrating traditional and online teaching methods. The SBL model showcases the transformative potential of BL in enhancing the educational experience for both students and academics. As we look back on this journey, we recognise that SBL implementation is an ongoing commitment to improving teaching and learning practices. The insights gained from UNITEN's experience can provide valuable guidance to other institutions considering a transition to SBL. While each implementation may vary, the core principles of strategic planning, stakeholder engagement, and continuous improvement remain universally relevant. As we move ahead, the lessons from UNITEN's SBL journey will continue to guide us through the evolving landscape of higher education.

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Tailored for Impact: Analysis of a Customized Online Learning System for TNB Chargemen Exam Preparation

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Abstract. SuKSES (Staff Knowledge and Skills Enhancement System), developed by Universiti Tenaga Nasional (UNITEN), is an innovative online learning system tailored for TNB staff preparing for chargemen competency examination. It offers advantages such as enhanced understanding through mastery learning approach, interactive learning, flexibility, adaptability, cost-efficiency, and pandemic readiness. The study's mixed-methods approach reveals a strong correlation between satisfaction with SuKSES features and system usage. Results show overwhelming positive feedback, emphasizing its flexibility, alignment with exam topics, and effectiveness. SuKSES fills a research gap, showcasing the potential of specialized online platforms for professional development and challenging previous findings. It stands as a promising tool for improving competency exam outcomes.

Keywords: Online Learning · Competency Examination · SuKSES · TNB · MATLAB

1 Introduction

In the realm of professional development, the role of chargemen within Tenaga Nasional Berhad (TNB) carries immense significance, representing a linchpin in the organization's operational success. Chargemen are entrusted with overseeing and maintaining critical machinery, ensuring uninterrupted power supply to millions of consumers. The competence and expertise of these individuals are pivotal to TNB's mission. However, the path to becoming a chargeman is not without its challenges. The "Peperiksaan Kekompetenan Penjaga Jentera Sekatan B0," the competency examination required for this role, serves as a formidable hurdle. This examination demands a profound understanding of intricate machinery, safety protocols, and operational procedures.

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Recognizing the pivotal nature of chargemen within TNB and the rigorous demands of the competency examination, Universiti Tenaga Nasional embarked on a mission to facilitate the preparation process. In response, they developed SuKSES (Staff Knowledge and Skills Enhancement System) - an innovative online learning platform tailored specifically for TNB staff preparing for the aforementioned examination. In 2021, as TNB staff prepared for this critical examination using SuKSES, its effectiveness and advantages became apparent, prompting this comprehensive analysis. This paper delves into SuKSES's features, benefits, and advantages over traditional classroom-based learning, with the goal of assessing its efficacy in improving chargemen competency examination outcomes.

2 About Sukses

SuKSES incorporates a range of features meticulously designed to enhance students' understanding and facilitate effective learning. One of its notable features is the automatic arrangement of questions in a progressive manner, starting from easy and gradually advancing to more challenging levels. This ensures that learners follow a structured path, promoting a step-by-step comprehension of subjects. Additionally, SuKSES categorizes learning into various levels, spanning from Level 0 to Level 10, with a focus on not only knowledge acquisition but also skill development and the cultivation of higher-order thinking skills. Furthermore, SuKSES aligns its content meticulously with the "Sukatan Pelajaran" (Syllabus) for the Competency Examination, ensuring that learners are well-prepared for the specific content they will encounter in the examination. Lastly, SuKSES offers comprehensive reporting features, including data on achievement levels, cohort performance, rankings, comparisons with other institutions, and usage statistics, providing valuable insights for both learners and educators.

SuKSES (Staff Knowledge and Skills Enhancement System), developed by Universiti Tenaga Nasional (UNTN), stands as an innovative and effective online learning platform, offering numerous advantages over traditional classroom learning methods. First and foremost, SuKSES enhances understanding through the mastery learning approach. This feature significantly aids comprehension, and students have the convenience of revisiting the questions to reinforce their understanding. The platform's flexibility is a key asset, as it offers 24/7 accessibility via computers or mobile devices, accommodating the diverse schedules of TNB staff and enabling them to tailor their learning to their individual needs.

SuKSES's adaptability is another strength, with systematic difficulty levels that accommodate varying knowledge backgrounds, ensuring continuous learning and skill development. Additionally, the costefficiency of SuKSES is evident, as it eliminates the need for travel, accommodation, and associated costs typically incurred with classroom-based learning. SuKSES also demonstrates its value in pandemic preparedness, providing seamless learning experiences during movement restrictions, such as the COVID-19 pandemic, when traditional classroom methods are disrupted. The platform's structured learning approach, with questions arranged systematically, facilitates steady progress and correlates positively with examination grades.

Instant feedback is another standout feature, with SuKSES offering automated marking and providing detailed solutions, enabling learners to receive immediate feedback on their performance and facilitating self-correction. Lastly, SuKSES brings HR and administrative benefits, allowing HR departments to monitor student progress effectively and generate reports on the system's effectiveness, aiding in informed decision-making. SuKSES, with its array of advantages, emerges as a powerful tool for TNB staff's competency examination preparation.

3 Literature Review

Recent studies have affirmed the steady rise in adoption of online learning plat-forms for workplace training and exam preparation purposes over the past decade. Brown [1] analyzed LinkedIn Learning usage data and found a 75% increase in enrollments from corporate learners between 2015 to 2019, indicating growing reliance on e-learning for professional development. Large-scale surveys provide further evidence on increased adoption of online training. The Association for Talent Development (ATD) State of the Industry [2] report tracked that the percentage of workplace training delivered via online formats rose from 30% to 45% between 2008 and 2018 across U.S. organizations (ATD, 2019).

Contemporary research provides ample empirical evidence that online learning has become a mainstream delivery mechanism for workplace training and professional development activities, supplanting more traditional face-to-face instructional formats. This has strong implications for the design of impactful learning interventions tailored to organizational contexts. Several studies have highlighted the benefits of customized online learning systems in improving engagement, knowledge retention, and exam performance in organizational settings. Sharma, Palvia and Kumar [3] propose that higher education should shift from standardized to customized learning enabled by technology, leveraging data analytics and machine learning to tailor content, assessments, feedback and recommendations based on individual learner profiles and needs. They contend customized online systems can optimize and personalize learning journeys to supplement or replace classroom teaching.

The development of teacher competence through effective professional training programs is a vital issue in education. The paper by Situmorang and colleagues [4] examines the implementation of innovative learning approaches in certificate programs for in-service teachers in Indonesia. Their study explores how problem-based learning (PBL) and lesson study can enhance teacher knowledge, skills, and professional attitudes compared to more conventional lecture-based learning. Pant and Baroudi [5] highlights the need to develop human skills in project management education and professional training programs. They recommend integrating activities that build human skills into curricula and development programs for project managers. Examples include participant-centered learning, behavioral modeling, and experiential scenarios engaging soft skills. While limited to one industry context, this exploratory study provides valuable insights into aligning project management education with the profession's evolving demands and competencies.

Oke and Fernandes [6] explores perspectives within the education sector on how innovations associated with the Fourth Industrial Revolution (4IR) are impacting teaching and learning. The 4IR, characterized by technologies like artificial intelligence, automation and the Internet of Things, is transforming many industries and societies. They highlight the need for teacher training and development to capitalize on emerging technologies while retaining human-centered pedagogies. The authors advocate for an “optimistic yet realistic” approach to integrating 4IR advances in equitable and responsible ways. This exploratory work contributes timely insights and implications as education systems globally grapple with technological change.

Recent research on online learning highlights the critical role that peer discussion and instructor involvement play in student engagement, satisfaction, and perceived learning outcomes. Martin and Bolliger [7] found that online university students rate peer collaboration and instructor interactions as top factors for engagement, underscoring the need to intentionally integrate these elements when designing online courses. Furthermore, Goggins and Xing [8] used data modeling to demonstrate that learners place significant value on instructor contributions to and oversight of peer assessments and discussions as drivers of meaningful participation.

Recent studies by Lee and Martin [9] and Gillett-Swan [10] underscore the importance of peer collaboration and instructor support for engaging and motivating online learners in both academic and corporate settings. Lee and Martin found that working professionals perceived peer interaction and instructor facilitation as key motivators for participating in online discussions, yet these collaborative elements were often lacking in corporate e-learning programs. Similarly, Gillett-Swan identified feelings of isolation and disconnection as primary challenges reported by online university students, highlighting the critical roles of peer communication and instructor guidance in fostering learner engagement and success. Together, these studies demonstrate that online learning formats can lead to disengagement and poor out-comes if not designed with strategic integration of peer learning and instructor involvement to provide connectivity, guidance, and support. Thoughtful community building and leadership emerge as essential to overcoming the barriers of isolation and limited interactivity inherent in many online environments.

Significantly, no prior study has specifically analyzed online learning systems tailored and customized exclusively for TNB chargemen exam preparation. This represents a notable research gap, underscoring the need for an in-depth investigation centered on the uniqueness of SuKSES and its strategic alignment with the TNB competency examination requirements. The current study addresses this gap through a robust mixed-methods approach incorporating surveys, usage metrics, and qualitative feed-back from TNB staff using SuKSES as an intervention.

4 Research Methodology

The study collected data through a structured survey administered to 86 male participants using the SuKSES (Staff Knowledge and Skills Enhancement System) online learning platform. The survey aimed to gauge participants’ satisfaction levels with the online learning program and their contentment with SuKSES’s educational offerings. The data collection process began by selecting participants from TNB (Tenaga Nasional Berhad) staff preparing for the “Peperiksaan Kekompetenan Penjaga Jentera Sekatan B0” via SuKSES. A well-designed survey questionnaire was used, containing questions specifically tailored to gather participants' perceptions. Notably, two questions focused on participants' satisfaction with the online learning program and SuKSES's program.

Participants completed the survey electronically providing honest feedback based on their SuKSES experiences. The responses were compiled into a dataset for subsequent analysis. Data quality control measures were implemented, including checking for missing or inconsistent responses. Data validation processes were potentially conducted to ensure data integrity. Thorough data cleaning eliminated errors, outliers, or inconsistencies. The data collection process aimed to capture participants' genuine opinions regarding SuKSES. By examining their satisfaction levels with the online learning program and SuKSES's offerings, the study sought to understand the relationships between these variables. This survey-based approach provided a foundation for meaningful insights into SuKSES's effectiveness in preparing TNB staff for competency examinations.

To evaluate SuKSES's effectiveness and its impact on participants' views, a statistical analysis was performed using MATLAB. This analysis, based on data from 86 active SuKSES users, focused on understanding the connection between their satisfaction with the online learning program and their contentment with SuKSES's educational offerings. The analysis involved several steps: first, importing survey data into MATLAB, including participant feedback on their satisfaction levels with SuKSES. Then, these responses were organized and a table was created to explore the link between satisfaction levels and program offerings.

The heart of the analysis was the Chi-Square Test for Association, using MATLAB's tools. This test assessed whether a significant connection existed between participants' satisfaction levels and the program offerings. MATLAB also provided essential statistical values like the P-value, Chi-Square value, and degrees of freedom, offering insights into the strength and importance of this connection. MATLAB was instrumental in conducting a statistical analysis of SuKSES's effectiveness, shedding light on the relationship between participant satisfaction and program offerings in the context of TNB staff's competency exam preparation.

5 Statistical Analysis

The analysis of participant satisfaction within the SuKSES program involved several key steps to gain valuable insights. First, numeric responses from the essential questions were consolidated into a matrix called "combined_responses" to provide a comprehensive view of participant satisfaction. Then, the total variance of these responses was calculated to gauge overall feedback variability. Further analysis included sum of squares computations for both total scores and individual item scores. This unveiled patterns and dispersion in participant feedback, shedding light on underlying trends.

Cronbach's alpha, an indicator of reliability, played a pivotal role. The coefficient of 0.81699 demonstrated a notable level of internal consistency among participants' responses, affirming the survey instrument's reliability. In addition, a correlation analysis utilizing the Pearson Correlation Coefficient was conducted to explore the dynamics of participant satisfaction. The coefficient, at 0.60922, indicated a moderate to strong positive correlation between satisfaction dimensions. Importantly, the two-tailed p-value of 4.8351e-10 confirmed the statistical significance of this correlation, suggesting a meaningful relationship between satisfaction aspects.

The Chi-Square Test for Association played a crucial role, uncovering a compelling link between participant satisfaction with the online program and their contentment with SuKSES, highlighting their interconnectedness in education. Several key parameters emerged, notably the P-Value at 0.0000, signifying strong deviation from the null hypothesis, indicating robust statistical significance. The Chi-Square Value stood at 217.0181, with 1 degree of freedom, focusing on comprehensive exploration of participant experiences.

Interpreting these results reveals the interdependence between participant satisfaction levels with SuKSES and contentment with SuKSES, emphasizing SuKSES's comprehensive impact on their educational journeys. Examining survey responses, all 86 participants expressed contentment with the online program, indicating strong resonance with SuKSES. This unanimous consensus from 100.00% of participants underscores SuKSES's efficacy in meeting diverse learning needs and reinforcing satisfaction with the online learning experience.

6 Discussion

The analysis of the SuKSES (Staff Knowledge and Skills Enhancement System) online learning system within the context of competency examination preparation has provided a wealth of valuable insights. SuKSES, designed specifically for TNB staff preparing for the "Peperiksaan Kekompetenan Penjaga Jentera Sekatan B0," represents a dynamic shift away from traditional classroom learning. By conducting a comprehensive analysis of SuKSES's features, benefits, and the results of statistical analysis, this study highlights the transformative potential of online learning in empowering learners to excel in their competency assessments.

The statistical analysis conducted using MATLAB serves as a pivotal component in comprehending the effectiveness of the SuKSES online learning system. By examining the relationships between participants' satisfaction with the online learning program and their contentment with SuKSES offerings, the analysis uncovers critical connections that shape the educational experience. Through the Chi-Square Test for Association, statistically significant links between these dimensions are illuminated, showcasing the intrinsic relationship between satisfaction and program quality. The incorporation of significance parameters, including P-values and Chi-Square values, solidifies the credibility of the findings and emphasizes the far-reaching impact of participant satisfaction.

The implications drawn from the statistical analysis transcend mere statistical significance, echoing throughout the educational landscape. The unanimous consensus of participant satisfaction underscores SuKSES's resonance and capacity to meet diverse learning needs. The calculated Cronbach's alpha coefficient emphasizes the reliability of the survey instrument and reaffirms the consistency of participant responses. The Pearson Correlation Coefficient's revelation of positive correlations between satisfaction dimensions underscores the interconnectedness of various aspects of participant contentment. These insights into participant satisfaction and its interplay with program offerings underscore the need for a holistic, participant-centric approach to curriculum design and program optimization.

SuKSES boasts fundamental features that set it apart as a potent tool for competency examination preparation. Its automatic arrangement of questions from easy to difficult facilitates a progressive learning journey, adapting to individual knowledge levels. The multitiered learning approach, encompassing knowledge acquisition, skill development, and higher-order thinking skills, enriches participants' understanding. Aligned with the Competency Examination syllabus, SuKSES's content ensures relevance and alignment with examination requirements. The robust reporting system provides valuable insights into achievement levels, cohort performance, rankings, and usage statistics, facilitating comprehensive self-assessment.

The advantages offered by SuKSES over traditional classroom learning are profound and far-reaching. The flexibility of online access, available 24/7 through various devices, accommodates diverse schedules and learning preferences. SuKSES's systematic difficulty levels accommodate learners of varying backgrounds, promoting inclusive and continuous learning. Moreover, the cost efficiency of online learning eliminates travel-related expenses, while its seamless adaptability ensures uninterrupted learning even during challenging circumstances, such as the COVID-19 pandemic. The structured approach to learning, instantaneous feedback through automated marking, and administrative benefits further reinforce SuKSES's position as a transformative educational tool.

The participants completed the "Peperiksaan Kekompetenan Penjaga Jentera Sekatan B0" at the end of 2021, and remarkably, over 90% of the candidates successfully passed the exams. This achievement stands in stark contrast to previous years' consistently low average pass rates of less than 30%. The impressive success of the candidates in the examinations has convinced TNB to maintain the use of SuKSES for future staff exam preparations.

7 Conclusion

The mixed-methods analysis demonstrated SuKSES's significant comparative advantages and effectiveness over classroom learning for TNB chargemen's competency examination preparation. Its tailored features promote engagement, flexible self-directed learning, enhanced understanding through multimedia content, and continuity during disruptions. These advantages were consistently highlighted through quantitative satisfaction data, system usage metrics, and qualitative feedback. The findings fill a notable gap in understanding online learning dynamics for specialized organizational contexts.

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Teaching Ergonomics Using Virtual Reality (VR) to Higher Education Learners

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Abstract. Ergonomics refers to the scientific study of workers in their working environment. The aims of ergonomics are to strategize or modify the work environment to fit the worker instead of vice versa, hence discomfort can be eliminated, and risk of injuries can be reduced. Upon investigation, many ergonomic studies were conducted for employees instead of higher education learners although ergonomics knowledge is vital as a preparation before these learners go through internship and employment. Hence, this paper discussed the design and development of VR-ERGO based on constructivism theory. The outcome of this study is a workflow and storyboard of VR-ERGO.

Keywords: enhance learning · ergonomics · education · higher education learners · occupational safety and health · technology · virtual reality

1 Introduction

The term 'Ergonomics' refers to the scientific study of employees in their working environment. The aims of ergonomics are to strategize or modify the work environment to fit the employees instead of vice versa, hence discomfort can be eliminated, and risk of injuries can be reduced. Ergonomics is widely being taught to employees as part of OSHA. As to date, very limited studies have been found in teaching and learning ergonomics to higher education learners although studies suggested that knowledge on ergonomics is vital as a preparation for these learners prior to entering a job environment. Hence, this paper attempts to discuss the design and development of VR-ERGO. Its design and implementation was informed based on constructivism learning theory.

This paper aim to address the following research questions:

1. How will constructivism theory being incorporated in Virtual Reality (VR) application to enhance learning of higher education learners?
2. How will the VR application for teaching ergonomics to be designed and developed?

This study has identified some of the issues in teaching ergonomics to higher education learners (1) lacking participation from participants and (2) lacking interactions during training. To increase the involvement of learners in ergonomics training as well

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as ensuring interactions, this paper embedded integrate constructivism learning theory into the design and development of the VR-ERGO.

Hence, this paper is segmented as follows, Sect. 2 provides a comprehensive literature review of the relevant research in the field. In Sect. 3 is the methodology employed to collect and analyze the data, ensuring transparency in our research process. Section 4 is dedicated to presenting the key findings and insights obtained from the study, shedding light on the core outcomes. Finally, in Sect. 5, conclusions and recommendations are offered for both researchers and practitioners.

2 Literature Review

2.1 Ergonomics in Higher Education

Ergonomics explains how the employers should design the workplace to eliminate discomfort and risk of injuries. The objectives of ergonomics is to strategizes or modifies the work environment to fit the employee instead of vice-versa. Failure to ensure the work environment is ergonomic friendly, could lead to physical and also mental health issues [1] such as Musculoskeletal Disorders (MSD). MSD affects the muscles, nerves, blood vessels, ligaments and tendons [2].

As mentioned previously, acquiring knowledge in ergonomics is important as it does not only affect individuals, but also impacts the organizations and nations. For example, studies have shown that MSD impacts the employees quality of life, loss of work, disability, early retirement and even death [2]. It is estimated that approximately 59 million employees are affected by ergonomics issue by 2020 [3]. Meanwhile, studies have linked MSD to economic losses to organization and nations. In America, $45 billion to $54 billion claims came from injuries related to MSD yearly [3]. Thus, acquiring knowledge on ergonomics prior to internship and entering job market could reduce the risk of injuries and eliminate potential discomfort.

Ergonomics education has been suggested by [4] to be part of the education curriculum in providing awareness to teachers, parents and students. For example, students who carry heavy backpacks, spend long hours sitting in the classroom or have incorrect body position can be considered ergonomics risk factors affecting their physical and musculoskeletal systems. In addition, establishing a proper understanding of ergonomics, related risk factors and what can cause injuries and health issues amongst students can improve the teaching and learning environment in many aspects [5]. Hence, this paper proposed to use VR-ERGO to teach higher education learners on ergonomics.

2.2 Teaching and Learning Ergonomics

Learning ergonomics can be perceived as a dull and dreary curriculum for students in higher education as it involves a lot of theory and understanding of how everyday life activities can contribute to ergonomic risk factors. Nevertheless, educators can adapt and innovate their teaching styles to make the learning environment more interesting such as blended learning, providing online courses and tests that students can repeat several times to enhance their understanding.

However, teaching and learning ergonomics, as in e-learning poses issues for students in assessing the study of ergonomic risk factors. For example, the practical exercises, activities and demonstrations of teaching the proper sitting position and body postures to avoid long terms MSD can only be taught face-to-face. Face-to-face teaching creates an immersive environment for students to participate. Furthermore, technology in education is no longer considered a new innovative way of teaching and learning. For example, three-dimensional (3D) simulations, video tutorials, and online-based interactive activities can help students better understand ergonomics. Still, the current technology in education and learning method does not captivate the student's attention and interest in learning ergonomics.

2.3 Virtual Reality as a Medium of Teaching and Learning Ergonomics

Recently, the introduction of advanced technology such as Augmented Reality (AR) and Virtual Reality (VR) has created a window of opportunities in education that provide an immersive 360° digital environment experience. In essence, VR simulates the user's physical presence in an artificially generated world that allows interaction within the environment. The virtual environment is usually three-dimensional and attempts to replicate the real world in its appearance and physical phenomena [6]. VR is the new innovative, and creative way of teaching and learning. It serves as an effective tool for assisting and facilitating the teaching and learning processes. Numerous studies and reports demonstrate that most students remember what they experienced in virtual reality, leading them to conclude that this environment is more memorable than practical face-to-face demonstrations [7–9]. Additionally, the benefits of VR education are as listed [10]:

- Student learns better through experience.
- Encourages creative thinking and sparks the imagination.
- Promotes peer interaction.
- Offers memorable educational experiences.

The implementation of VR education can be observed in the field of engineering, medical, and complex education topics such as space technology and mathematics. VR produce an interactive and immersive virtual environment that allows the student to comprehend practical demonstrations in the related field. For instance, Google Expeditions is a fantastic illustration which enables the instructor to take the whole class on a virtual field trip. With 360º videos captured at various locations, including an underwater exploration of a coral reef in the South Pacific or the Louvre Museum in Paris using Google Street View technology, the application recreates an immersive experience of the real world [11].

2.4 Teaching Ergonomics Using Virtual Reality to Higher Education Learners

The use of VR technology has inspired innovators, researchers and educators to take part in a new medium of teaching for educators and create innovative learning environments that capture student attention. For example, research by [12] designed an educational virtual reality application to learn ergonomics in workplaces for university medical students. However, to our knowledge, the implementation of VR education in the topic of ergonomics for higher education learners, specifically in the field of engineering and technology, is yet to be explored. In this paper, we introduce and describe a process of designing VR for higher education. The focus is on industrial training students that will undergo internships in the upcoming semester. The goal is for the students to learn hands-on virtual ergonomics experiences that are generally related to their workplace.

2.5 Constructivism

One of the important learning theories associated with VR is constructivism [13]. The constructivism theory explains how learning happens by highlighting that learners construct knowledge and meaning from their experience. The key principle of constructivism is the knowledge is actively built-up by the learners through interaction with environment. Additionally, the term 'microworld' is an important concept in constructivism. Microworlds are defined as any environments which may be explored in a non-linear way by users. Learners could explore and learn from what they receive from the environment in return for their exploration [14]. In essence, microworlds refers to a situation where learner becomes part of the scenario instead of just observing a particular domain and this situation stimulates learner interest and motivation. Hence, the design and development of VR-ERGO was based on the constructivism theory and microworlds concept.

3 Methodology

The VR modules are divided into two categories: theory and practical (Table 1) which is used in developing the storyboard. The module follows the standard guidelines on ergonomics risk assessment at the workplace and manual handling provided by the Department of Occupational Safety and Health (DOSH) from the Ministry of Human Resources Malaysia. Hence, students from engineering and technology backgrounds in Malaysia can benefit from this ergonomics VR education which will help them during internships within companies in Malaysia.

Table 1. Ergonomics Modules

Ergonomic Modules	
Theory	*Practical*
Ergonomics Introduction	Ergonomics Proper Standing
Ergonomics Risk Factors	Ergonomics Body Position
Work Related Injuries	Ergonomics Lifting and Standing
Manual Handling	Ergonomics Pushing and Pulling
Back – Strengthening Exercise	

4 Results and Discussion

A workflow for VR storyboard of ergonomics has been developed which can be use by educators and developers that serve as a guideline for teaching and learning in higher education. The VR storyboard has been copyrighted. The theory module covers the ergonomic risk factors, injuries related in the workplace, manual handling definition, and back strengthening exercises. The practical module of ergonomics allows students to view 360° proper body position, standing, lifting and lowering, and pushing and pulling, which is part of manual handling in the workplace. As a result, students are able to differentiate and acknowledge the parts of the 3D instructor's body that involves in reducing ergonomics risk factors in the workplace.

Creating a VR storyboard to teach ergonomics to college students is a novel way to educate. Virtual and augmented reality technology is just beginning to be used as a teaching tool in higher education. This technology allows for immersive learning experiences in environments that are typically not accessible to students, through the use of 3D models and interactive 360° videos. There is growing interest in using immersive VR applications to support various instructional design methods and outcomes in higher education.

However, there is a lack of research on the potential benefits and challenges of using VR-supported instructional design strategies or techniques to enhance teaching and learning. Ergonomics is crucial for human interaction with new technologies, ensuring high usability (efficiency, learnability, and satisfaction), proper functionality (easy navigation, easy interface condition), and the ability to achieve a wide range of goals. In summary, developing a VR storyboard to teach ergonomics to college students has potential, but more research is needed to fully understand the benefits and challenges of using VR technology in higher education (Fig. 1).

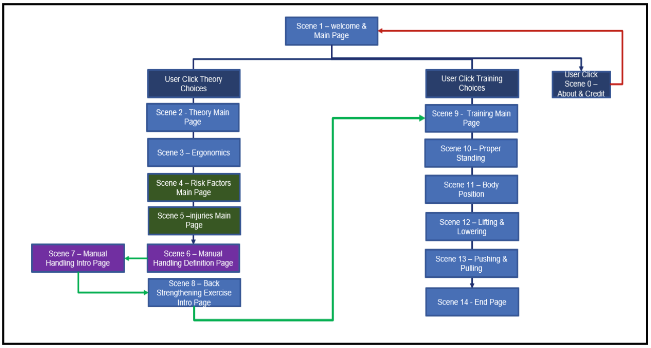

Fig. 1. Virtual Reality (VR) Ergonomics Workflow and Storyboard.

5 Conclusion

Teaching ergonomics using virtual reality (VR) enhances students' ability to comprehend the understanding and importance of ergonomics in the workplace before their internship begins. Hence, using VR as education technology improves the teaching and learning process between educators and students, creating an interactive and immersive environment. VR helps grasp student attention better than online tools or face-to-face learning environments. The findings presented by [15] supported that VR can improve students' ability to learn various skills while fostering their overall educational experience. Future works of this study, aside from the VR storyboard and workflows to develop VR applications for students in higher education and be utilised as a part of their curriculum before embarking on their internship journey in related companies. The pre-assessment and post-assessment of the VR ergonomics application will be performed as part of the VR development process.

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Technology Assisted Learning: Expectations and Self-preparation Among Gen Z Learners

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Abstract. COVID-19 pandemic phase is the main cause of the recent evolution in teaching and learning. Technology assisted learning is one of the evolutions that impacts Gen Z students. There are numerous indirect inputs on expectations and students' self-preparation towards technology assisted learning. At the same time, it is well known that technology requires additional investment by stakeholders, apparently it is much costly when it needs to cater a big number of students. Unfortunately, not all students are ready for technology assisted learning. Therefore, this study presents the expectations and self-preparation towards technology assisted learning among SPM 2022 leavers. This group of learners is from Gen Z generation. A qualitative approach through online survey was conducted on 108 respondents in which they shared their involvement and concerns towards technology assisted learning. The findings of the study can provide an insight to stakeholders, especially government and policy makers for better delivery in teaching and learning.

Keywords: technology · gen Z · expectation · learning · self-preparation

1 Introduction

Generation Z (Gen Z) is referred to anyone who is born between 1997 and 2012. Based on the Cambridge dictionary, Gen Z is defined as a way of referring to a group of people who were born in the late 1990s and early 2000s [1]. The focus of this study is to a group of people who were born in 2000 and has completed their Sijil Peperiksaan Malaysia (SPM) 2022 examination. The interest of this group is pivoting to their experience towards the change of the learning style and methods from pandemic phase to endemic phase. As announced by the Prime Minister Datuk Seri Ismail Sabri Yaakob in 2022, Malaysia enters endemic phase starting on 1st April 2022.

The Ministry of Education, Malaysia (MOE) informed that a total of 403,637 Gen Z students attempted the SPM 2022 examination at 3,355 examination centres nationwide [2]. It is well-known that the implementation of technology assisted learning for Gen Z during the endemic phase has supported them to increase their readiness to cope with the learning better. Armed with mental strength and emotional spirit as well as support

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Fig. 1. Applications of technology assisted learning.

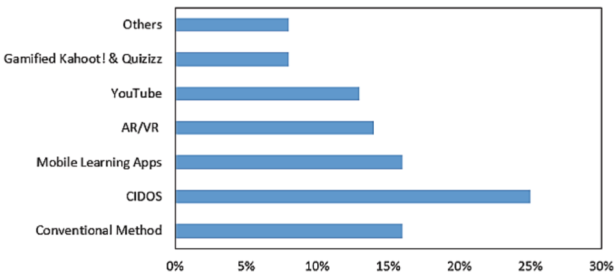

Fig. 2. Statistical implementation of technology assisted learning in school (CIDOS = Curriculum Information Document Online System).

from various parties, both offline and online, this generation has successfully completed the exam perfectly.

During the pandemic phase, secondary schools were forced to transform to online learning [3–5]. At the same, technologies that are common in offices and industries (Fig. 1) were brought to school to assist teachers in their delivery activities. These includes web-based application (both World Wide Web platform and organizational online system) [6], 3D smart drawing tool [7], virtual reality-assisted instrument (VR) [8], drone [9], online game-based activity, virtual tour through teleconference and smart whiteboard. Figure 2 shows the statistic of implementation of technology assisted learnings in school [10]. However, literature review shows that learning science in VR may overload and distract the learner resulting in less opportunity to build learning outcomes [11]. Similarly, implementation of e-lab, simulation-based laboratory or virtual laboratory is also a challenge when learners are not able to put their hands on or touch the materials and equipment in the laboratory hence resulting in lack of empathy and psychomotor skills [11]. It is perceived that learners' cognitive thinking potential is limited when they rely too heavily on technology, such as by searching, clicking or copying and ultimately finishing the task [12]. Considering these identified gaps from the literature, this study focused on the expectations and self-preparations by Gen Z, particularly SPM 2022 leavers to adopt a technology assisted learning prior pursuing their studies at institution of higher learning.

2 Methodology

In this study, a qualitative online survey was prepared based on 4 sections to develop an effective survey framework. Figure 3 shows the research methodology framework presented in this paper.

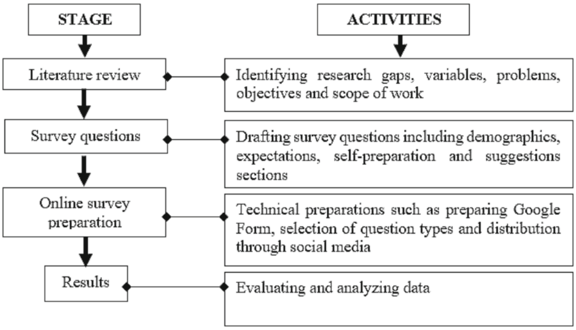

Fig. 3. Research methodology framework.

3 Result and Discussion

3.1 Demographic of Survey Respondents

A survey was conducted on 108 respondents among the Gen Z learners that have completed their SPM 2022 examination. The percentage of respondent out of the total number of SPM candidates for that year is about 0.03%, hence it is recommended that similar study should be conducted annually to reflect the dynamic perspective of Gen Z. When the survey was conducted, it is found that 76.5% respondents are still in their hometown waiting for higher learning opportunities while 23.5% have commenced their Matriculation/Foundation/Asasi or Diploma study.

When technologies are adopted by Gen Z to assist their learning experience, it is inevitable that the involvement of students utilizing the technologies are low during the early pandemic phase since investments are needed from various stakeholders to purchase the hardware and/or software of the technologies. Notably, this study found that 98% of respondents own electronic, smart gadgets such as tablet, laptop, smartphone and any related electronics that can be used to adopt technologies and enhance learning activities. Similar percentage was reported in literature where 98% of Gen Z are smartphone owners [13]. In contrast, 2% of respondents did not own any electronic, smart gadgets. To reflect a better understanding of the respondents, Table 1 shows the location and type of school which indirectly implies the availability or readiness of technology at schools. Despite the small number of respondents, the survey was attempted across Malaysia regions, covering all states including Sabah and Sarawak.

With respect to cognitive attribute of learners, it is described that learners' cognitive attribute are evolving during psychomotor learning [14]. It is reported that there are distinct differences between fast and slow learners. Specifically, fast learners were better able to identify relevant knowledge and to quickly and more efficiently access their knowledge. In contrast, slow learners spent more time on their knowledge search and used more numerous terms in their descriptions, thereby getting lost in details more often. When a study was conducted on 72 students in the use of a web-based learning environment, it is found that students spent almost 70% of their study time with texts, 11% with learning tasks and only 12% with the active and elaborated learning tools [6]. In the first part of the survey, respondents are asked to describe themselves either as fast learner, conventional learner or slow learner; based on Frank [14] description. Among the respondents, 13 of them described themselves as fast learner, 48 conventional learner, meanwhile 47 slow learner. Considering both fast learner and conventional learner as in one group, this gives about 56% of the respondents. This percentage is assumed to be the same category of learners obtaining at least pass in the SPM result, which is 57.1% (Fig. 4) [15]. To sum up, the perception and challenges towards technology assisted learning could be an indirect representations of different cognitive attribute and psychomotor skills during learning.

Table 1. Location and type of school of the respondents (SMK = Sekolah Menengah Kebangsaan)

Location	No. of Respondent	Type of School Attended
Johor	5	1 boarding school, 4 SMK
Melaka	2	All SMK
Negeri Sembilan	22	5 boarding school, 17 SMK
Selangor/Kuala Lumpur	64	55 boarding school, 8 SMK, 1 private school
Pahang	2	All boarding school
Perak	2	All boarding school
Kedah	2	All SMK
Perlis	2	All SMK
Kelantan	2	All boarding school
Terengganu	2	All boarding school
Sabah/Sarawak	3	All SMK

3.2 Expectations and Self-preparation of Gen Z

This study found that 86.7% of respondents have experienced in utilizing technology during their learning at secondary school. This means that most of Gen Z are expecting that technology will also be used when they are studying at the universities. It is plausible that these technologies are invested by stakeholders such as government, institutions, Association of Parents and Teachers, sponsors and parents since these technologies are costly. Despite the Gen Z enthusiasm and excitement upon using technologies, it is bound to have challenges. Findings from the survey show that 48.2% out of 86.7% respondents stated that internet coverage is the main issue. Several respondents blamed on slow service while very few mentioned the internet coverage is temporarily out of service. When these cases happened, the learners cannot access the softcopy note or the involved teacher would replace the class since there were no print outs available for the students to refer. Other issues, reported less than 5% each, are:

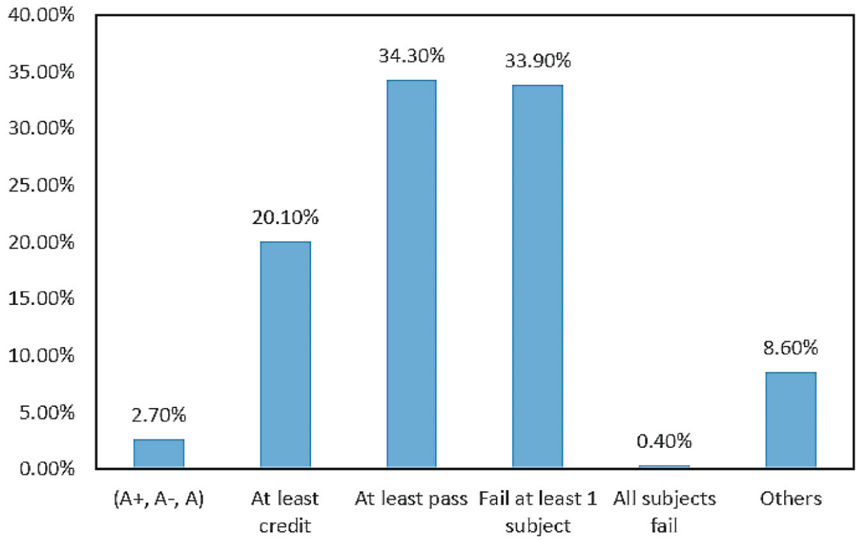

Fig. 4. SPM result analysis for 2022.

- Learning using technology makes the learning process slower than conventional learning.
- Repetition is needed to master the technology before the understanding or mastering the topic is achieved.
- Limited time since a lot of time are spent to master to technology than to master the topic.
- False use of technology.
- Teacher lack of exposure towards technology.
- Technology requires upgrading.
- Culture shock.

- Easily distracted.
- Insufficient mobile data.
- Technology is costly.

Ebrahimi and Jiar [16] reveals both pros and cons of computer assisted learning in Table 2. A study conducted on Gen Z (same cohort of Gen Z, they are in Form 1) from 30 SMK schools in Johor showed that one of the main challenges is time. It is perceived that utilization of computer assisted learning is time consuming to first digest the technology by the teacher, then help student to learn through the technology. Not forgetting, time is also needed to cover both mastery and Higher Order Thinking Skills (HOTS) level of the topic.

Schoor and Bannert [17] also report similar challenges when a study was conducted on computer assisted learning. They found that current motivation during computer assisted learning related neither to observed learning activities nor to knowledge acquisition during collaborative learning but were in part associated with learning activities and knowledge acquisition during individual learning [17]. Surprisingly, 13.3% of respondents in this study are not exposed to technology assisted learning. Majority of them stated the cause to this non exposure is lack of investment. This could indicate that there was no financial capacity by the school, the. number of technology provided is limited or learners do not afford to buy on their own. This is also reflected in Table 2 where 'large class' is stated under disadvantage.

Table 2. Benefits and challenges when employing technology assisted learning in 30 SMK schools in Johor.

Advantage	Disadvantage
User Friendly	Time
More Fun	Training
Organized Teaching	Large Class
Printing Reduction	Technical Support
	Insufficient Computer
	Validity of Information
	Role of Management

Gen Z believes that they need to be well-prepared with relevant information and skills on some available technology before furthering their studies. Most of the information are available online. They need to allocate some time either on daily or weekly basis to read the online materials or watch YouTube for better understanding through visualization. Majority of respondents stated that they are aware on the technology assisted learning at universities. This is because all universities in Malaysia shared information about their technology adopted in teaching and learning on their university website. Gen Z learners aware that the technology would be either more advanced than what they have experienced in secondary school or the number of technology available is more in order to occupy a big number of learners. Surprisingly, this study also reveals that not all Gen Z are ready for technology assisted learning. About 9 respondents still prefer the conventional learning using textbook and workbook to master certain subjects.

4 Conclusion

In a nutshell, the suitability of technology assisted learning for Gen Z achieved a positive expectancy and self-preparation prior pursuing their study. However, continual improvement on technology infrastructure is suggested to ensure the issues and challenges faced during secondary schools are not repeated. Furthermore, this study also found that technology assisted learning may not be helpful for certain subject such as history and religious study, some learners have lack of understanding on the topic learned since more time were spent to learn about the technology, and some learners are distracted by the technology itself. Moreover, financial support would be favorable since these technologies are costly and some require periodic maintenance. This paper only focuses on a small number of Gen Z and further study is required before a comprehensive insight can be obtained.

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The Determinants of Students' Satisfaction and Continuance Intention to Use Microsoft Teams as an Online Learning Platform

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Abstract. This study seeks to investigate the variables that influence the students' satisfaction and continuance intention to use Microsoft Teams (MS Teams) as the online learning platform post-COVID 19 pandemics. Due to the popularity of online learning after the pandemic, it is necessary to look more closely at selected online learning platforms, particularly in terms of their performance and ability to meet learners' demands. This study employs a structural equation model to analyze 107 valid samples gathered through online questionnaires by integrating the Delone and McLean (D&M) information systems (IS) success model, expectation-confirmation model (ECM), and service quality factor. The empirical findings showed that system quality has a significant impact on perceived usefulness, learning satisfaction and continuance intention in using MS Teams as an online learning platform. However, the perceived usefulness is statistically insignificant with learning satisfaction, which contradicts with previous studies which indicated that perceived usefulness is a significant contributing factor of users' satisfaction.

Keywords: Satisfaction · Continuance intention · Online learning

1 Introduction

The development of Information Technology (IT) contributes to the improvement of many domains, including health, business, finance, and education. In fact, the rapid development of IT in education has facilitated the advancement of online learning and its significance [1, 2]. Since the spread of COVID-19, the higher education sector relies significantly on online learning. It is learned that approximately six million students participated in at least one online higher education course in 2015 [3]. This is a significant increase compared to the 1.6 million participations in 2002. The finding implies that technology may enhance the quality of education in the age of globalization. This is most prominent in education, where teaching and learning can now be realized outside the classroom and over long distances with the help of technology.

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Online or virtual learning systems are defined as systems in which the learning processes, such as teaching and learning, utilize Internet connections. Online learning or e-learning is the delivery of learning courses over distances solely via the Internet [4]. Online learning is distinct from traditional or face-to-face learning as it does not require students to visit a classroom physically. In a face-to-face classroom, if the students are not self-assured or cannot reply fast, they may miss the opportunities to speak up in the classroom. However, online learning gives the students the flexibility they need and offers them a stimulating learning environment. Online learning also offers special Learning Management System (LMS) features, such as writing tools, rubrics, feedback tools, chat discussions, comment sections, assignment submission, and document sharing [5].

One of the most effective online learning platforms is Microsoft Teams (MS Teams). It is a cloud application digital platform that integrates conversations, meetings, files, and related apps into a single LMS to facilitate online learning. The MS Teams application is available via both desktop and mobile applications, and its features can be utilized globally. MS Teams is superior to other social media platforms in terms of chat rooms, collaborative discussions, content sharing, and video conferencing [6, 7]. In general, lecturers may use of MS Teams' features, which include scheduling meetings, sending invitation links to students, conducting web conferences, interacting in web conferences, sharing files or documents, sharing screens or application windows, communicating via chats, changing participant roles from attendee to presenter, recording web conferences, and download session recordings. In fact, learning materials, student engagement, and a conducive learning environment all contribute to students attaining their learning goals optimally [6].

Past research [8] examined online learning studies from 2001 to 2016 and found that the initial online learning studies started in the year 2001 primarily focused on the factors of intention to use, adoption, usability, course contents, and customization. However, the satisfaction factor was included in online learning studies from the year 2007 until 2016. Then, in 2013, most researchers started examining the general effectiveness of online learning and the effects of students' characteristics towards the success of learning. It is evident that early online learning studies concentrated primarily on the technological facets of e-learning. As online learning gained popularity, research attention turned to the attitudes and interactions of online learning users (students and instructors), as these are also significant factors that influence the success of e-learning [2]. It is necessary to look more closely at online learning platforms, particularly in terms of their performance and ability to meet the learners' demands. Notably, the success elements of online learning vary in relative importance given the environment, necessitating various approaches to cope with the issues. For instance, online learning implementation faced difficulties in developing nations due to issues with users, infrastructure, resources, and accessibility. Meanwhile, online learning in developed nations has been deemed efficient and advantageous since it enhances lifelong education and offers high-quality information [9]. Based on the preceding discussion, this study aimed to investigate the variables that influence the satisfaction and continuance intention of MS Teams as an online learning platform. Consequently, a model comprising MS Teams continuance intention predictors for online learning users was proposed.

2 Literature Review

There is an increasing number of scholarly works demonstrating a positive correlation between satisfaction and student engagement and academic performance [10]. Students' satisfaction in online learning has been a focus for scholars to assess any possible effects on the online learning process [11, 12]. Numerous research provided many definitions of students' satisfaction and its significance. Past study demonstrated that satisfaction pertaining to students' attitudes towards the learning process, was in line with their learning experience [13]. Another research showed that satisfaction with online learning is contingent upon the students' individual assessment of the educational system and its accompanying services [12]. Based on these definitions, it can be inferred that the students' satisfaction is significantly dependent on their assessment of their academic experiences.

Higher learning institution have experienced a large-scale transition to online learning due to the social distancing initiatives imposed by COVID-19 pandemic and to retain service during the outbreak [14]. As a result, the pandemic has led to a worldwide experimentation with online and distance learning in the education sector. They were forced to adjust to a crisis that had an impact on the delivery of traditional educational services in a number of contexts. Therefore, many academic staff are still utilizing remote learning technologies to deliver their educational programs [15]. Some research refers to this new system as an "emergency online education". The system presented unprecedented difficulties not only for the students who required technical assistance but also for the faculty and university administrators, who had to reinvent themselves to maintain campus operations during such unprecedented event [16].

Given the ongoing worldwide epidemic affecting numerous nations, it is expected that online learning will become an essential means for students to complete the university coursework. Past studies pertinent to factors contributing towards students' continuous use of learning management systems have been conducted [17, 18]. For the present study, the researchers integrated the Delone and McLean Information System Success Model (D&M IS Success Model) and the Expectation Confirmation Model (ECM) by incorporating the system quality factor to investigate the significant factors that influence Malaysian students' continuance use of MS Teams for online learning.

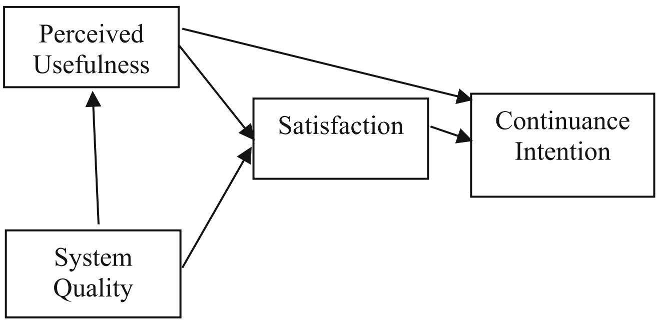

Fig. 1. Research Model

Based on the D&M model and the ECM, this study proposed a model of Malaysian university students' satisfaction and continuance intention to use MS Teams as an online learning platform. Figure 1 depicts the study framework which comprises of four constructs and five relationships aimed at examining the relationship between these constructs.

3 Methodology

This research employs a quantitative method that involves data collection and analysis. The instrument used for this study is a questionnaire to validate the hypothesis that contains 14 items; each question corresponds to a different construct. The instrument is designed to accomplish the research goals [19]. An adapted survey instrument was used in this study to determine the constructs associated with the use of online learning platform from several relevant studies. In this study, the questionnaire was adapted from previous studies where the reliability and validity of the instrument employed was verified respectively [2, 20]. For a Likert-type questionnaire, the respondents were inquired about the levels of agreement to the statements. Ranging from a scale of 1 to 5, this scale is represented as follows; 1 indicates "strongly disagree," 2 indicates "disagree," 3 indicates "neutral," 4 indicates "agree," and 5 indicates "strongly agree". The adaptation process developed a new instrument for the current study where the indicators were differentiated and tailored to the scope of study, namely, the use of MS Teams for online learning.

The data was analyzed using the reflection modeling of Smart PLS version 3.3.3 software, a widely used multivariate analytical tool. Therefore, the Partial Lease Square Structural Equation Modelling (PLS-SEM) was selected for this study for several reasons. First, the PLS-SEM is the most beneficial analysis method during primary research to establish the current study. Second, the PLS-SEM assists the researchers with complicated model-based investigations. Third, rather than splitting the model into groups, the PLS-SEM examines the entire model as a single entity. Finally, the PLS-SEM assists the concurrent analysis of the measurement and structural model, resulting in precise calculations. The SEM analysis enables the identification of causal effect relationships between constructs by combining factor analysis and multiple linear regressions [21]. The convenience sampling method was used for this study for its feasibility as the participants were easily reached to participate in this research. This method identified the intended group of participants out of the total number of a population [22]. In addition, the method is indeed suitable for the nature of this research as it requires many participants within a short time frame.

The respondents for this study are currently studying at Malaysian Higher Education Institutions (HEI) in Kuala Lumpur. The questionnaire was available online via Google Forms to reach a wider range of respondents and for ease of access. For data collection, the students received the questionnaire link via email. These students were contacted directly by the research team members who were involved in the online learning during and post-pandemic.

4 Results

4.1 Measurement Model Assessment

The measuring model was assessed using construct reliability and validity, and the major parameters for the evaluation were internal consistency and convergent validity. Composite reliability and Cronbach's alpha are normally used to measure internal consistency. As illustrated in Table 1, all latent variables' composite reliability varied from 0.930 to 0.972, and all Cronbach's alphas were over the cutoff of 0.7, which is adequate to demonstrate strong internal consistency and a satisfactory level of reliability.

Table 1. Cronbach's α, Composite Reliability and, AVE.

Constructs	Cronbach's α, Composite Reliability and, AVE.		
	Cronbach's α	*Composite Reliability*	*AVE*
System Quality (SQ)	0.887	0.930	0.815
Perceived Usefulness (PU)	0.931	0.972	0.878
Learning Satisfaction (LS)	0.961	0.956	0.855
Continuance Intention (CI)	0.952	0.930	0.875

To evaluate the convergent validity, the average variance extracted (AVE) was used. As can be seen in Table 1, all AVE values were greater than the recommended threshold of 0.5. This indicates that the convergent validity of each variable was high.

4.2 Structural Model Assessment

To determine whether the structural model supported the model path, the bootstrapping algorithm was used with a 5000-resample sample. Figure 2 details the results of the bootstrapping methods.

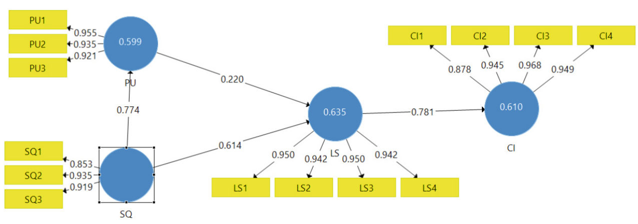

Fig. 2. Results of Research Model

The data confirmed that, with the exception of PU-LS, all proposed relationships were accepted. More specifically, it was discovered that satisfaction had a favorable influence on continuance intention (b = 0.781, p 0.000). Therefore, service quality was significantly associated with perceived usefulness ($b = 0.219$, $p < 0.001$) and learning satisfaction ($b = 0.774$, $p < 0.001$). However, it is learned that the relationship between perceived usefulness and learning satisfaction ($b = 0.220$, $p = 0.185$) was found to be statistically insignificant.

5 Discussion and Conclusion

This study aimed to investigate the factors influencing Malaysian students' satisfaction and continuance intention to use MS Teams as the online learning platform post-COVID-19 pandemic. The D&M IS success model and the ECM served as the foundation for the research model, which were utilized to assess 107 Malaysian HEIs students.

The empirical findings show that system quality has a significant impact on learning satisfaction but perceived usefulness has a relationship with learning satisfaction. This finding shows that the perceived usefulness does not bring significant satisfaction to the students in its use. It is contradicting with many other research that indicated that perceived usefulness is a significant contributing factors of users' satisfaction [17, 20].

A significant determinant of perceived usefulness and learning satisfaction is service quality. The findings showed that the utility and satisfaction of using MS Teams for online learning increase with service quality. As the system's value and utility become apparent, this might enable the students' expectations of the platform to be confirmed [20]. Service quality in this context includes giving operational instructions on effective ways to use the platform, offering pertinent educational services in accordance with a particular context, and having the ability to resolve technical issues during an online session may facilitate learning. The results contradict with previous study [23] as the service quality did not significantly affect the satisfaction of higher education students during the COVID-19 pandemic.

Finally, the study finds that students' continuance intention using the MS Teams is influenced by the users' satisfaction. This result is also in line with the findings of other researchers looking into similar relationships on this topic [24–26]. In other words, students' willingness to continue using the system will increase in accordance with their perception towards the usefulness of technology in learning. Hence, the students who are satisfied in employing MS Teams as their online learning platform are more inclined to continue using the system in the future.

6 Limitations and Future Research

The present study has the following limitations, which are described as follows. First, most of the respondents to this survey were students studying at higher education institutions in Malaysia. Future studies may also use primary school students, and secondary school students as research subjects, which could lead to varied findings for the various age groups. Second, the current study only included students from Malaysia, which would limit how far the findings can be applied for different contexts. Future research may carry out surveys in different nations or areas under diverse conditions and conduct multiple-group analysis to look for potential cultural and technological variations to draw more general conclusions. Third, the study mostly utilized quantitative research; however, qualitative research may be performed in the future to explore the issues in depth.

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The Issues and Challenges of Modern Teaching and Learning in Innovating an Augmented Reality Education for Science, Technology, Engineering and Mathematics

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Abstract. The success of today's social institutions depends on modern education and cutting-edge technology to address community demands for the survival of society and technological innovation. It must be thorough, long-term, and great in addition to adapting modernism to deal with the technical challenges of an unpredictably globalized world. In education, the most fundamental component of learning, especially for Science, Technology, Engineering, and Math (STEM) subjects, is the environment's supplies and requirements. Therefore, this research is conducted to determine the issues and challenges in general, that faced by educator, students and management in teaching and learning, either directly or indirectly. From this point, the potential of the model, respondents' acceptance (model) and the sustainability of the model use will be interpreted. This outcome will be used in our next research in order to design and develop a prototype model of augmented reality (AR) model-based education for STEM, named as Kidcadtech-Creativa. The model will design using Arduino programming and develop to be compliant to Ministry of Education (MoE) curricular standards found in school textbooks through Android-based applications. In supporting our industrial revolution 4.0 (IR4.0) evolution, this matter has to take a crucial and noteworthy point, especially for education improvement. With AR injection, the teaching and learning activities and operation will be more interesting, comprehensive and give maximum impact to their practioners.

Keywords: Augmented Reality · IR4.0 · Technology · STEM · TVET

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https://doi.org/10.1007/978-981-97-4507-4_90

1 Introduction

Vision for Shared Prosperity (WKB) 2030 which is a continuation of Vision 2020 is the focus once again in the mission to make Malaysia a developed country. In other words, the country's leadership needs another 10 years to make Malaysia a technologically advanced country. Whether or not Malaysia succeeds in achieving this vision in 2030 depends a lot on the government's commitment through ministries, agencies, the private sector and Malaysians as a whole. For that, it is very necessary for all parties; society, the ministry and the role of the private sector are united in implementing WKB2030. Deputy Prime Minister [1] said the concept of 'Malaysia Madani' is the country's move to make a paradigm shift to drive the country's development along with developed countries. The situation in the world is changing with various communication systems and technologies that are rapidly changing, of course we should not miss out on being on the front line to drive development. The reality of advanced economic development will include all aspects of the fields involved, including education and advanced technology, social and economic well-being [1]. Therefore, society should recognize that science and technology are tools to increase prosperity, quality of life, and well-being. Based on the worldwide challenge to build a scientifically advanced society, which has a strong capacity for change and has a long view, which not only uses technology but also contributes to the scientific and technological civilization of the future.

1.1 Advanced Technology in Education

Concerned with the direction of the country and Madani Malaysia, not to be left out, the Malaysian Government through the MoE has focused specifically on the field of education, whether primary school or secondary school [1]. In order to ensure that the country will continue to be competitive in the field of science and technology advancement, especially in the context of education and training, and technical training based on advanced technology such as teaching and learning (T&L) based on augmented reality (AR) technology in science-based learning, technology, engineering and mathematics (STEM) (see Fig. 1).

1.2 Ecosystem Innovation and TVET in Malaysia

In general, this research study will focus on the 7th Core: Ecosystem innovation with the application of a new learning environment that exposes students to cutting-edge technology such as AR, robotics and Adruino programming [2, 3]. This exposure can make students more interested in the inclusion of social media elements such as Youtube, Instagram and Tik Tok. Indirectly, the use of this AR-based T&L model can also increase the progress of science and technology in the teaching and learning process that can fulfill the next core in the Malaysian Education Development Plan (PPPM) 2015–2025, which is Core 8: Global Excellence.

With the model that will be developed, it will also expose students to technical training based on TVET (Technical & Vocational Education and Training) as one of the main cores in the PPPM 2015–2025 (Higher Education) in preparing students to face higher level learning high and university. Referring to the PPPM 2013–2025, the

Fig. 1. The Main Thrust in the Malaysian Education Development Plan 2015–2025

use of information and communication technologies (ICT) is also the main focus in T&L sessions in Malaysia [4]. Core or Shift 7: Utilizing ICT to improve the quality of learning in Malaysia aims to (1) providing Internet access and a virtual learning environment through 1BestariNet for all 10,000 schools; (2) Added online content for best practice sharing video starting with the best teachers delivering lessons in Science, Mathematics, Bahasa, and English; and (3) maximize the use of ICT for distance learning and self-paced learning to expand access to high quality teaching regardless of location or student skill level.

1.3 MRSM as Innovation and World-Class Education Center

Along with the vision and mission of school college Junior College of Science (Maktab Rendah Sains (MRSM)) which sets their vision to make MRSM an innovative and world-class center of educational excellence, by setting a mission to students with high potential in the fields of STEM, as well as having entrepreneurial characteristics, this project illustrates the precise direction in realizing the vision and mission of MRSM [5]. With the Kidcadtech-Creativa model that will be developed later, the benefits and benefits will be experienced by students as early as fifth grade in primary school. And the hands-on start will start as early as Form 2 at MRSM or schools throughout Malaysia. There are six programs based on STEM implemented at MRSM namely Premier, Bitara, Ulul Albab, IGSCE, IB MYP and Technical (Teknikal) (see Fig. 2).

MRSM Premier Program implements the MRSM Education System which integrates the national curriculum and the MRSM special curriculum based on STEM. It includes personality development modules, entrepreneurship modules and soft skills modules. This means that students at MRSM will follow the standard high school curriculum syllabus, special courses and personality development courses. Meanwhile, MRSM Teknikal also fulfills the criteria of the product to be developed where it also implements a STEM-based national curriculum with the application of technical elements for the upper secondary level. In secondary schools that implement the national curriculum, there are two technical subjects that are appropriate to apply this kit module based on AR technology, namely Technology Design (RBT) and Computer Science Basics (ASK) in line with the country's core in promoting ICT in T&L at MRSM [6].

Fig. 2. The MRSM Education System Program

2 Issues and Challenges in Modern Teaching and Learning

There are some problems when involving T&L activities in the classroom for example, the learning process that attracts students' interest while the teacher is teaching and also how students get involved in the class [3]. This has become a mess and the solution to the problem is still elusive. So, in order to test and confirm the problem statement, the researcher has conducted a preliminary survey on students in primary and secondary schools including teachers and students to ensure that the problem statement that is placed is the biggest problem and that everyone faces it while learning and teaching.

The availability of teachers in the face of rapid technology is not an easy matter to discuss. But, it is somewhat challenging to some factors in the teaching and learning session. Based on previous studies, factors such as age, gender, training, administrator encouragement and computer facilities provided in schools have been identified as obstacles to the use of computers and ICT among teachers in schools [7]. The availability of the computer devices is limited and sometime need more attention after a few years of usage. The cost will be getting higher and higher and the students are faced obstacles in understanding due to no hands-on activities [8].

The implementation of technical and hands-on teaching and learning sessions in schools, including the use of ICT and cutting-edge technology such as AR, VR, robotics and Arduino code & programming are among the new concepts in school education in Malaysia, but not is so foreign to the students of this millennium. Today's students are fond of studying STEM subjects that allow them to learn and work directly with applications that are more relevant to their eyes, heart and physical (practical) [3, 9] as also agreed by [10–15]. The T&L will be more interesting when proposed together with AR, VR, robotics.

From the initial data, the number of respondents has reached 100 respondents which include high school students and teachers, primary school teachers and also lecturers and students at public universities. They have stated that, 91% of them agree that we still have problems with traditional teaching methods and only 5% of them stated that they are not sure. The second question was doing we have problems understanding certain subjects without learning aids and 98% said yes to support the problem statement. This is the biggest issue that we need to solve to ensure that our education system has an improvement over how our education system worked 10 years ago [16].

Consequently, we will create awareness about this problem that will affect future generations when we are not ready to overcome this problem. While at school, students and teachers are exposed to a variety of resources and approaches that are suitable for imparting knowledge in the classroom, but does each resource and approach used really have the maximum impact [17]. For example, for RBT subjects at school, students and teachers need to prepare some tools and teaching aids such as electronic kits, diodes, sensors, circuits to learn electronic design chapters. The material should be used to test the level of student knowledge as well as students can feel the experience because students learn through hands on. But the supporting material to implement such things is only textbooks and manuals, the question here is whether the supporting material is able to help maximize the output from learning. Whether students can understand the concepts of the subject they are studying by only relying on textbooks and manuals.

Or we need to change or innovate supporting materials to materials that are more user-friendly and able to overcome existing problems. The problem here is whether the module design is suitable for use and practice in education, is it necessary in the form of printed books or electronic books or in the form of 3D construction by applying AR technology [18]. As the matters have identified, it will trigger what form of module is suitable to be used to achieve maximum effectiveness to produce quality students.

There are some doubts and concerns that may be obstacles in the future in the implementation and use of AR model-based kit module, namely Kidcadtech-Creativa, for example financial assistance, which is necessary for us to continue to develop with new and upcoming technologies. Both our products and services are aligned and directly correlated with the syllabus structured in the textbooks according to the Malaysian MoE. Another future challenge that needs to be taken into account in the continued use of Kidcadtech-Creativa is the political situation in Malaysia. The cabinet is expected to change every five years, so during that time, different ideologies are driven based on the individuals chosen for the cabinet. Keep in mind, that these ideologies are uncertain and may or may not support STEM subjects and technology provided to help students in school. Among the value-added that can ensure the durability of this kit model, is that its use is also suitable if developed or collaborated with technical and hands-on businesses such as Lego, or robotics courses and the like [19]. Existing user manuals can be replaced or improved using this application model.

In addition, the use of interesting teaching aids can influence students' learning style. The method of collecting and recording information becomes easier with the acceptance of students immersed in learning through teaching aids used by teachers during learning and teaching. This shows that the use of teaching aids can help students understand more clearly and can collect information systematically. Moreover, the relationship between teaching aids and learning styles can be seen when students can react or interact with their environment.

3 AR Innovation in Modern Education

Innovation can be directed towards progress in one, several, or all aspects of the education system: theory and practice, curriculum, teaching and learning, policy, technology, institutions and administration, institutional culture, and teacher education. It can be applied in any aspect of education that can have a positive impact on learning and students. In the same way, educational innovation involves all stakeholders: students, parents, teachers, educational administrators, researchers and policy makers and requires their active involvement and support. When considering students, we think of studying the cognitive processes that occur in the brain during learning - identifying and developing abilities, skills and competencies. This includes improving attitudes, dispositions, behavior, motivation, self-evaluation, self-efficacy, autonomy, as well as communication, collaboration, engagement and learning productivity.

While, teacher-centered learning is only in one-way form where the teacher delivers the content of the lesson and the student only listens has made the student passive or 'passive learner'. This will cause students to easily feel bored and to some extent has diluted the student's interest in learning at most of the teacher are certainly anxious to implement the advance technology. The use of Teaching Aids is closely related to teaching methods, learning styles and learning approaches to help learning more effectively. Many researchers believe that effective learning is an organized and systematic effort to optimize the T&L process and make maximum use of all learning components. If teachers use sophisticated teaching aids but inappropriate teaching methods will result in learning and teaching not being effective in achieving the objectives. Teacher-centered teaching methods make student involvement limited.

Therefore, teaching methods in the learning and teaching process need to be adapted by using teaching aids based on the topic to be taught. The use of kit module (AR model-based kit) will increased the potential of T&L in classroom and education environment as overall. As a clear depicted, Fig. 3 and Fig. 4 shows among the STEM subjects practiced in schools, such as Design Technology (RBT) and Basic Computer Science (ASK).

Besides, the use of code and programming (programming) is not an easy thing for teachers and students to understand. It requires training, talent and knowledge that only started to develop in the Millennium, the 2000s. This barrier is more prominent among older teachers. This is due to age difference factors and problems in using technology on a daily basis, even when trying to prepare their online classes (especially the impact of the COVID-19 pandemic in 2020) [20–22]. The availability of teachers in using new technology according to the national curriculum can be overcome with the development of Kidcadtech-Creativa as a model based on AR technology in learning based on STEM.

There are a number of teaching aids and applications that are user-friendly, but there are still some teachers who still face difficulties in using technology for the benefit of their students. Therefore, kit model-based education (module kit) will also provide


Aplikasi Teknologi BAB 2

2.2.1 Mengenal Pasti Komponen Mekanikal

Sistem mekanikal adalah beberapa komponen yang berfungsi sebagai penghantar bagi menyelesaikan sesuatu tugas yang telah diprogramkan. Selain itu, sistem ini juga merupakan mekanisme yang digunakan bagi mendapatkan sesuatu hasil pengeluaran.

Untuk menghasilkan reka bentuk sistem yang dikehendaki, pelbagai komponen mekanikal digunakan sama ada secara berasingan atau gabungan. Ada pelbagai jenis komponen mekanikal. Komponen ini saling berkait untuk menyelesaikan masalah atau tugasan seperti yang dikehendaki oleh pengendali.

INFO EKSTRA

Sistem mekanikal yang paling ringkas menggunakan sekurang-kurangnya dua jenis komponen mekanikal.

Komponen Mekanikal

Rajah 2.2.1 *Pelbagai jenis komponen mekanikal yang digunakan dalam reka bentuk sesuatu gajet mekanikal*

BAB 2 Aplikasi Teknologi

Gear

Gear ialah komponen yang digunakan untuk memindahkan kuasa. Gigi yang terdapat pada badan gear berfungsi untuk menyalurkan kuasa daripada sumber kepada penerima. Terdapat pelbagai jenis gear, iaitu gear serong, gear taji, gear heliks, gear tulang hering, gear rak dan pinan, gear *miter*, gear skru, gear dalam, gear serong pilin, dan gear belitan. Setiap gear ini mempunyai fungsi yang berbeza antara satu dengan yang lain.

Gambar Foto 2.2.1 *Komponen mekanikal yang digunakan pada jam*

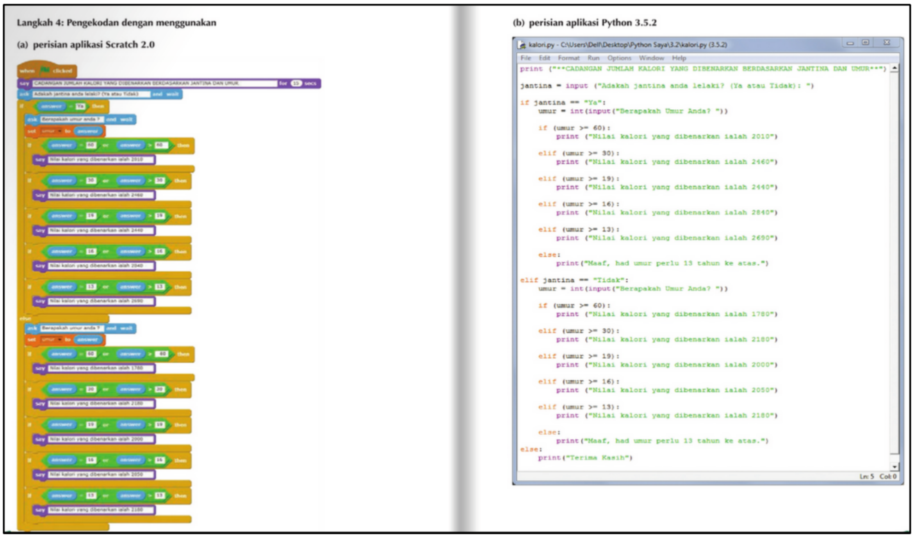
Jenis-jenis Gear

Gambar Foto 2.2.2 *Jenis-jenis gear*

MARI LAKUKAN

Nyatakan dua alatan mekanikal yang kamu tahu. Kemudian, nyatakan jenis gear yang digunakan pada alatan itu.

Fig. 3. The STEM subject, name RBT in secondary school (Form 2) as in Text book


Langkah 4: Pengekodan dengan menggunakan

(a) perisian aplikasi Scratch 2.0

(b) perisian aplikasi Python 3.5.2

kalori.py - C:\Users\Dell\Desktop\Python Saya\3.2\kalori.py (3.5.2)

```
print ("**CADANGAN JUMLAH KALORI YANG DIBENARKAN BERDASARKAN JANTINA DAN UMUR**")

jantina = input ("Adakah jantina anda lelaki? (Ya atau Tidak): ")

if jantina == "Ya":
    umur = int(input("Berapakah Umur Anda? "))

    if (umur >= 60):
        print ("Nilai kalori yang dibenarkan ialah 2010")

    elif (umur >= 30):
        print ("Nilai kalori yang dibenarkan ialah 2460")

    elif (umur >= 19):
        print ("Nilai kalori yang dibenarkan ialah 2440")

    elif (umur >= 16):
        print ("Nilai kalori yang dibenarkan ialah 2840")

    elif (umur >= 13):
        print ("Nilai kalori yang dibenarkan ialah 2690")

    else:
        print("Maaf, had umur perlu 13 tahun ke atas.")

elif jantina == "Tidak":
    umur = int(input("Berapakah Umur Anda? "))

    if (umur >= 60):
        print ("Nilai kalori yang dibenarkan ialah 1780")

    elif (umur >= 30):
        print ("Nilai kalori yang dibenarkan ialah 2180")

    elif (umur >= 19):
        print ("Nilai kalori yang dibenarkan ialah 2000")

    elif (umur >= 16):
        print ("Nilai kalori yang dibenarkan ialah 2050")

    elif (umur >= 13):
        print ("Nilai kalori yang dibenarkan ialah 2180")

    else:
        print("Maaf, had umur perlu 13 tahun ke atas.")
else:
    print("Terima Kasih")
```

Fig. 4. The STEM subject, name ASK in secondary school (Form 2) as in Text book

facilities for teachers, for example watermarks on the kit box as a very effective tutorial videos as recording material and reference [23] as shown as Fig. 5.

An AR system is a system or application that is able to create a view of the real world by inserting virtual objects produced by a computer including objects in 3-Dimensional

Fig. 5. The AR model-based kit module, namely Kidcadtech-Creativa

(3D) form into a real environment in real time. The difference between AR and VR is that VR refers to a situation where the goal is to fully immerse the user in a synthetic environment. While AR refers to a situation where the goal is to complete the user's perception or view of the real world through the addition of virtual objects [24]. The virtual environment actually completely replaces the real world, while with AR the user sees the real environment, that is, merging the virtual with the real; as shown in Fig. 6, Fig. 7 and Fig. 8.

Fig. 6. VR Teaching & Learning

Fig. 7. VR-AR Teaching & Learning

The first education-based AR application was fully developed in 2000. It works by allowing students to see and interact with virtual objects in a real environment. Preliminary studies conducted have proven that immersive learning is very valuable to students

Fig. 8. The augemnted reality (AR) Teaching & Learning

with special needs and manufacturing technical education [25]. The theory of multiple intelligences also proves that better achievement is shown among students towards immersive (fun) technology, proving that immersive learning such as the embodiment of 3D images, has more benefits for students with certain learning styles.

4 Conclusion and Recommendation

Innovating AR model-based education as modern teaching and learning in classroom provide several benefits, especially in clearly showing the spatial, temporal and contextual relationships between real items and virtual objects. This proves that AR technology has various applications. Due to the advantages of these virtual objects, AR technology has great potential to realize creativity in various applications, especially those involving educational and learning aids. Previous studies have shown that students learn better when information is provided close to each other, either spatially or temporally.

T&L uses the AR kit model with coordination that prioritizes the national syllabus curriculum, for technical subjects such as RBT which very much covers the most important objective of the Malaysian Ministry of Education to support STEM-based education is seen as very important. It guarantees students to understand and enjoy an immersive learning experience in line with the path taken by the country based on the Malaysian Education Development Plan 2013–2025, or 2015–2025. The Malaysian Ministry of Education has taken excellent steps. The Malaysian Minister of Education's Special Award for Innovative Curriculum Design and Delivery (AKRI) for Immersive Learning given by the Malaysian Minister of Education shows the Ministry's commitment to highlight virtual immersive approaches and applications (VR or AR or Virtual Simulation) that can deliver deep learning experiences that have significant. Impact on student academic performance.

For future, we will enhance this research by do design and develop the Kidcadtech-Creativa model-based AR kit model. It is very suitable in supporting and realizing the Malaysian strategic plan, covering one of the main cores of education mission in many of countries in the world. The development of this Kidcadtech-Creativa kit model will implement the STEM-based national curriculum, applying cutting-edge technologies such as AR, VR, robotics and Arduino, EV3 and Scratch code & programming in the Lego Spike application which is starting to become the focus of parents and consultants in the field robotics and technical.

Comprehensive exposure in augmented reality technology can also make graduates to generate industrial workforce with digital and cutting-edge knowledge in line with the current situation that prioritizes digitization, knowledge exploration without borders, lifelong learning and the generation of a high-income society.

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The Roles of Visual Elements in Lightboard Videos for Online Learning

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Abstract. As the number of higher education institutions embracing online learning continues to grow, there has been a significant shift towards utilizing lecture videos as a popular method. In the realm of massive open online courses (MOOCs), each lecture video serves as an independent resource for learning. To enhance the delivery of course content, educational settings have increasingly employed visual aids, such as animations, typography, and videos. These visual elements play a vital role in aiding information retention, recall, and motivating students by fostering interest and enjoyment in the learning process. Previous studies have highlighted the positive impact of visual aids on students' memory and information absorption. One notable approach for creating lecture videos involves the use of Lightboard technology. Consequently, this study aims to explore the role of visual elements in Lightboard videos specifically for online learning, particularly in STEM subjects (science, technology, engineering, and mathematics). By conducting a comprehensive analysis of relevant studies, the gathered data will be meticulously examined and presented as substantiating evidence to determine the most effective visual components for Lightboard videos. These discoveries will serve as valuable contributions to the integration of visual data in online courses, with a specific focus on harnessing Lightboard technology to engage students' interest and elevate their overall learning journey. It is worth noting that the incorporation of visual aids holds significant potential in enhancing the teaching and learning environment for educators and students, particularly when grappling with complex concepts.

Keywords: visual elements · eLearning · learning enhancement · lightboard technology · STEM subjects

1 Introduction

Amidst the widespread adoption of eLearning, educators are leveraging online videos for instructional purposes [1]. Research highlights the positive impact of online videos on student learning and engagement in higher education [2, 3]. Various formats, such as recorded lectures, screencasts, tutorials, animations, and simulations, are commonly

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utilized in online teaching [4]. Synchronous video conferences have gained popularity for facilitating eLearning [5], and educational videos not only enhance student engagement but also support teachers' professional development [6, 7]. Alternative teaching approaches are essential for effective learning outcomes [7], while visual aids play a vital role in education by enhancing memory, concentration, and information retention in students [8]. Visual communication, including animations, typography, and videos, improves information recall and motivates students to learn [9]. Integrating visual elements in online courses captures attention, enhances learning, and boosts motivation for both teachers and students [10]. Besides, adapting teaching approaches to the digitally native generation is crucial to effectively utilize the abundance of online resources available to students [11].

1.1 Motivation

The growth of video technology in education is driven by portable devices, increased internet users, and the popularity of MOOCs [7]. Videos facilitate memory transfer and require efficient content delivery to avoid overwhelming learners [12]. When selecting a video style, educators must consider the formats, visuals, skills, and duration [13]. This study focuses on investigating the use of Lightboard technology in eLearning, as its effectiveness is underexplored [14]. Various instructional video styles exist, catering to diverse online students [15]. In MOOCs, videos as standalone resources accommodate diverse online students who prefer interesting videos, regardless of their background knowledge [16]. Other than excessive cognitive load and the absence of embodied interactions, maintaining engagement during writing is also a challenge in eLearning [17–20]. Additionally, the influence of eLearning on the education sector is substantial, resulting in improved retention rates and time savings [21]. However, the transition to virtual learning presents challenges due to unpreparedness and outdated approaches [23]. Institutions should provide support and explore effective teaching methods [22] focusing on reducing cognitive load, increasing interactivity, and improving learning material quality [24]. Sketching information improves memory, making Lightboard technology a focus of this research [25]. Traditional whiteboards on the other hand pose challenges in observing students' body language, as instructors must turn their entire body, hindering engagement in online learning [26]. Therefore, this study aims to address these challenges and enhance engagement.

1.2 Objectives

This study aims to explore the potential of lightboard videos for eLearning, identify key visual components that enhance the learning experience, and understand their specific roles in creating an engaging online environment. The findings will contribute to the advancement of online education by optimizing lightboard videos for a more immersive learning experience.

1.3 Research Questions

There are three research questions that guided this study:

1) *What are the benefits of utilizing lightboard videos in eLearning?*
2) *Which visual elements have the greatest impact on student engagement and participation in Lightboard videos for eLearning?*
3) *How do visual elements in Lightboard videos enhance learning efficiency in an eLearning setting?*

1.4 Significance of Study

This research investigates the role of Lightboard and visual design in eLearning, aligned with the Malaysia Education Blueprint and UNESCO's Sustainable Development Goal 4 [27, 28]. Short instructional videos as supplementary resources have shown improved student learning outcomes, benefiting educators and enhancing online materials, while bridging disciplinary gaps [29]. The "Teach Less, Learn More" (TLLM) initiative emphasizes the significance of lecture videos and encourages diverse teaching approaches [30]. Visual aids, including Lightboard technology, prevent cognitive overload, enhance comprehension [30, 31], and create enjoyable and interactive online courses [32]. However, limited research exists on the impact of Lightboards on academic progress [33], necessitating further investigation through future research.

1.5 Scope of Research

Limitation: Limited research on lightboard videos, relying on peripheral studies. Delimitation: Qualitative inquiry and a small number of prior studies. More quantitative investigations needed for validation and comparisons between online and traditional settings.

2 Literature Review

2.1 Lack of Completion Rate, Students' Engagement and Participation in ELearning Environment

Online learning has gained popularity and fosters student engagement [34]. However, a concerning dropout rate of over 90% exists among eLearning participants [35]. Instructors should design engaging online resources to address this issue [35]. Predicting student performance is a research goal for tailored interventions [36]. Lack of motivation is reported by a significant percentage of undergraduates and graduate students [37]. Challenges such as isolation and distractions impact online students [37]. Successful eLearning requires self-discipline and meeting learning outcomes [38]. Low completion rates require continuous motivation, while limited social connections negatively affect well-being [39, 40]. Incorporating essential features enhance instructor satisfaction and address interaction concerns [40], and innovative approaches are crucial for engaging learning materials in the absence of face-to-face interaction [41, 42].

2.2 The Utilization of Video and Lightboard Technology in eLearning

Pre-recorded videos enhance academic performance [43], offering flexibility and movie-like benefits [44]. However, creating video lectures for online courses requires significant resources [45]. Gen-Z students show a preference for video content in independent learning [46]. Lightboard technology on the other hand improves teaching quality with dynamic drawing and gaze guidance [47, 48] while captivating viewers with transparent glass boards and fluorescent markers [49]. Lightboards also enable presenters to maintain eye contact with the camera while demonstrating concepts to the audience [50] (Fig. 1).

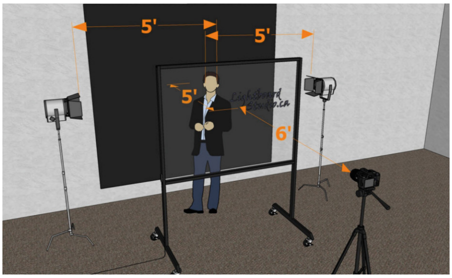

Fig. 1. Lightboard technology settings *(Lightboard Studio,* https://www.lightboardstudio.co.uk/lightboard-studio-components/*)*

2.3 The Use of Visual Elements in Lightboard Videos to Enhance Learning

Visual elements such as images, videos, infographics, animations, charts, graphs, and diagrams enhance the learning experience by providing context, simplifying ideas, and engaging the brain [51–58]. Image overlay in lightboard presentations benefits visual learners and improves comprehension [59, 60], and well-designed visuals aid understanding and promote higher-order thinking by offloading cognitive demands [61, 63]. Therefore, to cater the needs of visual learners, instructors should prioritize visual complementation and minimize excessive text [30] (Fig. 2).

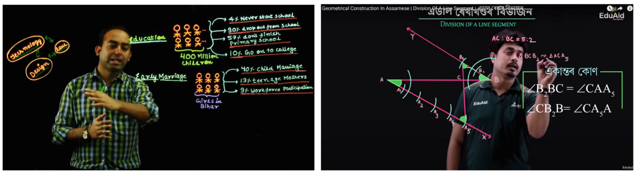

Fig. 2. Drawings and diagrams in Lightboard. (*Puve Lightboard India* https://www.lightboard.in/)

Integrating visuals with audio or text enhances the learning experience, accommodating different learning styles [64], while visually engaging elements capture attention, sustaining motivation and promoting active participation [65]. However, inappropriate, or excessive visuals can overwhelm learners and lead to cognitive overload [66].

Thoughtful integration of relevant visual elements, aligned with instructional goals, reduces cognitive load, enhances understanding, and fosters engagement in eLearning [67] https://www.youtube.com/watch?v=NJLjSxDAk64.

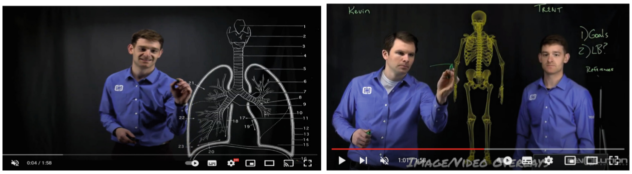

Fig. 3. Image overlay in Lightboard. (*Revolution Lightboard* https://youtu.be/Xzqj50KpAbM*)*

3 Methodology

In this study, a qualitative approach was utilized to assess learners' satisfaction regarding the integration of visual design elements in Lightboard videos. Data collection involves a preliminary survey involving 14 Gen-Z students from various universities in Klang Valley who have prior experience in learning online and using videos as an aid to learn STEM subject, and the utilization of existing data from prior research narrowed down, focusing on visual elements in eLearning, the impact of lightboard technology on eLearning, and the enhancement of learning through visual elements in an online environment, particularly for teaching STEM subjects.

3.1 Pre-existing Data

This study focused on investigating the roles of visual elements in lightboard videos within an eLearning setting, specifically in higher education institutions, with a particular emphasis on Gen-Z characteristics. The research was narrowed down to explore various topics including:

1) *the impact of visual elements in e-learning;*
2) *the effectiveness of lightboard videos for e-learning;*
3) *the benefits of using videos to facilitate learning;*
4) *methods to enhance the eLearning experience;*
5) *the different types of visual elements used in instructional videos;*
6) *the utilization of interactive videos in MOOC;*
7) *the use of videos in teaching STEM subjects; and,*
8) *the use of visual elements as visual aids to enhance learning in STEM subjects.*

3.2 Preliminary Survey

To address the research questions, a descriptive cross-sectional study was conducted involving 14 students from four universities in the Klang Valley. The survey targeted Gen-Z students aged 20 to 25, who had prior experience in learning science, technology, engineering, or mathematics subjects through online, face-to-face, or blended learning. Participation was voluntary, with all participants providing consent. The survey was administered using Google Form embedded in MOOC cohorts and shared with student groups through social networking apps. The survey commenced with students briefly watching various pre-existing lecture videos, including those employing lightboard technology. These videos showcased diverse visual elements such as diagrams, charts, infographics, animations, and more. The survey comprised 10 questions, a mix of closed-ended and open-ended, aiming to gather respondents' perspectives on existing lecture videos used in eLearning (Table 1):

Table 1. Survey questions

No.	Questions
1	Which of the videos presented above do you find the most visually appealing? (Consider all the incorporated visual elements)
2	Among the provided videos, which presentation style do you prefer in terms of storytelling and topic explanation?
3	Which visual elements below contribute to your information retention and engagement throughout the video? (Multiple answers allowed.)
4	Rate each element below based on its effectiveness in capturing and maintaining your attention during topic delivery
5	What is your preferred duration for a lecture video?
6	In an online course, do you agree that video content should align with the provided questions or activities?
7	Please share your overall feedback and opinions on effective communication methods for instructors using interactive videos
8	What do you consider the most important visual elements? (Open-ended)
9	Do you believe that incorporating interactivity into the videos would enhance your understanding of the topic? (Refer to the provided link for an interactive video example.)
10	Does the presence of your lecturer in the video create a stronger connection to the content or personalize the experience for you?

4 Result and Discussion

4.1 Pre-existing Data

Lightboard videos, a user-friendly and easily accessible resource for presenters in teaching, show potential to improve retention rates among undergraduate STEM majors [68]. Collaborating with teaching centers enhances efficiency in video creation and editing [68]. Students learning through lightboard videos experience a strong connection with the instructor, crucial for long-term engagement in STEM fields [68]. Lightboards enhance teaching across subjects, including STEM, by providing versatile features like title slides, graphics, audio, and interactive elements such as quizzing questions or H5P tools [69]. In educational settings like online courses and flipped classrooms, lightboard videos simplify complex ideas [62]. They find applications in corporate or business contexts for training and education [70].

Lightboard videos offer a unique and effective visual conveyance of information, surpassing regular whiteboard or chalkboard videos [71]. Traditional whiteboard writing presents challenges of instructor orientation and content obstruction, which lightboards or learning glass address by revolutionizing video production [72, 73]. Made of glass with LED lights, lightboards enable teachers to write or draw while facing students and the camera, with clear writing against a dark background [46]. The lightboard approach combines different learning modalities, enabling viewers to see, hear, and read information simultaneously, which may enhance comprehension and memory retention [74]. Lightboards also offer flexibility, allowing learners and instructors to pause, rewind, and replay videos, making it convenient for targeted studying or content review at a later time [75] (Fig. 4).

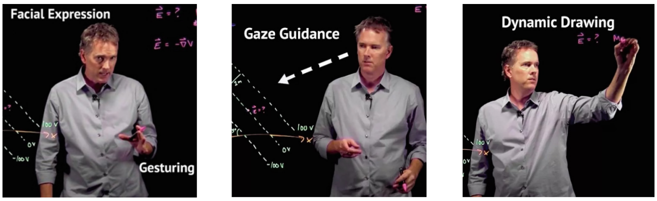

Fig. 4. Facial Expression and Gestures, Gaze Guidance, and Dynamic Drawing (*Learning Glass Europe (2022). Learning Glass Europe* https://learningglass.eu/lightboard-for-education/*)*

Drawing on existing data, the present study identifies 15 key visual components that are recommended for integration into Lightboard videos focused on subjects within the fields of science, technology, engineering, and mathematics (STEM). The identified visual elements are: diagrams, charts, infographics, animations, flowcharts, images, video (footages), concept map, simulations, virtual environments, gamified elements, dynamic drawings, gaze guidance, facial expression, and gestures.

Based on the pre-existing data, certain visual elements can either overload cognitive load or enhance the learning experience:

1) *Visual Elements Overburdening Cognitive Load:*

- Cluttered or complex visuals overwhelm learners [76], while irrelevant visuals distract from key concepts [77], and inconsistent or conflicting visuals create cognitive dissonance [78].

2) *Visual Elements Enhancing the Learning Experience:*

- Clear and concise visuals (diagrams, charts, infographics) aid understanding [77], and relevant visuals (images, animations, videos) provide context and support comprehension [77]. Organized visuals (flowcharts, concept maps, timelines) help organize information [79], while interactive visuals (simulations, virtual environments, gamified elements) promote motivation and active learning [80].

It is important to consider learners' prior knowledge, cognitive abilities, and preferences as the impact of visual elements can vary [81]. Effective data visualization avoids visual illusions and confusion [82]. Thus, it is crucial to select and design visual elements based on the instructional context and audience characteristics to optimize their contribution to learning.

4.2 Preliminary Survey Results

Survey findings reveal that respondents favor videos with a casual narrating style, accompanied by gestures, facial expressions, and simple animations. Students are attracted to visually appealing elements like color palettes, animated keywords, and real images or footage. Key visual elements for maintaining attention include diagrams, animations, images, and video footage. Simulations, virtual environments, and dynamic drawings are also important to students. Consistency in visual style and clear, readable text are preferred, minimizing distractions. Instructor presence does not significantly impact attention retention. Video durations of 1–5 or 5–10 min are preferred, depending on the topic and visual elements. Interactive features like gamified elements and simulations enhance understanding.

5 Conclusion

Research indicates that incorporating pre-recorded videos in eLearning improves academic performance, aligning with students' preference for video content and self-directed learning. Lightboard technology simplifies complex concepts and enhances engagement by combining visuals, audio, and text. Thoughtfully integrating relevant visuals reduces cognitive load and fosters learner engagement, while avoiding overwhelming or irrelevant visuals. Clear, concise, and interactive visuals contribute positively to the learning experience, while cluttered or irrelevant visuals hinder understanding. By considering learners' needs and preferences, visual elements can be optimized to enhance effective learning..

5.1 Recommendations

Furthermore, this study indicates that incorporating the recommended visual elements into lightboard videos can promote student analysis and reflection, while leveraging both visual and auditory channels enhances students' attention and understanding of the information presented. However, further investigation is needed to explore the specific roles of visual elements in lightboard videos for teaching individual STEM subjects. Due to limitations in participant number, subject differentiation, and reliance on preliminary data, future research should gather students' feedback on the impact and significance of each visual element. This feedback should encompass knowledge retention, motivation, and topic comprehension, involving a larger and diverse sample across STEM disciplines. Questionnaires and interviews with experts in instructional design and content development can provide insights into challenges and opportunities of utilizing lightboard technology and incorporating visual elements effectively.

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Towards a Conceptual Design Framework for Virtual Reality-Based Educational Animations

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Abstract. Virtual reality-based educational animations are one of the ways educators provide instructional guidance and knowledge. Even though virtual reality-based educational animations offer a range of learning opportunities, they need more major instructional guidance, making it more challenging to generate learning material that adheres to education curriculum and context. Thus, this study attempts to (a) identify various learning theories and design principles and (b) propose a conceptual design framework for virtual reality-based educational animation for learning. The proposed conceptual design framework for virtual reality-based educational animations is explored in this study.

Keywords: Animation · Educational Animation · Conceptual Design Framework · Virtual Reality-based Learning

1 Introduction

The phrase "Virtual Reality" (VR) has several different definitions. This may be due to the interdisciplinary nature of VR research since many concepts were borrowed from other disciplines, such as psychology and cognitive science [1]. As modern applications use VR, logic breakthroughs have made it possible to create a new style of learning that better suits the needs of the 21st-century learner, who desires entertainment, interactivity, involvement, and object manipulation [2]. For example, recent reviews showcase articles published involving countries worldwide; the European Union and the United States are the primary research centers of these technologies. Most papers can also be categorized into four categories: research and development, healthcare, education, and industry [3]. As a result, researchers have found that virtual reality offers an engaging method and motivates students to participate in their education. It is also appropriate for students who think more schematically and visually; it gives them a general understanding of the subject, helps them apply new information, and makes it simpler and faster for them to comprehend the course they have studied [4].

The numerous somewhat variable and heterogeneous definitions of VR in the literature demonstrate the lack of uniformity or consistency; consequently, as the number of

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related terminologies continues to grow and expand, a request for precise definitions of VR has become increasingly important [5]. There are thus many definitions from which VR might be deduced. Yet, the most comprehensive definition of VR is a real-world or computer-generated environment in which a perceiver feels telepresent [6].

This definition was chosen because it isolates the impact of technology and focuses on the strategy and uses for the present advancement of technology [3]. Additionally, according to technological advances over time and dynamic interpretations of society, the definition of virtual simulation today is as follows: virtual simulation is a strategy for encouraging a perceived live experience for a desired outcome through partial immersion in a digital learning environment [7].

VR has been extensively experimented with, but educators face challenges creating virtual environments due to learning objectives and staying up-to-date with rapidly evolving technology [8]. Moreover, according to Berney & Bétrancourt (2016) [9], research now explores the cognitive mechanisms involved in processing dynamic vision and the procedures that eventually result in learning" (p. 151). It is not uncommon that learning theories are frequently neglected when designing VR applications, with a greater emphasis placed on the design and usability of the VR application. The call for evidence-based design decisions is much needed with the advancement of readily available instructional technologies and the availability of virtual-based instructional material [10, 11]. Moreover, VR offers diverse learning opportunities but lacks instructional design, making it challenging to align with education syllabuses [12]. Thus, the framework provides a robust structural base, superb design, and simple problem-solving [13, 14].

This study explores germane learning theories and design principles that can be integrated into a conceptual design framework suitable for educational animation for virtual reality-based learning. To delve further, the researchers need to (a) identify various learning theories and design principles and (b) propose a conceptual design framework for virtual reality-based educational animation for learning.

2 Conceptual Design Framework

Through reviewing the literature in the area, several learning theories and design principles are selected: Virtual Reality Principles, Virtual Reality-based Learning Principles, Mayer's Multimedia Principles, and Cognitive Requirements for Learning. They are as follows:

2.1 Virtual Reality Principles

Virtual reality system comprises input devices, output devices, and simulated situations. Table 1 showcases six essential components for application development [15, 16]:

2.2 Virtual Reality-Based Learning

The term "Virtual Reality-enable learning" was used by C. Li & Ip (2022) [17] to characterize virtual reality's use in education. This word better describes *technology's role* in

Table 1. Essential principles for virtual reality

Characteristic	Definition
Interaction	Principles explore technology-human interaction through multisensory interfaces
Virtual technologies	User movements are captured instantly, allowing avatars to engage in the virtual world
Perception & Immersion	Utilizing the immersion concept to evaluate user presence in a virtual environment
Multi-sensory interaction	Human senses and the relationship between virtual reality are addressed by optimized technological design
Navigation	Virtual navigation involves controlling avatar motion using technologies
Virtual Mockup	Virtual prototyping involves product design, review, and evaluation

learning. Thus, this study came to five significant conclusions about VR-enabled learning. As seen in Table 2, the first two of the columns are concerned with the technological and psychological components of the VR experience, while the remaining three are concerned with learning [17]**:**

2.3 Mayer's Multimedia Principles

Mayer's multimedia principles developed by Richard E. Mayer are well-known in the field of multimedia learning and instructional design. These principles, based on cognitive psychology research, attempt to guide the successful use of multimedia in educational environments [20, 21]. The fundamental principles are as follows (Table 3):

2.4 Congnitive Requirement for Learning

Mayer's Multimedia Principles (MMP) lead many current researchers on multimedia learning efficacy [22–25]. Mayer's analysis also suggests three goals for multimedia design lessons: (a) eliminating unnecessary processing, (b) regulating critical processing, and (c) encouraging generative processing [26]. There are three cognitive capacity requirements for learners in Table 4:

Table 5 displays three pedagogical situations: extraneous overload, essential overload, and generative underuse. Extraneous overload hinders learners' ability to participate in essential and generative processing, essential overload exceeds learners' cognitive abilities, and generative underuse results from dull instructional videos.

3 Discussion

To propose a conceptual design framework for Virtual Reality-based educational animations, the fundamental principle of VR, Mayer's Multimedia Principles, and Virtual Reality-based learning principles are crucial when fulfilling the learner's cognitive

Table 2. Characteristic virtual reality-enabled learning

Characteristic	Definition
Immersion	A virtual environment should allow user-virtual or multi-user interactions to create a completely mediated experience—the researchers C. Li and Ip (2022) propose reporting virtual environments' technological capabilities by including sensory stimulation supply and interaction facilitation
Presence	Steuer (1992) defines presence as "being there"[6]. Even if presence is subjective, the study on VR-enabled learning must determine if increasing presence constantly improves learning efficacy [17]. Future VR learning studies should quantify presence, a fundamental VR concept
Pedagogy	A few standard educational strategies have been revised to complement learning activities in VR or outside VR. Inquiry-based, problem-based, and experiential learning are examples [17]
Targeted Learning Outcomes	Precise definitions of learning outcomes can help distinguish VR-enabled learning from VR entertainment. According to affective learning theory [18], using VR in educational settings to develop youth's intercultural sensitivity positively impacts learners
Learner Specific	Learner details may include age, gender, and learning style [17]. Learning style and its models are crucial to understanding people's learning [19]

requirements (refer to Fig. 1). Then the overall design should follow Mayer's cognitive capacity requirements to match learners' cognitive processing abilities. VR concepts emphasize maximizing multi-sensory interfaces, capturing avatar navigation and movement, and incorporating product research, analysis, and design. On the other hand, Multimedia Principles seek to improve comprehension and learning in multimedia presentations while fostering deep learning and optimizing knowledge transfer for successful, engaging, and lasting learning experiences. In addition, VR technology is used in immersive learning, or VR-enabled learning, to enhance the learning experience. Thus, Virtual Reality-enabled learning generally enriches education by providing immersive, interactive, and engaging learning experiences that improve information retention across various disciplines and subjects. Finally, all the principles must consider Mayer's cognitive capacity requirement, which states that educational materials should be created to correspond with students' cognitive processing capacities. This will assist learners in concentrating on vital information without interruptions by minimizing cognitive load.

Table 3. Mayer's multimedia principles

Principles	Definition
Multimedia	Words and visuals improve learning. Photos, animations, and explanatory text can improve learning and recall
Modality	Multimedia that matches the learner's senses helps information stick. Complex visual information may be better understood through animations or video, whereas procedural knowledge may be better conveyed through audio narration
Coherence	Multimedia presentations should avoid unnecessary content. Distracting pictures or music might impede student learning
Redundancy	Avoid duplicating text and audio. Repetition may impair learning
Contiguity	Show spatial or temporal relationships with similar words and images. Associating knowledge reduces cognitive load and increases comprehension
Personalization	Conversational language and personal pronouns enhance learning by establishing instructor presence
Segmenting	To assist students in understanding complex material, break it into smaller portions
Pre-Training	Accessing existing knowledge before a multimedia session improves learning outcomes
Signaling	Arrows and highlighting focus students' attention to important material
Practice & Feedback	Practice and feedback encourage learning and skill development

Table 4. Cognitive capacity requirement

Processing	Description
Extraneous	Processing that does not support the educational goal
Essential	Processing intended to help the reader retain the key information being provided
Generative Processing	Intended to make sense of the information

Table 5. Pedagogical Situations

Extraneous Overload: Too Much Extraneous Processing			
Required	Extraneous	Essential	Generative
Available	Cognitive Capacity		
Essential Overload: Too Much Essential Processing			
Required	Essential		Generative
Available	Cognitive Capacity		
Generative Underutilization: Not Enough Generative Processing			
Required	Essential		Generative
Available	Cognitive Capacity		

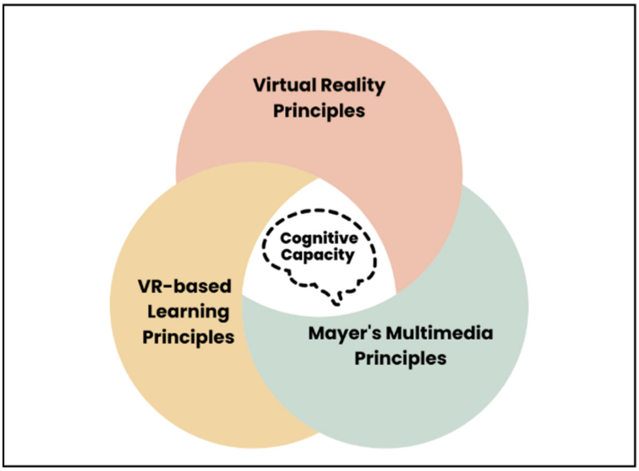

Fig. 1. Diagram of the Conceptual Design Framework.

4 Conclusion

With ever-expanding progress in VR technology and methods, guidelines such as a design framework can aid VR educational animation development. Educators can utilize design frameworks to decrease creative decision-making and enhance learning objectives to produce valuable instructional resources for various areas. Still, more study is required to improve and evaluate its potential. This design framework for virtual reality-based educational animation can support educators in producing a VR-based educational animation. A uniquely designed conceptual framework for virtual reality-based educational animation will successfully support educators or instructors in expanding and visualizing the learning target. With the current ever-expanding progress in virtual reality technology and methods, guidelines are becoming more important to refer to, as it will assist in maintaining efficiency during development, and it is critical for instructors to prepare instructional aspects and their integration so that students can achieve a defined goal on their own.

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Use of Virtual Session and Recorded Video to Improve Hands-on Skills in CHE Unit Operation Lab

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Abstract. Chemical Engineering Unit Operation Laboratory focuses on the application of mathematics, science and engineering fundamentals through laboratorial activities. This course is a core course in chemical engineering department and has been offered at second year of undergraduate study. It also involves activities such as hands-on skills, data collection, data manipulate, literature review, engineering principles and analyzing complex chemical engineering problem in order derive a conclusion based on science and engineering. Hands-on laboratory science experiences are critical to the learning process across all areas of study. The students were exposed to virtual learning by taking live session with interactor and using recorded video of the experimental lab to let the students explored and have some rough idea about the experiment. On completion of this course, student should be able to investigate simple or complex chemical engineering problems using research based on knowledge and research methodologies which match several levels of learning objective based on Bloom and SOLO taxonomy.

Keywords: Unit operation lab · chemical engineering · undergraduate · virtual · video · live sessions

1 Introduction

The lab activities were normally started at second week of the semester and finished by the week eleven. Students were normally grouped into small group consist of up to five people and they have to performed eight experiments (one per week). At the beginning of each lab session, the graduate assistant (GA) will provide short explanation about the experiment and students had to figure it out based on the experiment module that was provided. In addition, each group also had to develop their own method for one lab session based on very limited information.

Few difficulties had come up during the course, according to reports from the GA, the prior coordinator, and the students. The reports included the students' weak writing abilities for scientific reports, their complaints that some GAs weren't competent enough to manage the lab session, the absence of comments from the GA or lab coordinator for the students' reports, and their lack of comprehension of the lab module.

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A few intercession strategies are offered in this proposal to address the problems. In order to give the student ample direction, an appropriate class on writing scientific reports can be held during the first or second week of the course. To be able to standardize the module's content and give GA a clear picture of the lab operations that will be carried out, the lab coordinator and technician can also pre-make the video training module for GA. For the GA or coordinator to give the student their input, a common feedback form can be designed and used throughout the module's explanation before lab activities.

Chemical Engineering Laboratory II is one of the four laboratory courses offered to chemical engineering students from their second year to their final year of study. The number of participants in the course varies, ranging from as low as 20 to over 200 students. The lab sessions for Lab II typically take place from week two to week eleventh, with each session lasting around four hours per week. In the first week, the coordinator gathers all the participants to provide a general explanation of the lab activities, attendance rules, grading criteria, and contact information for the Graduate Assistants (GAs) and coordinator. The lab module is distributed to the students in week one, one week prior to the lab session, and students are expected to engage in self-learning to prepare for the experiments. The GAs are trained by the technician during the first week and are responsible for conducting the lab sessions and guiding the students.

During the lab sessions, it has been observed that students face difficulties in performing the experiments. They often spend a significant amount of time trying to understand how the equipment works, resulting in some students failing to collect the correct data or performing the experiments incorrectly. When asked about these issues, students mentioned that the provided lab module lacks clarity, and they also expressed dissatisfaction with the support and understanding of the experiments from the GAs. Another issue pertains to the feedback on the lab reports. In many cases, although the reports are marked by the GAs or coordinator, they are not returned to the students for feedback. From the perspective of the GAs and coordinator, it is evident that students still lack scientific report writing skills. The figure captions, tables, and graphs presented in the reports often have incorrect formats. Regarding the lab module, students find it challenging to follow or fully understand it. Adding more detailed information about the experiments and additional supporting information could improve the module.

This study will involve several training activities video-based learning. The specific activities that will be carried out include:

1. Training sessions for Graduate Assistants (GA): The GAs will receive training to enhance their knowledge and skills in conducting the lab sessions for complete and efficient lab recording.
2. Improving the lab module/manual and creating videos/animations: The lab module/manual will be revised and improved to provide clearer instructions and explanations. Additionally, videos or animations will be created to assist students in understanding the concepts and procedures.
3. Training session on technical report writing: A dedicated session will be conducted to train students on the essential skills required for writing scientific reports effectively.

The primary objective of virtual hands-on lab learning is to cultivate practical competence in students without the need for physical lab demonstrations. Laboratory learning offers opportunities for students to connect theoretical concepts taught in class and reinforce their understanding. Evaluating this type of learning can enhance students' grasp of the relationship between theory and practice, as well as their higher-level reasoning abilities. It contributes to the development of students' practical skills in laboratory work. Plus, virtual labs also outperform traditional laboratories in terms of overall value gained, as students appreciate the convenience and ease of conducting research [1]. In comparison to traditional learning methods, more time is required to complete tasks and interact with peers. Figure 1 shows the strategies of assessing virtual hands-on lab learning.

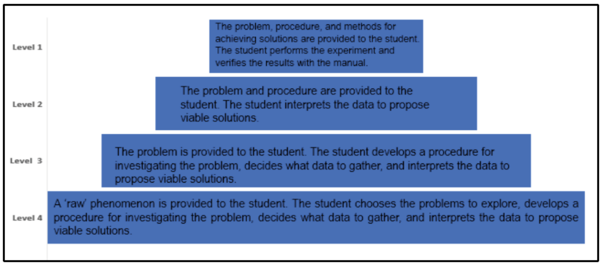

Fig. 1. Scientific enquiry rubric level of enquiry description [2].

2 Methodology

First, the students were asked to read and understand the lab manual which have been given one week before the laboratory session. They needed to collect all required materials included equipment sketch, equipment manuals, video or pictures, articles related to experiments and experimental diagrams. From these materials, the students were able to have some insight views and ideas about the experiment before attended it. The students were divided into two groups which were the control group and the experimental group. The control group followed the conventional hands-on approach in the lab, while the experimental group had access to virtual sessions and recorded videos in addition to the hands-on activities.

Then, the students were required to create videos documenting their participation in each experiment, with a maximum duration of 10 min per video. No editing was allowed for these videos. The recorded videos were then uploaded to YouTube and compiled on a Google Site, prepared by a teaching assistant. The text utilizes first- and second-level headings to organize ideas and facilitate readers' understanding of the content.

The video tutorials follow a teaching style that combines voice narration and handwriting, similar to traditional face-to-face and one-to-one tutoring, where explanations are provided through writing. To create these tutorials, Microsoft Windows Journal was used on a Lenovo Thinkpad X series PC tablet. The handwriting and voice audio were captured and edited using Camtasia software (Techsmith). The final product was saved as a Shockwave flash file (SWF), which can be viewed directly in any browser without the need for additional software or embedded directly in Blackboard. Each video focuses on a specific problem and remains under 10 min in length, resulting in file sizes ranging from 5 to 10 MB.

The tutoring materials were accessible to all students, allowing them to decide if they required additional tutoring and choose which specific tutoring video to view. Students have the flexibility to watch the videos according to their own needs, deciding when and where to access them including in google sites, google form, YouTube and others.

3 Results and Discussion

The findings of this study showed that using recorded films and virtual sessions in the Unit Operation Lab had a number of beneficial effects including enhanced learning experience, elevated flexibility and accessibility, and skills boosting in hands-on. The Fig. 2 shows the main differences of student's grading between different cohort (2021–2023) for their Lab work report and viva marks based on attending virtual session and watching recorded videos before entering actual lab sessions. It is clear from this figures that the students of cohort 2021 grading were mostly around 80% and below while cohort 2022 and 2023 students achieved higher grading mostly around 90% and above due to attending their virtual session with assigned teacher and graduate assistants and also properly watched videos prepared for them to understand the equipment and their operating methods via demo data provided for better understanding of data collection. These results also shows that these learning enhancement skills also improve the interest of students towards hand-on sessions and character developing towards experiment performance as overall grading also reflect same trend of student's scores in their total course score results for you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting. Please note sections A-D below for more information on proofreading, spelling and grammar.

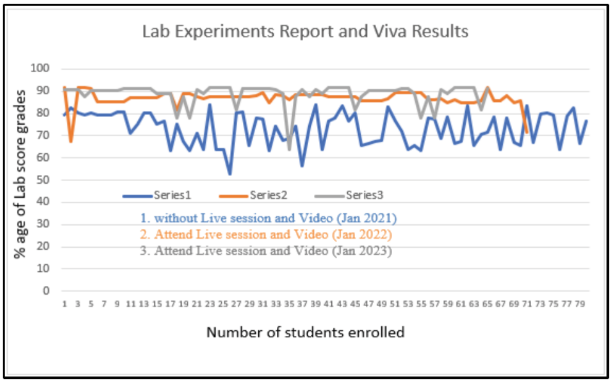

Fig. 2. Improvement of Lab work grading with virtual session and recorded videos

In comparison to the control group, students in the experimental group said their learning was more participatory and engaging. They were able to view close-up images of the equipment, view the experiments from various perspectives, and concentrate on particular parts of the procedures during the virtual sessions [3]. The underlying principles and concepts were better understood as a result of the improved visual access.

Furthermore, students have the freedom to access the lab materials at any time and from any location thanks to the recorded videos and virtual sessions. Those with scheduling conflicts or restricted access to the actual lab benefited from this in particular. The recorded movies may be watched by students several times to help them understand, which significantly boosted learning outcomes. The recorded movies served as useful tools for sharping practical abilities. While conducting experiments in the physical lab, students might refer to the videos to review proper procedures, safety measures, and troubleshooting skills. The experiments were carried out with greater assurance and accuracy as a result of this reinforcement.

The chemical engineering unit operation lab II's implementation of virtual sessions and recorded films proven to be a successful method for strengthening practical skills and enhancing the learning experience [4]. Students had access to an immersive and engaging learning environment thanks to the combination of recorded movies and real-time virtual sessions. The availability and adaptability of these tools increased the chances for students to interact with the course material, especially for those who had limited time or access to the actual lab.

There are several restrictions to be taken into account, even though this study concentrated on the favourable results. First off, a student's ability to experience some sensory elements, such as the tactile feedback of equipment, may be limited by the GA's absence from the lab which similar with earlier study [5]. Additionally, the accessibility of necessary tools and resources at the locations of students may differ, which could have an impact on how feasible it is to use virtual sessions in every situation. However, these restrictions can be lessened with the right preparation and organization.

4 Conclusions

In summary, the utilization of recorded films and virtual sessions has shown to have a substantial potential for improving practical skills in the chemical engineering unit operation lab. Educators may give students a more enriching learning experience, greater accessibility, and reinforcement of practical skills by utilizing these technological tools. The incorporation of virtual sessions and recorded videos into chemical engineering education can help to improve hands-on learning methodologies and better prepare students for practical applications in the area as technology develops.

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Enhancing Engineering Education in Drilling Fluids and Cementing Technology Through Active Learning Strategies

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Abstract. This research investigates the integration of "Think-Pair-Share" active learning strategies alongside traditional teacher-student interactions in Drilling Fluids and Cementing Technology education. The study assesses students' preferences for active learning, their motivation to engage in such methods, and the factors influencing effectiveness. A total number of 24 undergraduate students were involved in this survey. The survey evaluates perceptions of various active learning strategies in comparison to conventional teaching. It measures students' preference for active learning, their motivation, and their resulting academic performance. This research contributes empirical evidence and insights into factors that enhance successful active learning, aiming to improve the quality and relevance of Drilling Fluids and Cementing Technology education. It provides guidance for educators and institutions seeking to optimize pedagogical approaches, ultimately benefiting engineering education.

Keywords: Active Learning Strategies · Student Preferences · Motivation · Academic Performance

1 Introduction

Effective learning involves providing students with a sense of progress and control over their own learning. This requires creating a situation where learners have a chance to try out or test their ideas. This testing is ideally accomplished by connecting students' ideas to concrete experience and that's where the [1] "active" part of the learning comes in [2].

Active learning goes beyond passive listening and memorization. It encourages students to actively engage with the subject matter by talking, reflecting, writing, and applying what they've learned to real-life situations [3]. Traditional classrooms often fail to accommodate diverse learning styles and can hinder the development of well-rounded.

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Individuals. Therefore, it's crucial for modern classrooms and teachers to cater to individual differences and learning preferences, ensuring that every student grasp essential concepts and skills while fostering a positive attitude toward their chosen profession. This approach promotes a more meaningful and comprehensive educational experience [4].

Since the 2000s, there has been a growing emphasis on including personal well-being in education. Thorburn, 2020 noted that countries like Australia, England, New Zealand, and Scotland have taken various approaches to integrate well-being considerations into their national curriculum reforms. Matthews et al., 2015 highlighted that educational policies encompass well-being when schools address societal concerns related to students' mental, emotional, social, and physical needs. Norway stands out as an example of this approach, as it believes that schools can contribute to enhancing the quality and meaning of young people's lives, even in challenging economic conditions.

The concept of active learning has gained significant attention as an instructional approach aimed at improving students' learning capacity and developing their competencies and skills. Active learning focuses on student-centric, instructor-led activities and methods [6], challenging traditional teaching methods that rely solely on external sources for knowledge delivery.

Active learning emphasizes understanding over memorization and encourages students to take responsibility for constructing their knowledge [7]. While it offers benefits such as increased self-confidence, better access to prior knowledge, improved problem interpretation, enhanced observational skills, and cognitive development, it faces challenges like low student participation and limited faculty resources, leading many academic institutions to stick with traditional lecture-based teaching [8]. Economic pressures, faculty resistance, and student preferences for lecture-based teaching also hinder the adoption of active learning methods [9].

However, the digital revolution and increased reliance on technology have prompted the need to replace traditional instructional methods. Active learning strategies, such as class discussions, collaborative groups, and debates, have been recognized for their role in engaging students both behaviourally and emotionally [10]. This shift toward active learning methods is driven by the demand for individuals who can think critically, solve problems, and adapt to changes to support a rapidly evolving economy. As a result, the education system is adapting its approach to focus on the role of active learning in fostering personal growth and contributing to economic development. This study aims to explore the relevance of active learning mechanisms in influencing student engagement and participation.

1.1 Aim of the Study

The principal objective of this research is to assess how active learning affects the motivation levels of sophomore students in the field of petroleum engineering who are taking the drilling fluids and cementing technology course. By examining the survey responses gathered from these students, the study aims to pinpoint the active learning methods that exert the most significant impact on student motivation within this specialized discipline. Through the acquisition of empirical evidence, this study aims to enhance the current body of knowledge by establishing a direct connection between active learning and student experience, particularly in the context of the drilling fluids and cementing course for petroleum engineering undergraduates.

1.2 Research Questions

1. What specific active learning strategies employed in the drilling fluids and cementing course have the most pronounced influence on the motivation levels of senior petroleum engineering students?
2. How do senior petroleum engineering students perceive the relationship between active learning strategies and their motivation within the specialized context of the drilling fluids and cementing course?
3. Can empirical evidence be gathered to establish a clear and quantifiable link between active learning methods and student motivation in the drilling fluids and cementing course for petroleum engineering students, contributing to the existing knowledge base in this field?

1.3 Significance of the Study

In the following sections, we will delve into the specific dimensions of the study's significance, ranging from its potential to enhance pedagogical practices and tailor educational approaches to its capacity to contribute to empirical knowledge, address industry needs, and inform educational policies. The aim is to illuminate the far-reaching implications of this research and underscore the value it brings to the field of petroleum engineering education.

The significance is:

1. What specific active learning strategies employed in the drilling fluids and cementing course have the most pronounced influence on the motivation levels of senior petroleum engineering students?
2. How do senior petroleum engineering students perceive the relationship between active learning strategies and their motivation within the specialized context of the drilling fluids and cementing course?

Can empirical evidence be gathered to establish a clear and quantifiable link between active learning methods and student motivation in the drilling fluids and cementing course for petroleum engineering students, contributing to the existing knowledge base in this field.

2 Concept of Active Learning

The concept of active learning is at the heart of modern education, aiming to transform students from passive receivers of information into active participants in their own learning journey. Four key dimensions define active learning, each contributing to a holistic and engaging educational experience.

1. Purposive Learning: One fundamental pillar of active learning is the concept of purposive learning, where the tasks and activities assigned to students align closely with their concerns and interests [11]. It recognizes that when students find meaning and relevance in what they are learning, their engagement and motivation soar [12]. By tailoring educational content to resonate with students' real-world experiences and aspirations, educators can ignite curiosity and drive in learners. Purposive learning not only enhances students' understanding of the subject matter but also equips them with practical knowledge that can be applied in their future careers [13].
2. Reflective Learning: Reflective learning is another crucial facet of active learning. It encourages students to go beyond the acquisition of facts and figures by fostering critical thinking and metacognition. When students engage in reflective learning, they don't merely memorize information; they ponder the deeper meaning of what they've learned [14]. They question, analyze, and draw connections between new knowledge and their existing understanding [15]. This process of self-reflection enhances comprehension, encourages creativity, and equips students with the ability to apply what they've learned in novel situations.
3. Negotiated Learning: Active learning thrives on collaboration and the co-creation of knowledge [16]. Negotiated learning embodies this principle by emphasizing the negotiation of learning goals and methods between students and teachers. It recognizes that learners have unique needs and preferences, and that their involvement in shaping the learning process can lead to more effective outcomes. Through negotiated learning, students gain agency in their education, fostering a sense of ownership and responsibility for their learning journey. This collaborative approach also fosters a supportive and inclusive learning environment, where both teachers and students contribute to the educational process.
4. Critical Learning: Active learning encourages students to think critically and appreciate various approaches to acquiring knowledge. Critical learning goes beyond rote memorization; it encourages students to question assumptions, challenge established beliefs, and consider alternative perspectives [17]. By fostering critical thinking skills, educators empower students to navigate an ever-changing world, adapt to new challenges, and contribute meaningfully to society [18].

Critical learning not only equips students with the ability to evaluate information critically but also instils a lifelong commitment to intellectual curiosity and open-mindedness. Incorporating these dimensions of active learning into educational practices fosters an engaging and enriching learning environment. It equips students with the skills and mindset needed to become independent, lifelong learners who can navigate complex issues, contribute to their communities, and adapt to an ever-evolving world. Active learning, with its purpose, reflective, negotiated, and critical components, is a powerful educational approach that prepares students not just for exams but for the challenges and opportunities of life itself.

3 Methodology

In this research, a quantitative research design was employed in conjunction with a survey questionnaire to explore the relationship between student motivation and the impact of active learning. The primary objective was to examine how active learning correlates with student motivation while also delving into the firsthand experiences and viewpoints of students. By utilizing this research approach, the study sought to attain a comprehensive comprehension of the dynamic interplay between active learning and student motivation, elucidating the elements that enhance the effectiveness of learning experiences.

3.1 Participants

The individuals involved in this research were undergraduate students who were currently undertaking the Drilling Fluids and Cementing course as part of their petroleum engineering program. The study encompassed a group of 24 senior-level students who had already completed internships and were advancing toward more specialized studies in the field of petroleum engineering.

The specialization in Drilling Fluids and Cementing within the petroleum engineering course holds significant importance due to its multifaceted contributions to the oil and gas industry. It ensures safety and environmental responsibility in drilling operations, enhances efficiency and cost management, safeguards wellbore stability, and protects reservoirs. This specialization equips students with the expertise needed to address crucial aspects of the industry, making it a vital component of petroleum engineering education especially in drilling operations.

3.2 Survey Questionnaire

A customized survey questionnaire was formulated for the purpose of gathering comprehensive data on various facets of student motivation and active learning. The questionnaire encompassed inquiries aimed at gauging students' familiarity with active learning, their prior encounters with active learning techniques, their levels of involvement during active learning exercises, and their perspectives regarding how active learning impacts motivation, experience, understanding abilities, and overall satisfaction.

To ascertain the questionnaire's reliability and validity, established scales and validated instruments were integrated whenever relevant. This meticulous approach not only elevates the caliber of the gathered data but also fortifies the trustworthiness of the study's conclusions.

The participants were given the survey questionnaire through the online survey platform MS Form. Before taking the survey, they received explicit instructions on how to complete it and were informed about the study's objectives. Furthermore, they were guaranteed that their responses would be treated with confidentiality and anonymity.

4 Results

The visuals presented in this section serve as graphical depictions illustrating the perspectives and experiences of the participants regarding active learning and its influence on experience, motivation, understanding and overall satisfaction.

Upon analyzing Fig. 1, the majority of the students (79.16%) strongly agrees that the content in Drilling Fluids and Cementing Technology was well-structured indicating a

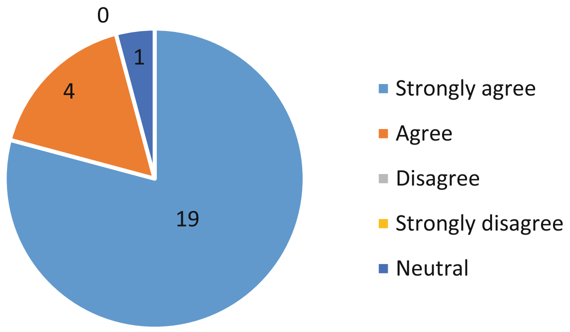

Fig. 1. Distribution of Responses for the Question "The course content in Drilling Fluids and Cementing Technology was well-structured."

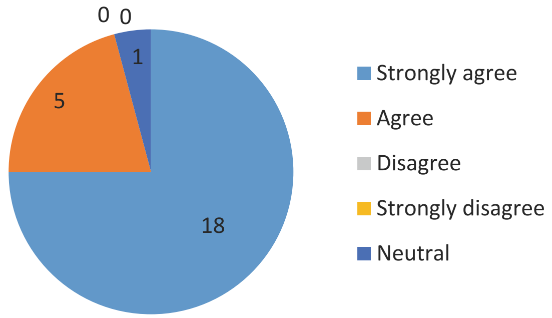

Fig. 2. Distribution of Responses for the Question "The course materials (e.g., textbooks, presentations) were helpful in my learning".

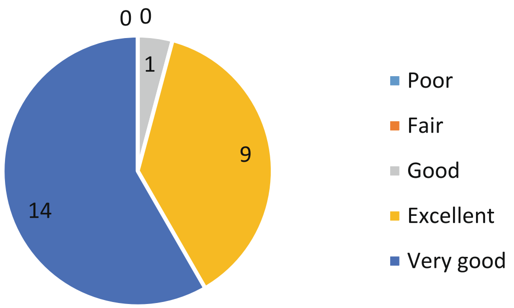

Fig. 3. Distribution of Responses for the Question "The instructor's experiences enhanced my understanding of the subject".

significant proportion with a reasonable experience of the learning materials. Meanwhile, 16.67% of them agree to the course content was well structured and a minority of 4% are neutral on the statement. The data from Fig. 1 suggests that the majority of respondents

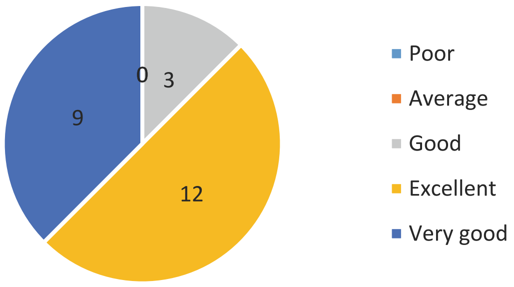

Fig. 4. Distribution of Responses for the Question "I felt motivated to actively participate in class discussions and activities".

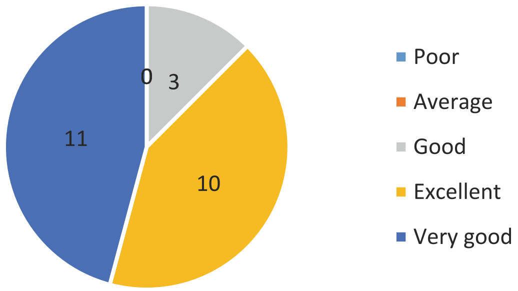

Fig. 5. Distribution of Responses for the Question "The teaching methods used in the course encouraged my engagement".

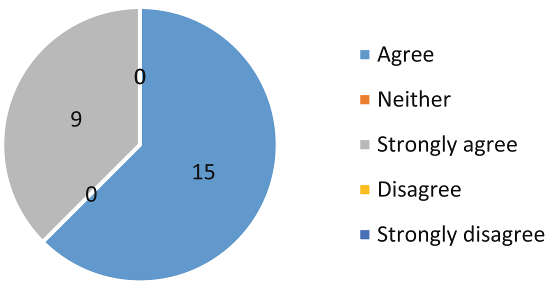

Fig. 6. Distribution of Responses for the Question "I have a clear understanding of the fundamental concepts in Drilling Fluids and Cementing Technology".

have at least agreed that the course content was well-structured. This finding highlights that the materials uploaded on the system are highly beneficial to the students.

Figure 2 synchronizes with Fig. 1 in which the majority, 75% of the total respondents, agree that the materials provided were very helpful in their learning. This result indicates that the materials uploading was organized, and it had been easier for them to understand and apply it in learning.

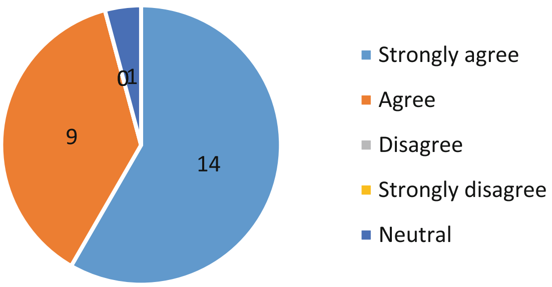

Fig. 7. Distribution of Responses for the Question "The course improved my problem-solving skills in this field".

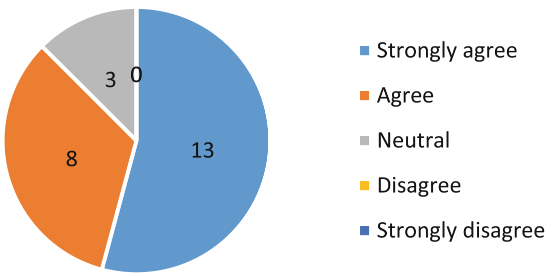

Fig. 8. Distribution of Responses for the Question "I feel confident in my ability to apply what I've learned in real-world scenarios".

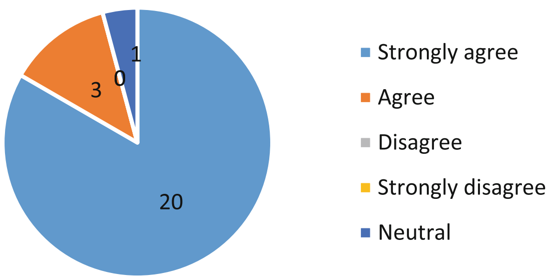

Fig. 9. Distribution of Responses for the Question "Overall, I am satisfied with the quality of education I received in Drilling Fluids and Cementing Technology".

Besides that, Fig. 3 depicts that almost everyone in the class (96%) extremely agrees that the instructor's experience had enhanced the knowledge of understanding on the subject matter. This explains that instructors operational experience especially in oil field highly valuable in relating the theory from the book to the real-life scenarios in the industry.

The findings have significant implications for teaching methods and instructional design. The data indicates that traditional lecture-based teaching can be improved by incorporating elements of active learning to boost student motivation. Instructors can

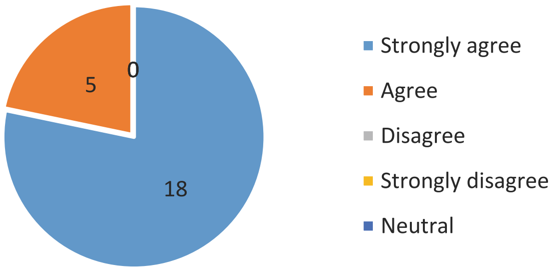

Fig. 10. Distribution of Responses for the Question "I would recommend this course to other students interested in the field".

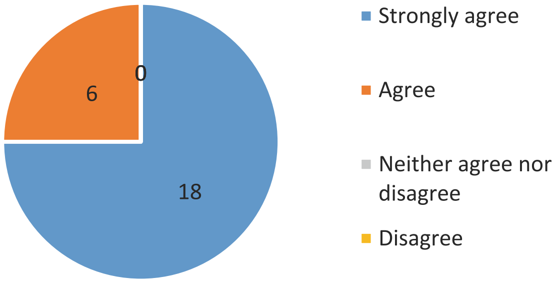

Fig. 11. Distribution of Responses for the Question "I believe the course has prepared me well for future courses or a career in this domain".

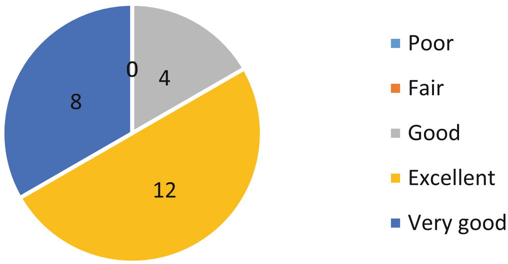

Fig. 12. Distribution of Responses for the Question "The course met my expectations in terms of depth and breadth of coverage".

enhance motivation and understanding by introducing opportunities for active participation, hands-on learning, collaborative activities, real-world relevance, and timely feedback. By creating a more dynamic and engaging learning environment through these methods, instructors can potentially increase students' motivation and facilitate a deeper comprehension of the subject matter.

Figure 4 explains that most of the class (87.5%) are highly motivated to actively participate in class discussions and activities. A handful of them (12.5%) are moderately motivated to participate in the class activities. Based on these results, it can be clearly seen that when students are given opportunities to share ideas among their peers, they get more excited and able to convey ideas rather than keeping quiet and working in silo. This indirectly encourages the students to confidently share their viewpoints and knowledge among their peers.

Figure 5 resembles the motivation that the students have in participating in the class activities. Around 87.5% of the class agreed that the excellent teaching methods used in the course encouraged my engagement in participating in class activities. Active leaning method of think pair and share has activated the courage in them to talk to their friends and share ideas of their knowledge. They were also able to defend their ideas by providing logical reasoning.

Figure 6 explains that all the students have a clear understanding of the fundamental concepts in Drilling Fluids and Cementing Technology. Here, students are exposed to laboratory equipment and experiments carried out to enhance the basic understanding of drilling fluids and cementing. Students also participated in site visits where the well experiences mud engineers explain the fundamental theories and given hands on experience to run the laboratory testing.

Figure 7 shows that 97% of the total participant agrees that the course improved their problem-solving skills in this field. A minority of 3% stay neutral on this understanding. It shows that collaboration with their peers, risk assessment, and continuous learning are key aspects of effective problem solving. Documentation of the problem-solving process is crucial for knowledge sharing and learning from past experiences. As the industry evolves, ongoing training and education play a vital role in ensuring that professionals have the necessary tools and knowledge to address real-world challenges, ultimately contributing to the safe and efficient construction and maintenance of oil and gas wells.

The confidence of students in applying what they have learned to the real-world scenarios can be seen from Fig. 8. Almost 87.5% of the senior students who will be graduating soon have confidence in facing the challenges of the outside world meanwhile a handful of 12.5% are still skeptical about it. This is due to the reason that either they are passive students who are interested in working alone or they are not excited to participate in active learning.

Figure 9 and Fig. 10 shows the overall satisfaction of the students which is 96% in the quality of education that they have received in drilling fluids and cementing technology subject and the same percentage would recommend this course to their friends to be taken in future. This explains the experience, motivation and understanding of students which incline to the active learning methods that have been applied in the teaching.

On the other hand, Fig. 11 and Fig. 12 explain that 100% of the students believe the course has prepared them well for future courses or a career in this domain and met their expectations in terms of depth and breadth of coverage. These findings underscore the importance of both active learning and traditional lecture-based approaches in facilitating a comprehensive comprehension of the subject matter. It's worth noting that none of the participants indicated that active learning strategies had a minimal or no effect on their motivation to learn. These results not only underscore the motivational advantages linked to active learning methods but also accentuate their potential to significantly boost overall student motivation for learning.

5 Conclusion and Recommendation

The study's findings provide valuable insights into various aspects of educational approaches and student motivation. Firstly, a significant number of respondents exhibited a reasonable understanding of active learning approaches, indicating their potential for effective integration into educational settings. The research also highlights that active learning is already being implemented to a considerable extent in educational environments, with many respondents regularly exposed to these methods. Furthermore, while a general lack of strong motivation was observed, none of the respondents reported a complete absence of motivation, suggesting a baseline level maintained by lecture-based approaches.

Secondly, active learning strategies were associated with higher levels of motivation, with a notable proportion of respondents expressing heightened motivation during active learning sessions. Increased engagement with the material emerged as a key contributor to motivation during active learning, emphasizing the importance of creating an engaging learning environment. Traditional lecture-based approaches were also shown to benefit from incorporating elements of active learning to enhance motivation and engagement, with the majority of respondents experiencing significantly higher engagement during active learning sessions.

Drawing from these findings, several recommendations can be proposed to advance instructional approaches and foster student engagement and motivation. These recommendations include integrating active learning strategies into teaching practices, offering supplementary support for students who may struggle with traditional lecture-based approaches, infusing elements of active learning into traditional lectures, delivering well-structured and understandable lectures, combining active learning and traditional lectures for a comprehensive understanding of the subject matter, and monitoring student performance to provide targeted assistance for those transitioning from traditional to active learning strategies.

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Enhancing Control System Education: Leveraging Video-Aided MATLAB/Simulink Laboratories

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Abstract. This paper presents a transformative approach to enhance control system laboratory education by leveraging video-aided MATLAB/Simulink resources in an open-handed lab environment, reducing reliance on graduate assistant intervention. Students are guided to acquire MATLAB skills through the Onramp online course and supplemented with course-specific videos, empowering them to independently model and simulate control systems. This innovative approach combats issues of unequal participation and knowledge-sharing found in traditional group labs. Comparative analysis of results from two semesters demonstrates improved overall performance and equitable assessment outcomes. This research contributes to the evolution of technology-enhanced learning and empowers students for more independent and successful project work in control systems.

1 Introduction

In the ever-evolving landscape of teaching and learning, it is imperative to adapt to new methodologies that not only engage students but also foster their independent problem-solving abilities (Chick et al. 2008). This paper delves into the realm of control system laboratory delivery, with a particular focus on how Video-Aided MATLAB/Simulink can be harnessed to create a more self-sufficient, equitable, and effective learning environment. By eliminating graduate assistant intervention and employing an open-handed lab approach, we aim to empower students to take ownership of their learning.

This endeavor finds its roots in the recognition that traditional teaching models often unintentionally foster uneven participation, as Vygotsky (1978) highlighted in 'Mind in Society,' where the students tend to rely on a few 'experts' within their groups, resulting in an imbalanced understanding of course material. By incorporating resources like the MATLAB/Simulink Onramp online course and targeted supplementary videos, we guide students toward mastering essential MATLAB skills, bridging the gap between theory and application via principles of active learning as advocated by Bonwell and Eison (Bonwell and Eison 1991).

In an empirical effort to substantiate the effectiveness of this approach, we conducted a comparative analysis of student performance between two semesters. The results from

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September 2021 showed a significant disparity, with an average of 94% in lab marks and only 69% in project marks. In stark contrast, the implementation of the Video-Aided MATLAB/Simulink method yielded promising results, with a lab marks average of 92.5% and a substantial improvement in project performance to an average of 79%.

This paper contributes to the ongoing dialogue surrounding technology-enhanced learning in higher education, emphasizing the importance of student autonomy and equitable learning outcomes. Siemens (2005) has proposed the concept of connectivism, which underscores the importance of leveraging technology for learning in the digital age. As the landscape of education continues to evolve, it is vital that we explore innovative teaching strategies that empower students to become active and self-reliant learners.

2 Methodology

In pursuit of an enhanced control system laboratory delivery, the methodology includes a crucial step where students are asked to complete the MATLAB/Simulink Onramp courses online before they embark on the laboratory sessions as shown in Fig. 1. This deliberate move is intended to establish a common foundational understanding among students, providing them with essential MATLAB/Simulink skills as a prerequisite to the hands-on lab work. This initial step sets the stage for a more effective and engaging learning experience throughout the subsequent labs and the overarching project.

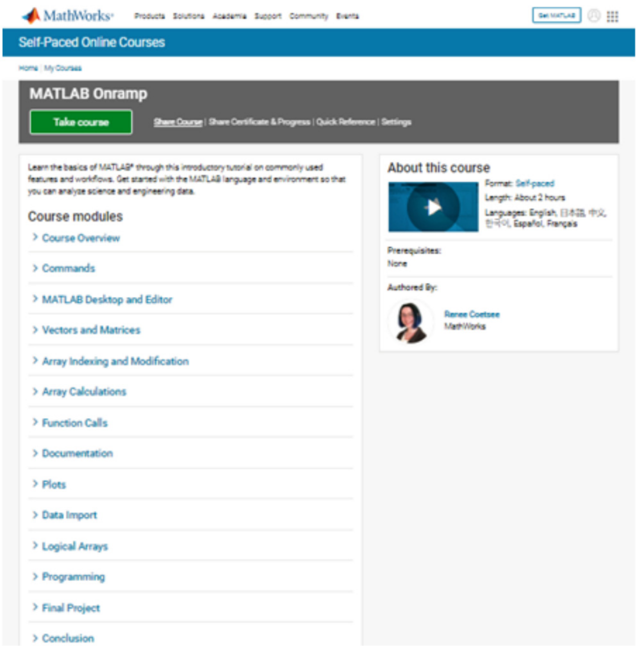

Fig. 1. The MATLAB Onramp course overview.

The methodology begins with the selection of four major topics within control system engineering: Basic Control System, Time Response, Root Locus, and Frequency Response. These topics are chosen for their foundational importance and relevance in control system theory, and they serve as the building blocks for deeper understanding.

The development of laboratory materials for each topic involves a comprehensive approach, incorporating theoretical content, practical exercises, and MATLAB/Simulink simulations. This carefully structured content guides students through a progression of learning, moving from theory to practice. Each lab is designed with a theoretical introduction, hands-on exercises, problem-solving opportunities, and self-assessment components, all aimed at nurturing a solid grasp of control system concepts. The lab will be supplemented with video-aided MATLAB/Simulink tools to increase students' knowledge of the content as shown in Fig. 2.

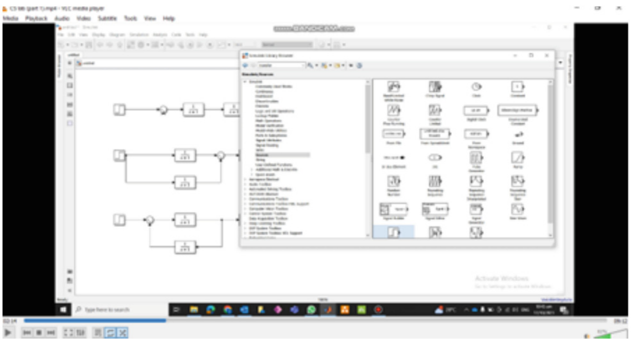

Fig. 2. The Video-Aided MATLAB/Simulink Laboratories.

The apex of this methodology is the extensive project that challenges students to apply their knowledge in a real-world context. Specifically, students are tasked with designing, building, setting up, and debugging a closed-loop control system for a solar water heater, complete with a valve and heat exchanger as shown in Fig. 3. The addition of a controller or compensator to improve system performance is a critical component of the project, and students are required to justify their choice based on principles learned in the prior labs.

Assessment and evaluation mechanisms, including quizzes, lab reports, and project evaluations, are utilized to gauge student performance and understanding. Data from these assessments are analyzed to assess the effectiveness of the Video-Aided MATLAB/Simulink approach in enhancing students' comprehension and problem-solving capabilities.

Throughout the process, student feedback is collected to further refine and iterate upon this teaching methodology, ensuring its responsiveness to the evolving needs of students in a technology-enhanced learning environment. In essence, this methodology seeks to empower students with a strong foundational understanding of MATLAB/Simulink, equipping them with the skills to effectively model, simulate, and control complex systems within the framework of technology-enhanced learning.

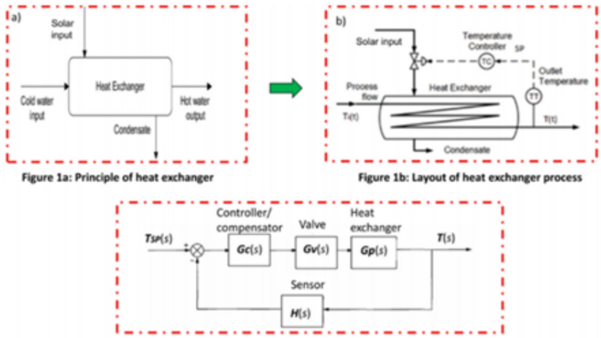

Fig. 3. The block Diagram for Control System project overview.

3 Result and Discussion

The implementation of a Video-Aided MATLAB/Simulink approach in the control system laboratory, coupled with the integration of an open-handed lab structure, has yielded notable improvements in student learning outcomes and program attainment. The results obtained from the September 2021 and May 2023 semesters provide insights into the effectiveness of this innovative teaching method.

3.1 Improvements in Lab and Project Performance

In September 2021, a total of 158 students participated in the control system laboratory, and the results indicated a substantial disparity between lab performance and project outcomes. The lab marks, which were traditionally high at an average of 94%, contrasted with project scores averaging at only 69% as shown in Fig. 4. This difference was attributed to issues arising from uneven group dynamics and knowledge-sharing practices, where a few students tended to dominate discussions, leaving others with limited opportunities to engage with and comprehend the material.

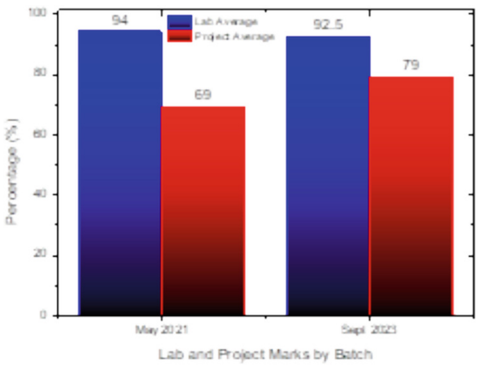

Fig. 4. The average results obtained for Laboratory and Project assessment.

However, the introduction of the Video-Aided MATLAB/Simulink approach in May 2023 led to marked improvements in both lab and project performance. Lab marks remained high, with an average of 92.5%, while project scores experienced a significant boost, averaging 79%. This enhancement suggests that the Video-Aided MATLAB/Simulink approach succeeded in leveling the playing field, allowing students to better grasp the subject matter and apply their knowledge effectively.

3.2 Enhanced Course Outcomes and Program Attainment

Furthermore, an analysis of course outcomes and program attainment over the two semesters revealed notable improvements. The shift to the new teaching methodology resulted in a substantial increase in both course and program outcome attainment. This suggests that students in the May 2023 semester not only performed better in their individual course components but also demonstrated a more comprehensive understanding of control system engineering (Fig. 5).

These results signify a substantial pedagogical achievement in the context of technology-enhanced learning. By integrating online learning resources and promoting individual problem-solving skills, the approach has shown promise in increasing student engagement and achievement in control system laboratory settings.

The substantial improvements observed in this study can be attributed to the effective fusion of technology-enhanced learning tools, such as MATLAB/Simulink Onramp and video resources, with a well-structured open-handed lab environment. This combination empowers students with a common baseline of MATLAB skills, thus reducing the reliance on graduate assistant intervention and promoting equitable learning experiences.

The findings align with the principles of active learning, where students are encouraged to actively engage with the material and take ownership of their learning process (Bonwell and Eison 1991). The Video-Aided MATLAB/Simulink approach facilitates a student-centered learning experience, enabling individuals to progress at their own pace and fostering independent problem-solving skills (Vygotsky 1978). The use of self-assessment components within the labs reinforces these principles, allowing students to reflect on their understanding and address knowledge gaps (Chick et al. 2008).

The improvement in project outcomes can be attributed to the successful integration of theory and practice. This aligns with Anderson and Krathwohl's revised Bloom's Taxonomy, which emphasizes higher-order thinking skills and practical application as essential components of a comprehensive education (Anderson and Krathwohl 2001). The project-based approach encourages students to apply theoretical knowledge in a practical context, mirroring real-world engineering challenges.

The findings also support the connectivist learning theory, as proposed by Siemens (2005), which highlights the importance of creating learning environments that foster connections and networks. The Video-Aided MATLAB/Simulink approach promotes collaborative learning through shared video resources, while the open-handed lab structure reduces free-rider issues and encourages equitable participation.

No.	CO Category	CO average >65%	CO pass rate >90%	Status
1	CO1	67.2	94.3	Pass
2	CO2	63.9	84.0	CQI
3	CO3	82.9	94.3	Pass
4	CO4	62.9	86.0	CQI

(a)

No.	CO Category	CO average >65%	CO pass rate >90%	Status
1	CO1	67.6	100.0	Pass
2	CO2	65.3	85.6	Pass
3	CO3	79.1	100.0	Pass
4	CO4	77.5	99.9	Pass

(b)

Fig. 5. (a) Course Outcome Sept 2021 vs (b) Course Outcome May 2023 batch

4 Conclusion

In the pursuit of enhancing control system laboratory delivery, the integration of Video-Aided MATLAB/Simulink in an open-handed lab environment has proven to be a transformative and highly effective teaching approach. The results and discussions presented in this paper underscore the positive impact of this innovative methodology on student learning outcomes, equitable participation, and program attainment.

By guiding students to complete the MATLAB/Simulink Onramp online course as a preliminary step, we ensured a common foundational understanding, setting the stage for a more productive and engaging learning experience. The development of well-structured laboratory materials, coupled with a sequence of carefully designed labs, helped students progressively build their comprehension of control system concepts. The introduction of an extensive project, challenging students to design and implement a closed-loop control system for a solar water heater, further solidified their knowledge and problem-solving skills. The addition of a controller or compensator component allowed them to apply their learning to a real-world context.

The remarkable improvements in both lab and project performance, with lab marks averaging 92.5% and project scores rising to 79%, signify the success of the Video-Aided MATLAB/Simulink approach. This approach successfully addressed the issues of uneven group dynamics and knowledge-sharing, leveling the playing field for all students and allowing them to apply their knowledge more effectively.

Furthermore, the increase in course outcomes and program attainment from September 2021 to May 2023 reflects the comprehensive understanding and improved performance of students in the control system engineering discipline. This approach not only fosters individual skill development but also contributes to broader program objectives, aligning with the principles of technology-enhanced learning.

In conclusion, the results and discussions in this paper validate the potential of technology-enhanced learning to empower students and promote equitable educational outcomes in the field of control system engineering. The integration of Video-Aided MATLAB/Simulink, along with an open-handed lab structure, supports the principles of active learning, collaborative knowledge acquisition, and practical application, all essential components of a modern, effective educational approach. This teaching methodology stands as a testament to the possibilities of innovation in pedagogy, promising to revolutionize control system laboratory delivery and, potentially, other fields in higher education. It is a model for harnessing technology to create enriched, autonomous, and equitable learning experiences.

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Industrial Engagement Activities to Gain the Skill of Final Year Student in Rockphysics Subject in Geosciences Department-UTP

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Abstract. The roles of industry and academia are inseparable. RockPhysics which the final-year students of the Geoscience Department of UTP take, is the cutting-edge science in the oil and gas industry, especially the oil and gas exploration. The courses are designed to engage constructive interaction between the students and the industry. Therefore, a mixed learning method between flipped classroom, blended learning, and problem-based learning was conducted. The industries and practitioners were invited to cooperate in the form of donating Rock Physics software that was used to solve daily industry problems, training, and adjunct lectures. The evaluation was conducted, which included the students explaining how to use the software they had learned to solve real industry problems in a short video. The expected output of the applied strategy in teaching and learning is being able to complete the Course Learning Outcome (CLO) and gaining the skills of the student. With this experience, students are expected to be more confident to graduate and become experts in the field of Geoscience, especially Rockphysics subject. In addition, industry recognition in the form of a certificate of completion was given to the student who had completed this learning. Later, this certificate can be used as an additional value when they apply for job.

Keywords: industry engagement · problem-based learning · blended learning · higher education · academic outcomes

1 Introduction

Students who are in their final year of university studies frequently struggle with issues like excessive academic pressure brought on by workload and a lack of time to complete assignments. In certain universities, undergraduate students are required to complete a final year project or thesis in addition to taking other classes, sometimes even a capstone course, all in the same semester. On the other hand, some students worry about their future careers when the time comes for them to join an organization and begin their careers. They may wonder if the skills they developed throughout their university studies are sufficient to function in the actual workplace.

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Similar circumstances apply to final-year students in geosciences departments at Universiti Teknologi PETRONAS (UTP). The capstone project and additional subjects must be taken during the final year semester, together with the thesis reporting and VIVA. One such subject is Quantitative Interpretation (QI) and Rockphysics, which is closely related to the competence needed for students who will begin their careers in the Geosciences industry.

The expected outcome from this subject is that student after this course, the students fully understand the theory behind it, such as rock physics in general, seismic data, well data, complementary data, quantitative interpretation or QI operation, and its workflow. It is also expected that students can perform and solve rock physics problems using commercial software that usually been used by industry companies. This is very crucial as the outcome of this course is to make students industry-ready, either theoretically or practically.

At least two things are most challenging in introducing this kind of subject such as QI and Rockphysics to final-year students. Besides the need to achieve the Course Learning Outcome (CLO), also how they could get more confidence when they graduate and have something that they can use for job application later.

2 Methodology

2.1 Teaching and Learning Activities

The Teaching and Learning (T&L) activities have been applied to handle this subject first the student attended the theoretical class with the lecturer. This class covers the whole area of the rock-physics and quantitative interpretation topics. After that, the students attended a self-learning class that was provided by an engaged company which taught the students about commercial software (RokDoc software). To enhance the knowledge of the students, Adjunct lecture/s were conducted by inviting experts from the industry. We tried to engage as much as we could the industrial support, and other workshops on other commercial software were conducted to make students more familiar with various industrial software. At the end of the workshop, students were tasked to apply their knowledge and skills to solve the real problem given by using commercial software they had learned. Students need to report their findings through a short video that needs to be uploaded to a YouTube channel. Other soft skills are expected to be raised by making a short video and uploading it on social media. To put it simply, the rock physics class is divided into 3 activities for the learning process, such as theory learning in class, implementation activity, and adjunct lecture from the company as a bridge that correlates the theory in class and the implementation by using the real case problem that often arises in the industry world. The flow of teaching and learning activities is summarized in Fig. 1.

The learning model from this case study seems to be a combination of blended learning and flipped classroom [1, 2]. Blended learning is a model that integrates face-to-face and online learning activities, while the flipped classroom is a model that reverses the traditional order of instruction and practice. Furthermore, the students also did problem-based learning by following the process to solve the problem that was included in the video [3]. The problems that were given are related to real cases such as,

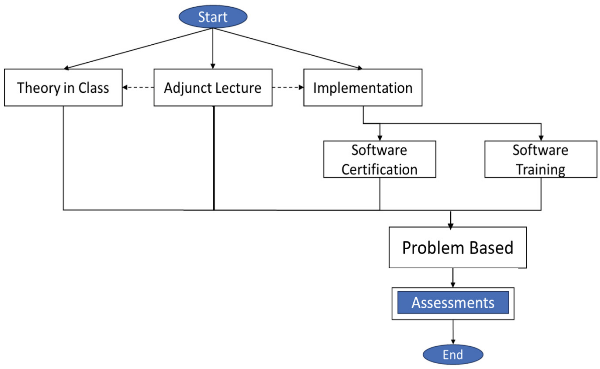

Fig. 1. Summary of Teaching and Learning Activities

- How to properly input and process the data such as well and seismic data.
- How to make a feasibility study using rock physics techniques.
- How to calculate the elastic and reservoir properties from well data.
- How to perform an inversion process using well and seismic data.
- How to delineate reservoir and optimize the drilling location based on rock-physics and quantitative interpretation.

2.2 Adjunct Lecturer from Company

As for the sharing of knowledge from the industry practitioner, an adjunct lecturer from an industry company was also invited. An expert from the industry such as UMD Petroleum Sdn Bhd was invited to give the lecture. This company's focus is on the upstream business venture, particularly in exploring oil and gas asset opportunities and acquisitions. This company is very expert and has many experiences in rock physics topics. Regarding oil and gas exploration and production, rock physics plays a crucial role in understanding the physical properties of subsurface rock formations. It helps in predicting the behavior of reservoir rocks, including their porosity, permeability, and elasticity, which are essential factors for successful exploration and production operations. The sharing session through adjunct lectures from the company such as UMD Petroleum Sdn Bhd was a very good opportunity for the students to learn from the expert directly, not just the theory of rock physics but also real case problems that usually arise during real operations, and how to connect the correlation between rock physics theory and its real application on the field.

2.3 Software Certification

Engagement with the industry to get a software certification also has been done on this T&L subject. We have engaged with the Ikon Science company to conduct these activities. The software being used is RokDoc which is a software donation from this company. Software RokDoc is one of the leading-edge software in the industry currently. Its ability to perform detailed rock physics calculations to answer many real industry-level problems. This software is focused on Rock physics and Quantitative Interpretation. Ikon Science generously shares the software license to the academics which narrows the gap between student academic understanding and the industry needs. In addition, Ikon Science also provides a self-E-learning module for the students to study from the start until they can solve real problem cases. At the end of the E-Learning module completion, the student will receive a completion certificate awarded by this company. This opportunity is valuable for the students to improve their cognitive and practical knowledge. Furthermore, by familiarizing themselves with the widely known software in the industry, the final-year students will have more confidence to apply for a challenging job.

2.4 Other Software Training

To support student skills, other software training by the company is also conducted. One of these programs is introducing the other software related to the subject. The Decision-Space program, or DSG, was introduced. This software was provided by Halliburton as a software donation for UTP as well. DSG software is a complete software package for the upstream oil and gas sector. The reservoir characterization, drilling, production, and reservoir management processes are all streamlined by this program, which covers many areas of exploration and production activities. In this training, the student was also assisted with detailed instructions and troubleshooting for this software. It is also important to familiarise the learner with the program because it is outstanding and utilized by many firms. The benefit of this software training is that it teaches students how to use the newest and most cutting-edge software tools and technologies for interpreting and analyzing rock physics and enables students to get actual knowledge and experience utilizing the program on scenarios and data sets from the real world.

2.5 Problem-Based Solving

To complete the assessment, together with the other type of assessment, students were given the real problem to be solved using the commercial software that they already thought.

In the final output of the problem-solving, students were instructed to report their findings in a short video. The video content consists of an explanation of the method used and the step-by-step on performing the selected software to solve the problem. The students need to participate in each part of the video to showcase their understanding of the topics. Thus, the finalized video will be uploaded to the YouTube platform as reference material for the students themselves.

3 Result and Discussion

3.1 Industrial Engagement through Industrial Software Training

In this software training, interaction between the instructor and the students is crucial to promoting efficient learning. A dynamic exchange of thoughts, stories, and information occurs throughout this engagement. The practitioner interacts with the students, providing a cooperative atmosphere where inquiries are welcomed, and knowledge is exchanged. This interaction's capacity to troubleshoot and address practical issues with both the program and the taught theoretical ideas is an essential component. Students benefit from having more practical problem-solving abilities as well as a greater comprehension of the material. Furthermore, conversations centered on the theory and its use in the program are crucial to the learning process. These talks help students fill the gap between their theoretical understanding and its application in real-world situations, establishing a thorough understanding of the subject. In a workshop context, practitioner-student contact essentially takes the form of a dynamic, varied process that improves the educational process and gives students the tools they need to succeed. Figure 2 shows an example of software training activities conducted on this subject. Each student has one PC to explore their capability.

Fig. 2. Software training activities.

Exposure to various software tools and techniques that are employed by the sector for the quantitative interpretation of rock physics. This aided them in putting what they had learned in theory into practice and gaining practical experience. The interaction between instructors and students is essential to learning. Students will gain a thorough understanding of the software's use in the field of rock physics as well as specific insights thanks to this dynamic exchange of information. Instructors are heavily involved in assisting students to efficiently explore and utilize the software's capabilities for rock physics studies.

The interactive training sessions are purposefully created to provide an immersive and hands-on learning environment by allowing students to apply their newly acquired information to real-world settings. Students are given the knowledge and confidence to effectively use industrial software such as RokDoc, Hampson Russel, and DSG software in the context of rock physics studies thanks to this mix of active contact, in-depth software coaching, and interactive seminars. From the standpoint of the student, industrial software training proved to be an educational experience. It gave participants a thorough comprehension of the program as well as useful abilities that they can now use with assurance in rock physics. It was emphasized how important it was for students to actively engage with knowledgeable teachers since this allowed them to ask questions, get answers to their inquiries, and learn more than what was available in textbooks. Additionally, the workshop's hands-on method, which involved using the software in actual-world circumstances, was quite successful. Students' confidence in using that industrial software for analyses and simulations of rock physics was increased in addition to their comprehension being strengthened. Overall, industrial software training has given students the information and abilities they need to succeed in their future endeavors in this profession in addition to broadening their knowledge.

Industrial engagement to give some benchmarking through certification on the process of T&L related to the skill through e-learning access provided. Students are given access to the E-Learning provided by Ikon Science. The certification of the e-learning completion certificate also served as documentation of their abilities and expertise when they applied for jobs. This improved their chances of being employed and raised their confidence. An example of the completion certificate awarded by Ikon Science to the student who completed the module is shown in Fig. 3.

Fig. 3. A completion certificate awarded by Ikon Science

3.2 Industrial Engagement through Adjunct Lecture

The interaction between professionals in the field or seasoned employees and students during a rock physics adjunct course is quite beneficial. It builds a link between theoretical understanding and practical implementation. Sharing real-world case studies during these sessions gives a practical dimension to academic learning. Sharing their expertise, industry experts demonstrate how the ideas covered in class are put to use in practice. Incorporating these case studies into the course material makes the complex concepts of rock physics more relevant and interesting for the students. Additionally, lively debates between professionals in the area and students enhance the educational process and enable a closer examination of the complexities within the discipline of rock physics. These discussions foster critical thinking and offer insights (Fig. 4).

Students' confidence in their ability to comprehend the issues faced by industry is also increased. Critical thinking, problem-solving, and communication skills are all actively developed during this process and are essential for success in the workplace. Students learn to bridge the gap between academic knowledge and practical application,

Fig. 4. Online Adjunct Lecture by Industry

generate creative solutions, and communicate effectively, giving them the skills, they need to succeed in their future employment.

3.3 Output

As part of the assessment, the student was instructed to create a step-by-step video on solving several study cases relating to QI and Rock Physics subject. Their video should consist of the introduction of the theory behind the selected study case, the methodology of how to solve the problem, the solution to the problem, findings, and conclusion and recommendation. The explanation of the theoretical aspects needed to be accompanied by suitable references which introduced the students to presenting scientific with citations. The explanation regarding the methodology should include the workflow they are used to solve the problem and software interface workflows. The result was also accompanied by related papers which having similar study cases. It showed their understanding of the method and the interpretation of QI and Rock Physics. At the end of the video, the student also gave feedback based on their experience in the whole semester. By finishing the video task, the student developed the knowledge of Anderson-Bloom Taxonomy [4]. By participating in this subject, the students received many benefits, such as exposure to different software tools and methods that are used by the industry for rock physics and quantitative interpretation. This helped them to apply what they had learned in theory to practice and gain hands-on experience.

Moreover, they demonstrated their deep understanding of the subject by creating a video that was used by the next year's students. Hence, this also improved their self-esteem and pride in their work, as they were able to produce impactful and useful products that could help others learn [5, 6].

Furthermore, the students gained more confidence in understanding the problems and challenges of the industry from the sharing of knowledge and experience by the practitioners. This developed their critical thinking, problem-solving, and communication skills that were essential for working in the industry [7]. In addition, the certificate of completion of the e-learning served as proof of their skills and knowledge when applying for a job. It is expected can increase their chances of getting hired and boosted their confidence.

4 Conculsion

By conducting a mix of teaching methods such as flipped classroom, blended learning, and project-based learning with industry engagement we expected could provide better learning environments for the Rock Physics students. The Rock Physics students who were final year students could receive many benefits that could deepen their understanding of the course, and in the end also produce a very praiseworthy final product. In addition, by following this subject they could receive certificates of completion. This certificate could be useful when they apply for a job.

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Author Index

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