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Usage of Semiconductor Interactive Learning Application (SemIL App) in Electronics Subjects

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Abstract

The changes in today's world that have entered the era of industrial revolution 4.0 have led to all aspects of human life becoming increasingly dependent on digital technology. At a time when the threat of the Covid-19 Pandemic hit and changed the strategy of education services, mobile applications are seen to be able to provide a solution to a more viable learning method against the current worsening situation. Smartphones are the device of choice for teaching and learning (PdP) because they are comfortable and easy to carry anywhere. Although there are various other platforms such as WhatsApp, Telegram, Google Classroom and others, but access to the Internet sometimes makes it difficult to access learning materials for students. Based on this, the idea to develop a SemIL Application came about when there were students who did not get the notes or learning materials that were delivered.

Keywords **:** *Application; Electronic Subject; SemIL Apps; Semiconductor*

I. INTRODUCTION

The usage of mobile applications is a must because it is not focused on communication only, even the education sector is required to use smartphones and laptops because it has shifted to M-Learning [1]. According to [2], the highlight of the study concludes that learning based on mobile learning can solve problems in learning, especially Mathematics. The focus on using App Inventor to develop applications is seen to help self-learning. [3] stated that the existence of Android open source allows m-learning applications to be built. As a result, students can access archived final exam questions regardless of time and location.

In fact, according to [4] study, students appreciate mobile learning as an approach and significantly increase their motivation and create a positive effect on academic achievement and performance. In conclusion, [5] stated that android-based mobile devices are the choice of many people because of good performance, availability of connections, application support at reasonable prices and are learning media that are easily accessible anywhere and anytime using M-learning.

II. LITERATURE REVIEW

Based on previous studies, there are several issues that highlight the use of applications among which Uys in [6] stated that students spend almost 16 hours a day on the use of smartphones but most of the time is intended to interact with friends and there is no data on the use for learning purposes. Norliza In [7] stated that the level of readiness and suitability of mobile learning is at a high level. But based on [8], students' willingness to accept mobile devices is an issue because it distracts students from learning. Even in higher education, there are challenges in terms of internet access, censorship by university and economic issues. But according to Arokiasamy in [9], to face the challenge, mobile devices play an important role in increasing access to education in Malaysia and globally.

The research findings of [11] concluded that the perception of usefulness and ease of use of the application has a correlation in influencing the use of additional mobile application-based learning materials. According to Park & Lee in [12], study respondents have around 80 mobile applications and only 16% are used directly for learning. Thus, based on the study of [13], to integrate any technology meaningfully into education, developing content and platforms for use must be a requirement that meets the instructional design approach.

A. Objective & Hypothesis

The objective of this study is focused on students' perception and motivation towards the interactive application that is SemIL Application in the subject of

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Electronics. In order to achieve this objective, research questions as below have been formulated:

1.What is the student's perception of the usability of SemIL applications in electronic subjects?

2.What is the level of student motivation to apply SemIL in electronics subjects?

3.To what extent do student perceptions influence student motivation towards the use of the SeMIL application in electronics subjects?

The null hypothesis (Ho) resulting from research question 3 is there is no statistically significant relationship between the mean of perception and the mean of students' motivation towards the use of the SeMIL application in electronic subjects.

B. Digital Application Based Learning

According to Posnik-Goodwin in [14], students are Generation-Z that is digital native will be excited to try something new, learn creatively, have fun and think outside the box. Thus, according to [7], mobile applications such as smartphones and tablets stimulate student involvement in knowledge-oriented activities and motivate self-learning because they are flexible. The use of devices in line with the wave of 21st century technology opens the opportunity for educators to build applications for additional learning modules. Based on this, the potential use of mobile applications in PdP Electronics subject can trigger the fun of learning and improve students' mastery of cognitive and psychomotor aspects.

According to Robiatul and Halimah in [11], positive student behavior results when teachers use digital teaching aids, compared to conventionally using picture cards and textbooks. Additionally, according to [15], learning based on digital games is more fun and can increase motivation and interest in learning, even making PdP more interesting. In fact, in addition to virtual face-to-face applications, interactive applications are more interesting and different from regular teaching.

D. SemIL Application Interface

App Inventor is not a software that is based on writing complex code, instead it designs Android applications visually. App Inventor uses the block concept to determine the functionality of the application to be designed. This SemIL interface results from the drag and drop method of visual objects to create an application that can be opened on the Android system. Once the design is complete, the application will be uploaded on the smartphone. In short, this SemIL Application is very easy to use where users can access the information in this application on mobile phones based on the following methods:

C. SemIL Application Development

The SemIL Application was developed to help students understand semiconductor theory, master component testing methods and apply semiconductor measurement practices using smartphones. Students will use this application to improve their understanding of the learning process of the subject of Electronic Devices and Semiconductor Devices. This application is built without using any financial cost. This is because it is developed using MIT App Inventor software which is open source and suitable for windows and android platforms. This makes it easy for users to install the SemIL application on a desktop computer or phone. This application can also allow users to explore the objects provided as well as cultivate critical skills, collaborate and adapt to the development of learning. Based on Figure 1, the characteristics of mobile applications are adapted from the study of [16].

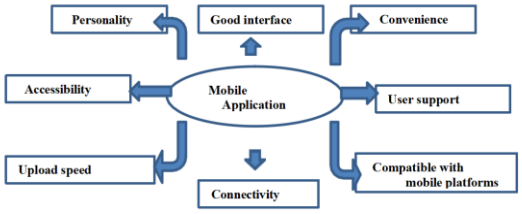

Figure 1 Mobile application features in general

i.The user needs to install the SemIL Application to the mobile phone and open it

ii.The user needs to allow the application access to the mobile phone.

iii.Users select the desired subtopic by pressing the link button

iv. Learning materials are produced in the form of notes, videos, demonstrations and others.

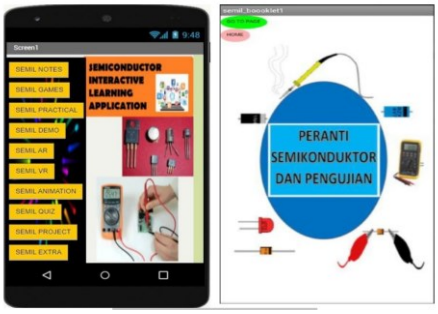

Figure 2 SemIL Application Interface

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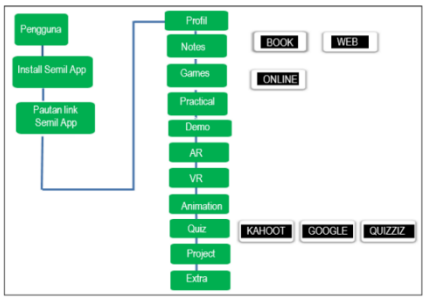

Figure 3 *SemIL application interface*

III. RESEARCH METHODOLOGY

A. System Development

The development of this application system is aimed at the needs of interactive learning materials and makes it easier for students to access references using smart phones. This application saves costs because it does not require a thick sheet of notes and can be used as an e-module. The development of e-modules as digital literacy media in 21st century learning makes it move in tandem with Information and Communication Technology (ICT). SemIL changes the tradition of teacher-centered learning to student-centered learning. The atmosphere in the lecture room also demands physical changes that meet the aspirations of today's generation.

B. Data Collection and Surveys

Data collection from libraries and online open sources was chosen as a method of obtaining reference sources and information related to mobile applications and smartphones in education. This method is also used to find research information related to this field of study and to find recommendations for future studies A simple survey technique was chosen to be implemented to get student feedback about the potential use of this SemIL application.

C. *Study Design, Instrument and Sample*

The research design is a simple survey technique to obtain quantitative data. The research instrument consists of questionnaires for the purpose of data collection. The sample of the study is Electrical and Electronic Diploma students who have taken the electronics subject as many as 20 students.

IV. RESULT & DISCUSSION

A. *Results*

Research Question 3: To what extent do students' perceptions influence student motivation towards the use of SemIL applications in electronic subjects? Pearson's correlation analysis was used to find out the strength or height of the relationship between the mean of perception and the mean of students' motivation towards the use of the SemIL application in electronic subjects. Table 1 shows the correlation of perception with student motivation. The results show that the results of the correlation value between the perception and motivation variables have a very weak positive linear relationship where the motivation variable will increase if the perception variable increases.

Table 1 Correlation of Student Perception and Student Motivation

	Mean Perception	Mean Motivation	Conclusion
Perception Mean Pearson Correlation Sig. (2 ends) N	1 20	.066** .781 20	pp ≠ 0 (HO rejected) There is a statistically significant relationship
Mean Pearson Correlation Motivation Sig. (2 ends) N	.066** .781 20	1 20	

B. *Discussion & Suggestion*

This SemIL application can help explain concepts related to semiconductor components where students can make connections between theory and material provided in the application through the digital content method. Indirectly, students will not only be able to master cognitive and psychomotor aspects, but also be more confident in handling semiconductor components in the workplace. The following are the results of the analysis obtained from the distribution of questionnaires.

Table 2 Perception student toward usability of SemIL Application

Question	Analysis results
1.	9 respondents (45%) strongly agree, 9 (45%) agree and 2 (10%) moderately agree that the SemIL application (SemIL App) is easy to operate and user-friendly
2.	5 respondents (25%) strongly agree, 10 (50%) agree and 5 (25%) moderately agree that the SemIL application (SemIL App) does not burden students because it is easily accessible and the time of use is flexible
3.	8 respondents (40%) strongly agree, 7 (35%) agree and 5 (25%) moderately agree that the SemIL application (SemIL App) requires a short time to be mastered and it is easy to get help from others when facing difficulties using it
4.	5 respondents (25%) strongly agree, 11 (55%) agree and 4 (20%) moderately agree that the SemIL application (SemIL App) is effective for the latest teaching and learning sessions
5.	7 respondents (35%) strongly agree, 9 (45%) agree and 4 (20%) moderately agree that the SemIL application (SemIL App) can help complete activities or assignments quickly and make learning productive/effective
6.	6 respondents (30%) strongly agree, 10 (50%)

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	agree and 4 (20%) moderately agree that the SemIL application (SemIL App) can increase knowledge about electronic subjects because the content is easy to understand
7.	6 respondents (30%) strongly agree, 11 (55%) agree and 3 (15%) moderately agree that the SemIL application (SemIL App) can improve skills about electronic subjects because the experimental steps are easy to learn
8.	7 respondents (35%) strongly agree, 10 (50%) agree and 3 (15%) moderately agree that the SemIL application (SemIL App) can influence positive behavior in learning electronic subjects because its functionality is good and appropriate
9.	Referring to the graph, 8 respondents (40%) strongly agree, 7 (35%) agree and 5 (25%) moderately agree that the SemIL application (SemIL App) allows users to fully explore the content of the subject because the activities in it are easy to implement
10.	5 respondents (25%) strongly agree, 10 (50%) agree and 5 (25%) moderately agree that the SemIL application (SemIL App) makes it easier for users to share their understanding of lesson content with friends because the guidance is clear and consistent

Table 3 Student Motivation Using SemIL Application

Question	Analysis results
1.	9 respondents (45%) strongly agree, 7 (35%) agree and 4 (20%) moderately agree that the SemIL application (SemIL App) helps time management in learning electronic subjects
2.	3 respondents (15%) strongly agree, 13 (65%) agree and 4 (20%) moderately agree that the SemIL application (SemIL App) encourages reviewing electronic subjects at home
3.	6 respondents (30%) strongly agree, 10 (50%) agree and 4 (20%) moderately agree that the SemIL application (SemIL App) saves time to make references anywhere and anytime in understanding the subject electronics
4.	6 respondents (30%) strongly agree, 9 (45%) agree and 4 (20%) moderately agree and 1 (5%) disagree that the SemIL application (SemIL App) increases self-learning access in electronic subjects
5.	4 respondents (20%) strongly agree, 13 (65%) agree and 3 (15%) moderately agree that the SemIL application (SemIL App) helps make electronic subject learning more interactive and competitive
6.	6 respondents (30%) strongly agree, 12 (60%) agree and 2 (10%) moderately agree that the SemIL application (SemIL App) helps make electronic subject learning activities more quality
7.	6 respondents (30%) strongly agree, 9 (45%) agree and 5 (25%) moderately agree that the SemIL application (SemIL App) helps the development of electronic subject learning inside and outside the classroom
8.	6 respondents (30%) strongly agree, 11 (55%) agree and 3 (15%) moderately agree that the SemIL application (SemIL App) gives a lot of control over electronic subject learning activities
9.	9 respondents (45%) strongly agree, 7 (35%) agree and 3 (15%) and 1 (5%) strongly disagree that the SemIL application (SemIL App) motivates learning electronic subjects because of the e-Learning element increase interest in exploring what information is being learned

V. CONCLUSION

The results of this study concluded that the level of students' perception and motivation towards the use of SemIL applications is at a high score. This is possible because this application has the potential of good usability, useful and effective to be applied in the subject of electronics at Community College. Research feedback shows that this application has advantages in PdP because it can provide a more enjoyable learning environment for students. In addition, this application also provides a teaching design that implements a fully mobile device that has a neat and good interface, display and functions for students to implement. The development of more applications like this is very appropriate to the current needs and demands where they can be used as efficient teaching aids and support the implementation of PdP online based on new norms. In order to further increase the learning potential of students, it is suggested that a physical game board be provided that can be combined with the SemIL application so that the learning process of students is more competitive and provides a more enjoyable learning environment for students. Therefore, the use of SemIL Application innovation is very important for students to review.

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Project Teacher Assistant Program: Still Sustainable and Competitive?

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Abstract

Today, teachers' duties are becoming increasingly diverse, burdening them with side tasks that detract from their primary responsibility of teaching. Consequently, the proposal of a Teacher's Assistant Program as an alternative is expected to address various issues related to teachers in schools. The objective of this study is to assess the feasibility of the Teacher Assistant Program across five dimensions such as desire, practical, able to implementation, viable, and sustainability. A quantitative approach using surveys was employed, with a questionnaire instrument measured on a 5-point likert scale. Data analysis was conducted using Statistical Packages for Social Sciences (SPSS) version 27. The respondents included 20 teachers randomly selected from primary and secondary schools across Malaysia. The main findings indicate a high level of feasibility for the Teacher Assistant Program across all aspects: desire (Mean = 4.59), practical (Mean = 4.35), able to implement (Mean = 4.17), viability (Mean = 4.55), and sustainability (Mean = 4.41). This study has significant implications for enhancing current practices in supporting teachers with teaching and learning management methods. Moreover, it offers valuable insights for addressing issues associated with the increasing workload of teachers. Further research could explore the utilization of technology, considering digitization in education as one of the alternatives to alleviate the burden on teachers in schools.

Keywords **:** *teacher assistant; responsibility; learning; improvement; classroom; program*

I. INTRODUCTION

The Teacher Assistant Program plays a crucial role in enhancing the teaching and learning process within schools. Acting as a support system for both teachers and students, the program facilitates the realization of the school's vision and mission. Moreover, it significantly impacts teacher job satisfaction. Teacher assistants are individuals who assist teachers with instructional tasks, often possessing specialized expertise necessary for effective teaching. They serve as essential support within and beyond the classroom, offering valuable assistance to teachers and aiding students with learning difficulties.

The responsibilities of teacher assistants range from class preparation to nurturing students' personal and social development. They support teachers by handling tasks that would otherwise consume instructional time, such as preparing classrooms, creating resources, and displaying student work. Additionally, they assist in student supervision during various school activities and help maintain classroom order. Teacher assistants also play a role in lesson reinforcement, reviewing material with students individually or in small groups, fostering independent learning skills, and aiding time management.

Key skills required for teacher assistants include effective communication, interpersonal skills, resilience, and adaptability to manage challenging behaviors. They must also possess basic literacy and numeracy skills, stay updated on educational policies, and demonstrate patience, creativity, and a proactive approach. Furthermore, they should respect diversity and prioritize student safety and well-being.

Despite the valuable contributions of teacher assistants, teachers still bear administrative burdens such as personnel management, data

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collection, and financial management. Therefore, the Teacher Assistant Program serves as an initiative to empower teachers to focus more on teaching, aligning with the Ministry of Education's goal of safeguarding teachers' welfare and enhancing educational effectiveness.

II. LITERATURE REVIEW

Active and effective interaction between teacher assistants and students plays an important role in learning. This statement is supported by previous research [5], which explains that this practice is applied to support students in learning through interaction between teachers, teacher assistants, and students through individual and group activities. This provides a good opportunity for students to improve their academic performance through teacher assistants as an alternative learning support.

As we know, the main task of teacher assistants is to help teachers by managing students individually and in groups during the learning process. In a previous study related to this topic, a study [17] explained the roles of teacher assistants in the learning process, including support for teachers and curriculum, support for school administration, student learning support, and support for direct and indirect activities involving students. According to the study, the task of a teacher's assistant in managing and supporting student learning takes up 4 hours every day. This means that within the given time, the teacher's assistant is able to engage in teaching activities by planning various activities that interest the students.

Related research findings can be found in a study that examined the main task domain of teacher assistants in Hong Kong Primary and Secondary Schools [28]. The study instrument examined the practice of teacher assistants based on aspects such as learning support, teaching support, behavior management, collaboration, and administrative support. Referring to the findings of this study, it is explained that teacher assistants are aware of their role as supporters in the learning process, and this Teacher Assistant Program is considered effective and appropriate for implementation in schools.

Furthermore, Suleymanov [26] explains that the responsibility of the teacher's assistant is to implement the program under the guidance of the teacher. Teaching assistants support students in mainstream classes by assisting those who need help. The intended support involves the active role of the teacher's assistant when students encounter difficulties in learning. Their role is limited to encouraging and assisting students when they require support. Several recent studies [25] state that in-class support involving teacher assistants can also be carried out in the context of classroom management under the direction of the teacher, and the role of teacher assistants will support individual students or small groups. This illustrates the relationship between teachers, teacher assistants, and students in carrying out their duties and responsibilities. Recent studies [25], further added that the concept of the relationship as a form of partnership represents an investment in a better approach that supports the learning process.

In a study [14] related to teacher job satisfaction among 62 staff at Yayasan Pembangunan Keluarga Darul Takzim (YPKDT) in Nusajaya, Johor Bahru, the findings explain that high job satisfaction influences employees to exhibit good work performance or results. Accordingly, teachers are considered to be able to provide work performance in their career when there is a sense of satisfaction in carrying out the teaching and learning process.

Moreover, in the study [29], it is stated that the aspect of teacher job satisfaction is at a high level, which explains that job satisfaction can increase the motivation of teachers to contribute to effective learning and facilitation. Additionally, this level of motivation is expected to result in a high level of professionalism in planning and implementing guidance. Another study indicates a medium-high level of job satisfaction, explaining that teachers are still striving to improve their career performance and earnestly carry out their responsibilities in order to enhance the quality of education and the excellence of the country's education sector [33]. This context is explained through responses from the respondents of this study who expressed their enjoyment of their work.

The study by Ali [2] found that the level of job satisfaction is influenced by the role of organizational leaders (schools) who shape the work experience of employees in fostering employee attitudes and their sense of loyalty to the organization. That is, loyalty can exist when an individual has and increases a sense of satisfaction with their organization. If an employee has a sense of trust in the authority of their leader, it will effectively impact job satisfaction. The previous studies did not focus much on evaluating the program, which has created a gap in carrying out a study on the feasibility of the Teacher Assistant Program, considering that this study is very limited. The motivation to conduct this study is strong to add further studies for the effectiveness of this program so that there is no wastage of money and human capital.

A. Problem Statement

The National Union of Teachers' Services (NUTP) stated on April 18, 2022, that over 10,000 teachers opt for early retirement annually in recent years, significantly surpassing the Ministry of Education Malaysia's (KPM) statistics. This number starkly

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contrasts with KPM's data released on November 9, 2021, reporting only 4,360 optional retirement applications by teachers from January of the same year. This escalating trend of early teacher retirements is alarming. In 2015, 2,777 teachers chose early retirement, a number that surged to 3,591 in 2016. The trend worsens as it peaked at 4,360 applications in 2021, equivalent to 1.06 percent of the total teacher count. Complaints flood social media platforms, with many attributing stress and work pressure as reasons for their lethargy and inclination to retire after years of service.

Prolonged stress or pressure often leads to burnout syndrome, where individuals feel emotionally exhausted and powerless to fulfill their job duties. Freudenberger [13], initially explored this concept, later detailed by Maslach and Leiter [19] as emotional exhaustion, decreased work performance, and depersonalization. Teaching is a rewarding yet challenging career, with teachers facing heavy workloads and administrative burdens, compromising their ability to focus on teaching and diminishing their job satisfaction.

The feasibility of the Teacher Assistant Program is frequently questioned and requires reassessment. Empirical evidence from studies like this one can aid in determining the program's continuation. Additionally, such research is beneficial for stakeholders and the Ministry of Education (MoE) in formulating development plans to enhance the program's potential.

B. Importance of The Study

Importance of improving existing practices: This study is important to carry out because it provides a clear initial picture of the current situation and reality in relation to the Teacher Assistant Program, which has stopped in the middle of the road. This study will be able to provide a more detailed explanation about the existing practices of teachers, especially in relation to making the vision and mission of the teaching and learning process a success. The information obtained from this study is very important because it is able to benefit stakeholders as well as interested parties such as the Malaysian Ministry of Education (KPM) and the teachers themselves. The results of this study will help to understand more deeply the relationship between desire, practicality, ability, viability, and sustainability in policy feasibility. Through this understanding, the Ministry of Education, for example, will get useful information to organize and formulate appropriate actions to overcome problems and challenges among teachers in Malaysia. In addition, the findings of this study will also help the MoE to diagnose issues related to the Teacher Assistant Program in more depth.

Importance to the development of knowledge and the existing body of literature: Studies regarding the feasibility of Teacher Assistant Programs among teachers in the Malaysian context are still lacking because existing studies are more focused on profit-based sectors such as the private and business sectors. Therefore, it is important for this study to be carried out in the context of education so that the existing knowledge and understanding of the feasibility of this basic program can be further developed and narrow the gap regarding the lack of research related to the Teacher Assistant Program issue. In addition, this study is also able to provide some added value in terms of literature and knowledge development, especially regarding the relationship and connection between achieving the vision and mission of the teaching and learning process and burnout among teachers in Malaysia.

Importance to teachers in overcoming the problem of burnout in the teaching profession: Through this study, it is a step towards solving the problem of burnout that occurs in the teaching profession where most teachers decide not to continue their service until retirement due to the increasing workload factor. Too much workload and high levels of stress can cause burnout or fatigue among teachers. This study provides input to be able to continue and further strengthen the Teacher Assistant Program in schools to safeguard the welfare of teachers as the core of the effectiveness of education delivery.

III. RESEARCH METHODOLOGY

This study is quantitative in nature. The researcher employed a questionnaire as the primary data collection instrument, which was distributed to the respondents. The questionnaire consisted of systematically arranged questions designed to elicit specific responses. Questionnaires are essential tools for researchers as the quality of the questionnaire directly impacts the overall value of the research. Data for this study were gathered through a questionnaire comprising focused questions, facilitating respondents' ease of providing answers.

The questionnaire provided to respondents was divided into two parts: Part A focused on gathering information about the respondents' profiles, while Part B assessed the feasibility of the Teacher Assistant Program. Respondents were asked to indicate their level of agreement or disagreement with each statement, measuring their attitudes [21]. The items were assessed using a Likert scale, with five suggested responses provided for each question. Respondents simply needed to indicate their agreement or disagreement by selecting the corresponding score at the end of each item. An example of the Likert Scale classification is presented in Table 1.

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Table 1: Likert Scale Classification of Questionnaires

Strongly disagree	Do not agree	Not sure	Agreed	Strongly Agree
1	2	3	4	5

A. Population and Sample

Population refers to a group of individuals who share common characteristics [9]. In this study, the population comprises teachers currently employed in primary and secondary schools across Malaysia. Conversely, a sample is a subset of the population that is studied and used to represent the larger population [23]. A total of 20 teachers participated in this questionnaire. The selection of this sample size aligns with the recommendations of Isaac and Michael [30], who suggest that a sample size ranging from 10 to 30 is sufficient for a pilot study. Similarly, Hill [31] also recommended a sample size of 10 to 30 respondents for survey studies.

B. Research Instrument

This study utilizes a questionnaire instrument to gather the necessary information in accordance with the study objectives. According to Chua Yan Piaw [7], the questionnaire instrument is highly suitable for this method and is capable of producing reliable and consistent items if prepared effectively. The questionnaire used in this study was adapted from a previous study conducted by Irma [16]. It consists of 25 items to be rated by respondents using a 5-point Likert scale. Minor modifications were made to enhance respondent clarity and comprehension when answering the questionnaire items. The instrument is structured into 5 main constructs assessing the basic feasibility namely desire, practicality, implement-ability, viability, and sustainability, with each construct comprising 5 items.

C. Data Collection Methods

The data collection method for this study involves online methods. The questionnaire was distributed to respondents via the Google Form web page. Noraini [23] noted that data collection methods through online channels offer advantages in terms of ease of administration, prompt results, real-time data sets, and sometimes achieve response rates exceeding 50 percent if managed effectively. Once all responses via the Google Form web page are collected and recorded, the subsequent step involves analyzing and interpreting the data. For this purpose, the collected data will undergo statistical analysis using IBM SPSS Statistics software. Before proceeding with data analysis, the researcher will first acquire proficiency in using the SPSS software, typically by receiving guidance from a lecturer experienced in utilizing this application. The initial stage of the data analysis process using SPSS entails inputting the data by constructing an SPSS template.

IV. RESULT AND DISCUSSION

The study findings will report the objective scores of the study by identifying the level of feasibility of the Teacher Assistant Program from the aspects of desire, being practically implemented, able to be implemented, viable, and sustainable. The data collected has been analyzed using IBM SPSS Statistics 27 Software. Consistent with the study's objectives, the analysis focuses on identifying the feasibility of the implemented Teacher Assistant Program. Demographic profile data of the respondents in Part A were descriptively analyzed using frequency and percentage. Similarly, the data in Part B of the questionnaire were analyzed using frequency and percentage. Since the Likert scale represents ordinal data categories, frequency and percentage calculations for each category were utilized for quantitative comparison Chua Yan Piaw [7].

Table 2 presents the findings from the descriptive analysis pertaining to Part A, which focuses on the gender of the study respondents. From the data analysis, it was observed that both male and female respondents consisted of an equal number of 10 individuals (50.0%) who participated in answering the questionnaire. Descriptive analysis was employed to analyze the data obtained from 20 respondents in order to address the research question.

Table 2: Gender frequency table

Levels	Counts	% of Total	Cumulative %
Men	10	50.0%	50.0%
Female	10	50.0%	100.0%

Table 3 displays the teaching experience information for the respondents who answered the research questions. Two categories, teaching experience of 16-20 years and 6-10 years, each had the highest value, with 6 people (30%) in each category. Following these, the teaching experience of 11-15 years was reported by 5 people (25%), and teaching experience of 20 years and above was reported by 3 people (15.0%). However, none of the respondents had teaching experience of less than 5 years.

Table 3: Table of respondents' teaching experience

Teaching experience	Counts	% of Total	Cumulative %
11-15 years	5	25.0%	25.0%

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16-20 years old	6	30.0%	55.0%
20 years and above	3	15.0%	70.0%
6-10 years	6	30.0%	100.0%
5 years or less	0	0%	0%

Table 4 indicates that the highest number of respondents who answered this questionnaire belonged to the DG44 position grade, with 13 people (65.0%), while the lowest number belonged to the DG34 position grade, with only 1 person (5.00%). Additionally, 4 people (20.0%) were from the DG41 position grade, and 2 people (10.0%) were from the DG48 grade.

Table 4: Respondent's position grade table

Position Grade	Counts	% of Total	Cumulative %
DG34	1	5.00%	5.00%
DG41	4	20.0%	25.0%
DG44	13	65.0%	90.0%
DG48	2	10.0%	100.0%
DG52	0	0%	0%
DG54	0	0%	0%

Descriptive analysis, including the mean and standard deviation of the dependent variable, will be reported, and the mean scores will be interpreted based on Table 5. According to the results presented in Table 6, it was observed that the mean for each item construct regarding the feasibility level of the Teacher Assistant Program from the aspect of desire ranged between 4.40 and 4.80, indicating a very high level of agreement among respondents. Item (P5) exhibited the lowest mean value of 4.40, suggesting respondents' agreement with the notion that the Teacher Assistant Program contributes to enhancing teachers' personal competence.

Conversely, item (P4) demonstrated the highest mean value of 4.80, signifying that the Teacher Assistant Program assists teachers in addressing burnout issues within the teaching profession. This disparity between the lowest and highest mean items suggests that, despite their enthusiasm and experience, teachers are susceptible to burnout syndrome due to the dynamic demands of the contemporary educational landscape, influenced by globalization.

Furthermore, items (P2) and (P3) displayed identical mean values of 4.65, indicating strong agreement among respondents regarding the fulfillment of educational transformation desires and the prioritization of teacher welfare as outlined by the Ministry of Education. These findings align with the objectives outlined in the Malaysian Education Development Plan (2013-2025), particularly Shift 4, which aims to elevate the teaching profession to a preferred occupation, thereby allowing teachers to concentrate on their core teaching functions.

Although item (P1) exhibited the lowest mean value of 4.45, respondents strongly agreed that the Teacher Assistant Program aligns with national education policies.

Table 5: Mean scores of input, process and output levels (Creswell, 2005)

Min Score	Interpretation of Min Score
1.00 to 1.80	Very low
1.81 to 2.60	Low
2.61 to 3.40	Medium
3.41 to 4.20	High
4.21 to 5.00	Very high

Table 6: Table of program feasibility levels from the aspect of desire(N=20)

Desire	Mean	SD	Level
P1. "Teacher Assistant Program" in line with the national education policy?	4.45	0.686	Very high
P2. "Teacher's Assistant Program" fulfills the main purpose of the Ministry of Education's focus, where is taking care of teachers' welfare as the core of the effectiveness of education delivery?	4.65	0.489	Very high
P3. "Teacher's Assistant Program" fulfills the desire of educational transformation?	4.65	0.489	Very high
P4. "Teacher's Assistant Program" helps teachers overcome the problem of burnout in the teaching profession?	4.80	0.410	Very high
P5. "Teacher Assistant Program" help teachers improve their competence?	4.40	0.883	Very high

Referring to Table 7, the distribution of the percentage and frequency of the level of feasibility of the program from the aspect of desire where item (P4) has the highest percentage for the option 'Strongly Agree'. This shows that most respondents agree that the "Teacher's Assistant Program" helps teachers overcome the problem of burnout in the

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teaching profession. While the percentage of 'Agree' is high for items (P1, P2 and P3). This shows that the respondents believe that the Teacher Assistant Program is in line with the national education policy, fulfilling the main focus of the Ministry of Education, where looking after the welfare of teachers is the core of the effectiveness of education delivery and fulfills the desire of educational transformation. The 'Uncertain' option is a minor choice for respondents on item (P1).

Table 7: Distribution table of the percentage and frequency of the level of feasibility of the program from the aspect of desire

DESIRE	P1. "Teacher Assistant Program" in line with the national education policy?	P2. "Teacher's Assistant Program" fulfills the main purpose of the Ministry of Education's focus, where is taking care of teachers' welfare as the core of the effectiveness of education delivery?	P3. "Teacher's Assistant Program" fulfills the desire of educational transformation?	P4. "Teacher's Assistant Program" helps teachers overcome the problem of burnout in the teaching profession?	P5. "Teacher Assistant Program" help teachers improve their competence?
Very Not Agreed	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Do not agree	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5.0%)
Not sure	2 (10.0%)	0 (0%)	0 (0%)	0 (0%)	2 (10.0%)
Agreed	7 (35.0%)	7 (35.0%)	7 (35.0%)	4 (20%)	5 (25.0%)
Strongly Agree	11 (55.0%)	13 (65.0%)	13 (65.0%)	16 (80.0%)	12 (60.0%)

Table 8 indicates that the mean for each construct item regarding the feasibility level of the Teacher Assistant Program from a practical aspect ranges between 3.95 and 4.75, signifying a very high level of agreement among respondents. Descriptive analysis, including the mean and standard deviation of the dependent variable, will be reported, and the mean score interpreted based on Table 5.

Item (P3) exhibited the lowest mean value of 3.95, suggesting respondents' agreement with the notion that the Teacher Assistant Program is easy to implement. This observation may stem from respondents' negative impressions of the previous Teacher Profession Strengthening Pilot Program initiated in 2013, which was discontinued midway, leading to uncertainty regarding its implementation status. Consequently, some respondents may harbor doubts regarding the ease of implementing such programs.

Table 8: Table of program feasibility levels from the aspect of practical fulfillment

Practical	Mean	SD	Level
P1. "Teacher's Assistant Program" suitable for implementation at the school level?	4.75	0.444	Very high
P2. "Teacher's Assistant Program" can be managed at the school level?	4.55	0.510	Very high
P3. "Teacher Assistant Program" easy to implement?	3.95	0.759	High
P4. This "Teacher Assistant Program" is not at risk of failure?	4.00	0.725	High
P5. Practical "Teacher Assistant Program" to implement?	4.50	0.607	Very high

Referring to Table 9, which displays the distribution of the percentage and frequency of the feasibility level of the program from a practical aspect, item (P1) exhibits the highest percentage for the option 'Strongly Agree.' This indicates that the majority of respondents believe that the "Teacher's Assistant Program" is suitable to be implemented at the school level. Conversely, the percentage of 'Agree' is high for item (P4), where respondents concur that this "Teacher's Assistant Program" is not at risk of failure. However, there is a notable proportion of respondents who selected 'Unsure' for item (P3), indicating uncertainty regarding the ease of implementation of the "Teacher Assistant Program."

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Table 9: Distribution table of percentage and frequency of program feasibility level from a practical aspect

PRACTICAL	Very Not Agreed	Do not agree	Not sure	Agreed	Strongly Agree
P1. "Teacher's Assistant Program" suitable for implementation at the school level?	0 (0%)	0 (0%)	0(0%)	5(25.0%)	15 (75.0%)
P2. "Teacher's Assistant Program" can be managed at the school level?	0 (0%)	0 (0%)	0 (0%)	9 (45.0%)	11 (55.0%)
P3. "Teacher Assistant Program" easy to implement?	0 (0%)	0 (0%)	6 (30.0%)	9 (45.0%)	5 (25.0%)
P4. This "Teacher Assistant Program" is not at risk of failure?	0 (0%)	0 (0%)	5 (25.0%)	10 (50.0%)	5 (25%)
P5. Practical "Teacher Assistant Program" to implement?	0 (0%)	0 (0%)	1 (5.0%)	8 (40.0%)	11 (55.0%)

In Table 10, the mean for each construct item of the feasibility level of the Teacher Assistant Program from the aspect of being able to be implemented ranges between 3.70 and 4.65, indicating a very high level of feasibility. Descriptive analysis, including the mean and standard deviation of the dependent variable, will be reported and interpreted based on Table 5. Item (P4) exhibits the lowest mean value of 3.70, suggesting that respondents agree with the statement that the Teacher Assistant Program can be implemented with sufficient provisions. However, there is uncertainty among 10 teachers regarding the availability of adequate allocations due to the program's interruption and lack of clear direction from stakeholders. Conversely, 10 respondents expressed agreement, including Strongly Agree responses, that the program could succeed with proper attention and sufficient allocation. On the other hand, item (P1) holds the highest mean value of 4.65, indicating that the Teacher Assistant Program is capable of aiding in providing teaching services and student management. Classroom support involving teaching assistants can contribute to classroom control by assisting students individually or in groups, implementing zoning practices, and fostering reflective collaboration between teaching assistants and teachers [25]. Considering the issues at hand, the Teacher Assistant Program's role is perceived as a promising solution for addressing challenges faced by both teachers and students [5].

Table 10: Table of program feasibility levels from the aspect of being able to implement (N = 20)

Able to implement	Mean	SD	Level
P1. "Teacher's assistant program" able to help in providing teaching services and student management?	4.65	0.587	Very high
P2. "Teacher's Assistant Program" is able to be implemented because it has sufficient human resources?	4.20	0.768	Very high
P3. "Teacher's Assistant Program" is able to be implemented because it has sufficient facilities and infrastructure?	3.80	0.616	High
P4. "Teacher's Assistant Program" is able to be implemented because it has sufficient allocation?	3.70	0.801	High
P5. "Teacher Assistant Program" able to perform non-teaching tasks under the supervision of teachers?	4.50	0.607	Very high

Based on Table 11, nearly 14 individuals (70.0%) Strongly agree that the Teacher's Assistant Program is easy to implement, particularly since the Ministry's primary focus is on enhancing teacher welfare to bolster the effectiveness of educational

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delivery. Conversely on Table 10, item (P1) demonstrated the highest mean value of 4.65, indicating respondents' belief that the Teacher Assistant Program is suitable for implementation at the school level. Referring to Table 11, which presents the distribution of the percentage and frequency of the feasibility level of the program from the aspect of being able to be implemented, item (P1) demonstrates the highest percentage for the option 'Strongly Agree'. This indicates that most respondents agree that the "Teacher Assistant Program" is capable of aiding in providing teaching services and student management. Conversely, the percentage of 'Agree' is notably high for item (P3), with respondents concurring that the "Teacher's Assistant Program" can be implemented due to sufficient facilities and infrastructure. However, the highest proportion of respondents selected 'Unsure' for item (P4), which pertains to the "Teacher Assistant Program" being able to be implemented because it has sufficient allocations.

Table 11: Distribution table of the percentage and frequency of the level of feasibility of the program from the aspect of being able to be implemented

ABLE TO IMPLEMENT	Very Not Agreed	Do not agree	Not sure	Agreed	Strongly Agree
P1. "Teacher's assistant program" able to help in providing teaching services and student management?	0 (0%)	0 (0%)	1 (5.0%)	5 (25.0%)	14 (70.0%)
P2. "Teacher's Assistant Program" is able to be implemented because it has sufficient human resources?	0 (0%)	0 (0%)	4 (20.0%)	8 (40.0%)	8 (40.0%)
P3. "Teacher's Assistant Program" is able to be implemented because it has sufficient facilities and infrastructure?	0 (0%)	0 (0%)	6 (30.0%)	12 (60.0%)	2 (10.0%)
P4. "Teacher's Assistant Program" is able to be implemented because it has sufficient allocation?	0 (0%)	0 (0%)	10 (50.0%)	6 (30.0%)	4 (20.0%)
P5. "Teacher Assistant Program" able to perform non-teaching tasks under the supervision of teachers?	0 (0%)	0 (0%)	1 (5.0%)	8 (40.0%)	11 (55.0%)

Next, in Table 12, it was found that the mean for each construct item of the feasibility level of the Teacher Assistant Program from a viable aspect is between 4.35 and 4.70, indicating a very high level. Descriptive analysis, including the mean and standard deviation of the dependent variable, will be reported and interpreted based on Table 5. Item (P4) has the lowest mean value of 4.35, indicating respondents' agreement with the statement that the Teacher Assistant Program helps students use the provided teaching resources correctly. Meanwhile, item (P5), which has the highest mean value of 4.70, suggests that the Teacher Assistant Program assists teachers in overcoming the burden of non-essential tasks that need to be completed. Overall, the findings of the study on the level of administrative support are at a high level. This indicates that teacher assistants carry out various responsibilities effectively, facilitating the school's administrative functions. Referring to the findings of the study by Abdulqader [1], which indirectly supports school administration, the role of teacher assistants is considered instrumental in helping to solve problems faced by teachers in the teaching and learning process of students.

Table 12: Table of program feasibility levels from a viable aspect (N =20)

Viable	Mean	SD	Level
P1. A "Teacher's Assistant Program" can assist teachers in performing work that involves extra attention and instruction to the students under their care?	4.65	0.489	Very high
P2. "Teacher's Assistant Program" helps ensure school and classroom rules are followed?	4.45	0.686	Very high
P3. The "Teacher Assistant Program" helps and provides teachers with information and details about students?	4.60	0.503	Very high
P4. "Teacher's Assistant Program" helps students use the teaching resources provided correctly?	4.35	0.671	Very high

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P5. "Teacher's Assistant Program" helps teachers overcome the burden of non-essential tasks that need to be completed?	4.70	0.470	Very high

Referring to Table 13, which presents the distribution of the percentage and frequency of the program's feasibility from a viable aspect, item (P5) has the highest percentage for the option 'Strongly Agree'. This indicates that most respondents agree that the "Teacher's Assistant Program" helps teachers overcome the burden of non-essential tasks that need to be completed. Meanwhile, the percentage of 'Agree' is high for item (P4), where respondents agree that this "Teacher's Assistant Program" helps students use the teaching resources provided correctly. However, some respondents expressed 'Unsure' for items (P2 and P4), which pertain to the program's role in ensuring school and classroom rules are followed and helping students use the teaching resources provided correctly.

Table 13: Distribution table of percentage and frequency of the level of feasibility of the program from the aspect of viability

VIABLE	Very Not Agreed	Do not agree	Not sure	Agreed	Strongly Agree
P1. A "Teacher's Assistant Program" can assist teachers in performing work that involves extra attention and instruction to the students under their care?	0 (0%)	0 (0%)	0 (0%)	7 (35.0%)	13 (65.0%)
P2. "Teacher's Assistant Program" helps ensure school and classroom rules are followed?	0 (0%)	0 (0%)	2 (10.0%)	7 (35.0%)	11 (55.0%)
P3. The "Teacher Assistant Program" helps and provides teachers with information and details about students?	0 (0%)	0 (0%)	0 (0%)	8 (40.0%)	12 (60.0%)
P4. "Teacher's Assistant Program" helps students use the teaching resources provided correctly?	0	0 (0%)	2 (10.0%)	9 (45.0%)	9 (45.0%)
P5. "Teacher's Assistant Program" helps teachers overcome the burden of non-essential tasks that need to be completed?	0 (0%)	0 (0%)	0 (0%)	6 (30.0%)	14 (70.0%)

In Table 14, it is observed that the mean for each construct item of the feasibility level of the Teacher Assistant Program from a sustainable aspect ranges between 4.05 and 4.55, indicating a very high level. Descriptive analysis, including the mean and standard deviation of the dependent variable, will be reported and interpreted based on Table 5. Item (P3) has the lowest mean value of 4.05, signifying that respondents agree with the statement that the Teacher Assistant Program will receive support from all parties. On the other hand, both item (P1) and item (P5) have the highest mean value of 4.55, indicating that the Teacher Assistant Program is capable of developing to enhance the quality of education in Malaysia and can improve the performance and competence of teachers.

Table 14: Table of program feasibility levels from a sustainable aspect (N = 20)

Sustainable	Mean	SD	Level
P1. "Teacher Assistant Program" able to grow to improve the quality of education in Malaysia?	4.55	0.510	Very high
P2. "Teacher Assistant Program" can help maintain the welfare of teachers as the core of the effectiveness of education delivery?	4.60	0.503	Very high
P3. "Teacher's Assistant Program" will get support from all parties?	4.05	0.759	Very high
P4. Will the "Teacher Assistant Program" remain relevant?	4.30	0.657	Very high
P5. "Teacher Assistant Program" can improve the performance and competence of teachers?	4.55	0.759	Very high

Referring to Table 15, which displays the distribution of the percentage and frequency of the feasibility level of the program from a sustainable aspect, item (P5) shows the highest percentage for the option 'Strongly Agree'. This indicates that most respondents agree that the "Teacher Assistant Program" can enhance the performance and competence of teachers. Additionally, the percentage of 'Agree' is notably high for item (P4), where respondents agree that this "Teacher's

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Assistant Program" will remain relevant. However, there are some respondents who selected 'Uncertain' for item (P3), indicating uncertainty regarding whether the "Teacher Assistant Program" will receive support from all parties.

Table 15: Distribution table of percentage and frequency of program feasibility level from a sustainable aspect

SUSTAINABLE	P1. "Teacher Assistant Program" able to grow to improve the quality of education in Malaysia?	P2. "Teacher Assistant Program" can help maintain the welfare of teachers as the core of the effectiveness of education delivery?	P3. "Teacher's Assistant Program" will get support from all parties?	P4. Will the "Teacher Assistant Program" remain relevant?	P5. "Teacher Assistant Program" can improve the performance and competence of teachers?
Very Not Agreed	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Do not agree	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5.0%)
Not sure	0 (0%)	0 (0%)	5 (25.0%)	2 (10.0%)	0 (0%)
Agreed	9 (45.0%)	8 (40.0%)	9 (45.0%)	10 (50.0%)	6 (30.0%)
Strongly Agree	11 (55.0%)	12 (60.0%)	6 (30.0%)	8 (40.0%)	13 (65.0%)

Based on Table 16, it shows that the overall level of feasibility of the Teacher Assistant Program based on the teacher's perspective is at a very high level.

Table 16: Table of the overall feasibility of the Teacher Assistant Program based on the teacher's perspective

No	Aspect	Mean	SD	Level
1	Desire	4.59	0.491	Very high
2	Practical	4.35	0.429	Very high
3	Able to implement	4.17	0.512	Very high
4	Viable	4.55	0.471	Very high
5	Sustainable	4.41	0.470	Very high

A. Discussion

The purpose of this study was to assess the feasibility of the Teacher Assistant Program. A questionnaire was developed comprising five main constructs: desire, practicality, able of implementation, viability, and sustainability. In total, 25 items were included, with each construct consisting of five items. The findings of the analysis indicate that the feasibility of the Teacher Assistant Program is very high.

Desire

Based on the overall mean value for the construct item desire, which is 4.59, it is categorized as Very High. 16 people (80%) stated that the Teacher Assistant Program helps teachers overcome the problem of burnout in the teaching profession. Burnout, a specific type of workplace stress, leads to physical and emotional fatigue, resulting in decreased work performance and depersonalization (Mayo Clinic, 2020). The relationship between burnout and prolonged work-related stress is well-documented (Schonfeld, Bianchi & Palazzi, 2018).

Herzberg (1959) identified two factors influencing job satisfaction for employees: motivators (such as work assignments, responsibilities, progress, and appreciation) and hygiene factors (including supervision, co-workers, and working conditions). Teachers require a satisfactory work environment to perform their assigned tasks effectively [33]. Attention to teachers' workload and pressure is crucial to prevent decreased work performance. Work performance is defined as the result of tasks carried out by individuals contributing to organizational goals Hassan [32].

Teacher assistants play a vital role in lightening teachers' workload by assisting in classroom management, preparing class materials, devising student learning strategies, and allowing

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teachers to teach comfortably. Therefore, it's imperative to improve the workload distribution system for teachers. Job satisfaction among teachers not only affects the quality of their work but also impacts their focus during the teaching and learning process [4]. Cupido [10] supported this view, stating that teacher assistant programs foster a culture of involvement through ongoing interaction between instructors and teacher assistants. Collaborative practices between teachers and teacher assistants contribute positively to teaching and learning practices, thereby alleviating teachers' workload.

Furthermore, 13 people (65%) strongly agree that the Teacher Assistant Program fulfills the Ministry of Education's core focus on safeguarding teachers' welfare, which is essential for effective education delivery and educational transformation. Additionally, 12 respondents (60%) strongly agree that the program helps teachers enhance their competence, while 11 respondents (55%) strongly agree that it aligns with national education policy.

Practical

Based on the overall mean value for the practical construct item, which is 4.35, it falls into the Very High category. 15 respondents (75%) stated that the Teacher Assistant Program is suitable for implementation at the school level. Teachers believe that teacher assistants can effectively contribute during the teaching process, allowing teachers to focus more on their primary task of teaching students. This perspective aligns with the findings of Charles [6], who suggested that teacher assistants enable teachers to concentrate on teaching in the classroom.

The practice described reflects teachers' perceptions that teacher assistants support learning by directly engaging with students through intervention activities, such as assigning individual and group tasks. Nash [22] supports this finding, highlighting that learning support fosters positive interaction between teacher assistants and students. Direct support to students during assignments is essential for building effective interaction, as emphasized by Yan [28], who underscores the significance of teacher assistants' support in student learning.

Furthermore, 11 respondents (55%) strongly agree that the Teacher Assistant Program can be effectively managed at the school level and is practical to implement. Additionally, 10 respondents (50%) agree that the program is not at risk of failure, and 9 respondents (45%) strongly agree that it is easy to implement.

Able to implement

Based on the overall mean value for the construct items related to implementation, which is 4.17, the feasibility is rated as Very High. 14 respondents (70%) strongly agree that the Teacher Assistant Program can enhance teaching services and student management. The program's close association with classroom management and planning processes contributes significantly to the overall learning activities. This practice, effectively applied, positively impacts student achievement, particularly by fostering a positive interaction between teachers and students. Firdaus [12], supports this view, emphasizing the importance of teacher-student relationships in students' academic and social development.

Moreover, 11 respondents (55%) strongly agree that the Teacher Assistant Program can handle non-teaching tasks under teachers' supervision. Teacher assistants collaborate with teachers to fulfill responsibilities and execute teaching and learning plans effectively [10]. Euphthymia [11] also supports this finding, indicating that teacher assistants manage students' needs while teachers, as supervisors, oversee and guide them appropriately. This aligns with the findings of Awang-Hashim [33], who emphasize the supervisory role of teachers in effectively overseeing and guiding teacher assistants.

Viable

Based on the overall mean value for the viable construct items, which is 4.55, the feasibility is rated as Very High. 14 respondents (70%) strongly agree that the Teacher Assistant Program helps teachers alleviate the burden of non-essential tasks. Essentially, teacher assistants significantly support the classroom teaching and learning process Ayers [3]. Their role can be identified through their support toward teachers' needs, workload, and direct support to individual students [28], [1], providing an opportunity for collaborative planning and effective learning outcomes (Webster & Boer, 2019).

Furthermore, 13 respondents (65%) strongly agree that the Teacher Assistant Program aids teachers in addressing students' individual needs and providing additional attention and guidance. For instance, teacher assistants often serve as supporters and guides for students with behavioral issues, managing student behavior both inside and outside the classroom. This aligns with the perspective of Yan [28] and the view that the program serves as behavioral guidance and a classroom management intervention [34].

Sustainable

Based on the overall mean value for the sustainable construct item, which is 4.41, the feasibility is rated as Very High. 13 respondents (65%) strongly agree that the Teacher Assistant Program can enhance the performance and competence of teachers. Hence, it is suggested that policymakers and stakeholders nationwide adopt the positive psychology paradigm,

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focusing on supporting teachers' growth rather than merely retaining them in the profession. This study has the potential to revolutionize the conditions under which teachers fulfill their vital roles. Through the Teacher Assistant Program, teachers can enhance their emotional intelligence, thereby improving the quality of their work assignments and job satisfaction [15]. An unsatisfied employee may neglect their responsibilities.

Additionally, 12 respondents (60%) strongly agree that the Teacher Assistant Program can uphold teachers' welfare, which is crucial for effective education delivery. Furthermore, 11 respondents (55%) strongly agree that the program can evolve to enhance the quality of education in Malaysia. Present-day challenges faced by teachers, such as workload, role conflicts, and the absence of social support, have led to resignations and burnout, impacting education quality. Therefore, the implementation of the Teacher Assistant Program can contribute to enhancing teaching quality.

V. CONCLUSION

The results of this study show that the feasibility level of the Teacher Assistant Program is very high for all aspects of desire, being practical, being able to be implemented, viable, and sustainable. This study has implications through improvements by the Ministry which is more focused on helping teachers in the issue of dealing with the workload of teachers in schools. It is also a catalyst for changes in the teaching and learning management of teachers to be more proactive and improve the quality of learning. If this Teacher Assistant Program is implemented, it is suggested to the Ministry to also study the implementation method in foreign countries such as the United States and so on. Further research can be carried out by looking at the technological aspect where digitization in education is one of the alternatives that can be implemented in dealing with the issue of teacher workload in schools.

Being a teaching assistant is a huge commitment along with patience, dedication to student well-being, and a basic understanding of child development, advanced training is often required to keep up with new teaching methods and qualifications. The management practice of the Teacher Assistant Program which is considered as guidance and support for the teaching and learning process. In detail, in the form of task sharing with teachers at the school, the practice of teacher assistants can contribute to the school in terms of learning support, teaching, behavior, cooperation and administrative support. This is because, the practice of teacher assistants provides support to teachers in making the vision and mission of the teaching and learning process a success and also avoid things that can affect the teacher's main duties. In other words, in terms of teacher job satisfaction, some teachers feel satisfied in carrying out the responsibility of the teaching and learning process with the help and support of teacher assistants to lighten their duties in controlling the classroom and helping to provide for the students' learning needs.

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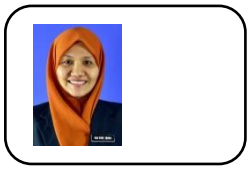
First Author: Wan Nurul Hidayah Wan Mohamad Akil 	Kuala Langat Community College Sepang Branch, Ministry of Higher Education Email: wnhkkhl@gmail.com
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Motivating Logistics Service Certificate Students in Entrepreneurship: A Study on Factors and Strategies

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Abstract

The advancement of many graduates in entrepreneurship stands as a primary national agenda, aligning with the National Entrepreneurship Policy 2030 (DKN 2030). Institutions of Higher Education (HEIs) bear the responsibility of fostering and instilling entrepreneurship among students, equipping them to confront future challenges. However, discourse on motivating students regarding the subject of entrepreneurship remains limited and lacks extensive debate. In light of this, the present study aims to delve into the motivation of Logistics Service Certificate (SLK) students concerning the Entrepreneurship subject at the Kuala Langat Community College Sepang Branch (KKKLCSG). The methodology employed in this research utilizes a survey method coupled with a quantitative approach. Questionnaire instruments are assessed using a 5-point Likert scale, and data are analyzed using Statistical Packages for Social Sciences (SPSS) version 27 software. The respondents comprise 48 students selected from KKKLCSG through easy randomization. The primary findings of the research reveal that the motivation level of SLK students at KKKLCSG is exceptionally very high (Mean = 4.44, SD = 0.580), indicating significant effort by instructors to foster a positive outlook towards learning entrepreneurship subjects. This research bears important implications for the development of instructors' knowledge in teaching and learning practices. It offers insight into the current state of entrepreneurship-related aspects among Community College students. Additionally, there is a dearth of research focusing on digital entrepreneurship within ranked Community Colleges, warranting further investigation into the level of motivation among students, especially those pursuing different areas of study.

Keywords: *Entrepreneurship; motivation student; Logistics Service Certificate; community college; subject*

I. INTRODUCTION

The field of entrepreneurship has experienced rapid growth in tandem with government initiatives aimed at encouraging Malaysians to explore opportunities beyond traditional employment provided by the government and private sectors. In today's competitive business environment, a robust education in entrepreneurial skills can equip graduates with the necessary competencies. Several recent studies [21] underscore the importance of emphasizing graduates' ability to work independently and maintain positive mental health, which can help reduce instability in our country and contribute to its vision of becoming a developed nation. Additionally, Zafir [22] notes that the "Entrepreneurship Fever" began in the mid-1980s, leading to rapid advancements in the field. The shift towards independence and subsequent changes in the education system have significantly influenced Malaysian society.

The introduction of the New Economic Policy (NEP) in 1970, championed by Malaysia's second Prime Minister, Tun Abdul Razak Hussein, has encouraged Malaysians to explore entrepreneurship. Traditionally, graduates aspire to secure employment in either the private or public sector commensurate with their educational qualifications. However, intensifying competition for job vacancies and the proliferation of high-qualified positions have limited opportunities for those with advanced education. Candidates with

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higher qualifications often prioritize roles that match their credentials, prolonging their entry into the workforce compared to those who accept positions below their qualifications. Moreover, the annual increase in the number of graduates from higher education institutions, both public and private, exacerbates the situation, as job openings fail to keep pace with the influx of applicants.

In economic terms, this scenario resembles excess demand, where the demand for jobs surpasses the available supply. Consequently, many individuals remain unemployed for extended periods due to a strong preference for salaried employment and reluctance to pursue entrepreneurial endeavors. Recent studies [14] indicate that our society tends to discourage entrepreneurship among children, reflecting a low propensity for risk-taking. Therefore, graduates should be encouraged to explore self-employment opportunities or start small businesses, as the field of entrepreneurship currently offers abundant job prospects.

Entrepreneurship education has been integrated into Malaysia's educational system as early as primary education. Recognizing its significance in providing students with the skills and mindset to pursue entrepreneurship as a career path, the Ministry of Higher Education has demonstrated commitment to its implementation, particularly through Community Colleges. Entrepreneurship is a compulsory subject across all programs offered at Community Colleges. Initial surveys indicate that students enthusiastically engage in business activities outlined in the syllabus and achieve success.

II. LITERATURE REVIEW

As highlighted by Suria [23] in the paper titled "Readiness of Higher Education Students to Venture into Entrepreneurship; A Case Study," 80 percent of the study respondents lacked confidence in their ability to succeed as entrepreneurs. Consequently, the primary objective of this study is to introduce entrepreneurship motivation to cultivate students' interest in entrepreneurship and, subsequently, instill the self-confidence needed to pursue entrepreneurial endeavors. Additionally, the study aims to encourage and bolster students' confidence levels in embarking on entrepreneurship or aspiring to become entrepreneurs in the future. Specialized entrepreneurship education within specific fields, particularly in Technical and Vocational Education, not only trains skilled and semi-skilled labor but also fosters students' interest in entrepreneurship.

According to a study by Mohammad Kamaluddin [16], engineering graduates from Universiti Teknologi Mara (UiTM) were found to be more inclined towards working with existing organizations rather than pursuing entrepreneurship. This trend is also observed among a significant number of engineering graduates from KUiTTHO. Research findings by Steward and Boyd (cited in Zaidatol Akmaliah, 1993) suggest that 50% of entrepreneurs who start businesses possess prior experience. Moreover, evidence indicates that apart from motivational factors, access to capital, and favorable location, formal education in entrepreneurship plays a crucial role in enabling individuals to establish businesses.

Khairuddin [12] notes that entrepreneurship has often been perceived as a last resort or temporary occupation, chosen after failing to secure more stable and prestigious jobs. This perception contradicts contemporary aspirations and challenges. Several studies [8] argue that students' choice of career is influenced by their field of study, as well as by external factors such as teachers, parents, friends, and the prevailing environment, which may contribute to the inclination towards entrepreneurship.

Students at Kuala Langat Community College Sepang Branch (KKKLCSG) frequently participate in entrepreneurship activities and programs organized by the college and external agencies. These initiatives include seminars, carnivals, business challenges, entrepreneurship workshops, and sales activities. Despite observed student interest in these programs, feedback from KKKLCSG alumni data suggests that entrepreneurship is not the primary career choice for students. This could be attributed to the lack of effective exposure to and nurturing of entrepreneurship among students, as well as a dearth of feedback mechanisms to gauge student interest in entrepreneurship. Therefore, this study aims to identify factors contributing to final semester students' inclination towards entrepreneurship. Moreover, graduate unemployment remains a pressing issue for the country, and entrepreneurship is viewed as a potential solution to address unemployment, stimulate economic growth, and foster competitiveness [1]. Providing exposure to entrepreneurship equips students to adapt in case of difficulties in securing employment in their respective fields upon graduation. Hence, the researcher seeks to ascertain the motivation of Logistics Services Certificate students towards entrepreneurship.

Furthermore, the vision of the Community College is to spearhead entrepreneurship development, while its mission is to produce entrepreneurs who apply knowledge and technical skills in alignment with the Higher Education Entrepreneurship Development Policy. Presently, entrepreneurship appears to be dominated by non-bumiputera individuals. Hence, the study questions whether graduates from this Community College possess the potential to become successful entrepreneurs through exposure to entrepreneurship

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and their motivation towards entrepreneurship subjects. Consequently, this study aims to assess the level of motivation among Logistics Services Certificate students towards entrepreneurship subjects.

A. Importance Of The Study

The significance of this study extends to three main stakeholders: the college, lecturers, and the Department of Polytechnic and Community College Education (JPPKK), under the Ministry of Higher Education (KPT).

From the college's standpoint, this study serves as a valuable tool for college authorities to evaluate the level of implementation, awareness, and proficiency in entrepreneurship skills acquired through the teaching and learning process. It offers insights into the effectiveness of current practices and highlights areas for improvement in fostering entrepreneurial competencies among students.

For lecturers, the study's findings offer valuable research outcomes, particularly for those involved in teaching entrepreneurship subjects. It provides evidence-based insights to help educators plan effective strategies for integrating entrepreneurial skill elements into their teaching methodologies. By understanding students' needs and challenges related to entrepreneurship education, lecturers can tailor their instructional approaches to better address these areas, ultimately enhancing students' learning experiences.

For students, this study serves as a means to raise awareness about the significance of entrepreneurship skills. These skills are essential for students as they navigate their academic and professional journeys, regardless of their field of study. By understanding the importance of acquiring entrepreneurial skills, students can better appreciate the value of incorporating such competencies into their personal and professional development. Additionally, the study can empower students to actively engage in opportunities to enhance their entrepreneurial capabilities, thereby preparing them for future challenges in the dynamic job market.

In summary, this study contributes to the collective efforts of colleges, lecturers, and educational policymakers in promoting entrepreneurship education and fostering a culture of innovation and enterprise among students. By leveraging the insights gained from this research, stakeholders can collaboratively work towards enhancing the quality and relevance of entrepreneurship education programs, thereby equipping students with the skills and mindset needed for success in the modern workforce.

III. RESEARCH METHODOLOGY

A. Design Research

This study adopts a quantitative approach utilizing a survey design, implemented through the distribution of a questionnaire adapted from existing literature and research instruments [9]. According to Creswell [5], non-experimental studies may not establish cause-and-effect relationships, but they are effective in elucidating relationships between variables and identifying trends in data. In this non-experimental study, the aim is to discern the motivation levels of Logistics Services Certificate students towards entrepreneurship subjects. Survey research, as affirmed by Chua [3], is capable of addressing various types of inquiries, particularly in exploring attitudes, perspectives, beliefs, emotions, and behaviors. This study specifically targets Logistics Services Certificate students enrolled in entrepreneurship subjects.

To ensure the questionnaire's validity in measuring the intended constructs, a pilot study will be conducted with a small focus group. This preliminary testing phase is essential for refining the questionnaire and ensuring its effectiveness in capturing relevant data.

B. Population and Sample

The population in this research refers to a collective of individuals who share common characteristics [5]. Specifically, the population comprises all Management Certificate students in Logistics enrolled in the entrepreneurship subject. A sample, on the other hand, represents a subset of the population and is utilized to draw inferences about the entire population [11]. In this study, the sample was selected through regular random sampling, involving 48 students from KKKLCSG who completed the questionnaire. Cooper [4] suggests that an appropriate number of respondents for a pilot study falls within the range of 25 to 100 individuals. Additionally, Johnson [10] recommends a minimum of 30 respondents for a pilot study.

C. Instruments of Research

This research employs a questionnaire as the primary instrument for data collection, aligning with the research objectives. According to Chua [3], a questionnaire is particularly well-suited for survey research as it can yield reliable and consistent results when appropriately designed [9]. The questionnaire comprises 10 statements, which students rate using a 5-point Likert scale. To ensure validity, the researcher enlisted the help of two entrepreneurship subject teachers to evaluate *the* language, format, and sequencing of the questionnaire items. Subsequently, minor adjustments were implemented to enhance respondent comprehension and facilitate accurate responses.

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D. Pilot Study

The data collection method for this survey research was conducted online, with the questionnaire distributed to respondents via a Google Form webpage link for one week. According to Noraini [11], online data collection methods offer advantages such as ease of administration, quick results, real-time generation of data sets, and sometimes achieving response rates of over 50 percent if well-administered. After collecting and recording responses through the Google Form, the next steps involve analyzing and interpreting the data. The collected data will be analyzed using statistical methods with IBM SPSS Statistics software. Before conducting data analysis, the researcher first learned how to use the SPSS software from a skilled lecturer.

The initial step for the data analysis process using SPSS is to enter data and build an SPSS template. All negative items need to be changed to positive items, where scale 1 for negative items is changed to scale 5, scale 2 to scale 4, scale 3 remains unchanged, scale 4 to scale 2, and scale 5 to scale 1. Negative items within this research are items 3, 6, 7, and 10. Next, the researcher will assess item reliability. The method used to estimate the reliability of research items in this pilot study is by determining internal consistency, as indicated by Cronbach's alpha value [13]. Several recent studies [3], [15] have stated that the accepted Cronbach's Alpha for individual instruments is between 0.65 to 0.95. Based on Table 1, the Likert scale and example question items from the survey were used to gauge respondents' perceptions.

Table 1: Likert scale and sample question items investigate

Very Not Agreed	Do Not Agree	Not sure	Agreed	Strongly Agree
1	**2**	**3**	**4**	**5**
Item				
Q1. I'm having fun learning entrepreneurship subject				
Q2. I gain positive encouragement to learn subject entrepreneurship from lecturer				
Q3. I do not enthusiastic when class entrepreneurship started. **(Negative items).**				
Q4. I immediately make entrepreneurship assignment that given by the lecturer				
Q5. I gain a goal understanding in theory and practice in entrepreneurship subject				
Q6. I procrastinated make an assignment entrepreneurship by lecturers. **(Negative item).**				
Q7. I lack interested involve into area entrepreneurship. **(Negative item).**				
Q8. I learned entrepreneurship subject longer than another subject				
Q9. I'm sure get excellent marks in entrepreneurship				
Q10. I participate less activity in entrepreneurship subject directed by the lecturer **(Negative items).**				

IV. RESULT AND DISCUSSION

The data obtained have been collected and analyzed using IBM SPSS Statistics 27 software. In line with the research objectives, the focus of the analysis is on the level of motivation of logistics students at KKKLCSG towards entrepreneurship. Respondents' demographic profile data in Section A were analyzed descriptively using frequency and percentages. Meanwhile, data in Section B of the questionnaire were also analyzed using frequency, percentages, and standard deviation. Since the Likert scale falls under the ordinal data category, frequency and percentage calculations for each category were used for quantitative comparison [3].

Tables 2, 3, and 4 present information and findings from the descriptive analysis related to Part A regarding the background of the respondents in the research. From the analysis of the data, Table 2 reveals that the highest number of respondents who answered the investigative questions were male students, totaling 26 people (54.2%), while female students totaled 22 people (45.8%). Descriptive analysis was used to analyze the data obtained from the 48 respondents to answer the research questions.

Table 2: Table percentage respondents follow gender

Levels	Counts	% of Total	Cumulative %
Men	26	54.2%	54.2%
Female	22	45.8%	100.0%

Next, Table 3 lists the ages of respondents who answered the research questions. The highest number of students aged 19 years old, totaling 24 people (50%). This is followed by 15 people (31.3%) aged 18 years old, 5 people (10.4%) aged 20 years old, 2 people (4.2%) aged 21 years old, 1 person (2.1%) aged 23 years old, and 1 person (2.1%) aged 24 years old.

Table 3: Table frequency age

Ages	Counts	% of Total	Cumulative %
18	15	31.3%	31.3%
19	24	50.0%	81.3%
20	5	10.4%	91.7%
21	2	4.2%	95.8%
23	1	2.1%	97.9%
24	1	2.1%	100%

From analysis of the data, Table 4 found respondents the highest 33 students (68.8%) have experience or skills in entrepreneurship, while 15 people (31.3%) are vice versa.

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Table 4: Table period experience / skills entrepreneurship by respondents

Levels	Counts	% of Total	Cumulative %
No	15	31.3%	31.3%
Yes	33	68.8%	100.0%

Based on the analysis results presented in Table 5, it is observed that the minimum scores for each item of the student motivation construct range between 3.17 and 4.44. This suggests that students' motivation towards entrepreneurship is notably high. Item Q6 has the minimum value of 3.17, indicating that students do not agree with the statement 'I procrastinate in completing entrepreneurial assignments given by lecturers'. Conversely, item Q2, with the highest value of 4.44, suggests that students receive positive encouragement to learn entrepreneurship subjects from lecturers. The range between the lowest and highest minimum items reflects acceptable data consistency, as it indicates that students consistently receive positive encouragement from lecturers and are unlikely to procrastinate in completing entrepreneurial assignments.

Moreover, item Q10 exhibits the minimum value of 3.25, indicating disagreement with the statement 'I participate less in entrepreneurial activities directed by lecturers properly'. This is consistent with the overall positive encouragement students receive from lecturers, leading to active participation in entrepreneurial activities. Additionally, item Q1 has a very high value of 4.35, and item Q9 has a high value of 4.27. This analysis of respondent data indicates a favorable correlation, affirming that students genuinely enjoy learning entrepreneurship subjects and are confident in achieving excellent results in this area.

Table 5: Analysis descriptive mean and deviation standardized items (N = 48)

Item	Mean	SD
Q1	4.35	0.635
Q2	4.44	0.580
Q3	3.40	1.455
Q4	4.19	0.673
Q5	4.27	0.644
Q6	3.17	1.358
Q7	3.46	1.304
Q8	3.23	1.171
Q9	4.27	0.818
Q10	3.25	1.361

Referring to Table 6, it is notable that item Q3 has the highest percentage for the option 'Strongly Disagree', accounting for 16.7%. This indicates that the majority of students do not agree with the statement "I am not enthusiastic when the entrepreneurship class starts." Similarly, item Q6 exhibits the highest percentage for the choice of 'Disagree', comprising 20.8% of responses, suggesting that most students do not agree with the statement "I procrastinate when completing entrepreneurship assignments given by lecturers."

The highest percentage for the 'Not sure' option is observed for item Q8, with 29.2% of students indicating uncertainty about whether they have been studying entrepreneurship longer than other subjects. Conversely, the 'Agree' option receives a high percentage for item Q4, with 58.3% of students indicating their willingness to promptly complete entrepreneurship assignments given by lecturers. This suggests that the majority of students are proactive in their approach to completing assignments in this subject.

Furthermore, the high percentage of 'Strongly Agree' responses for item Q2, accounting for 47.9%, indicates that a significant proportion of students perceive positive encouragement from lecturers when learning entrepreneurship subjects. Overall, these findings suggest a generally positive attitude towards entrepreneurship education among the surveyed students.

Table 6: Percentage and frequency of items

Item	Very No Agreed	Do not agree	Not sure	Agreed	Strongly Agree
Q1	0	0	4	23	21
	0%	0%	8.3%	47.9%	43.8%
Q2	0	0	2	23	23
	0%	0%	4.2%	47.9%	47.9%
Q3	8	6	7	13	14
	16.7%	12.5%	14.6%	27.1%	29.2%
Q4	0	1	4	28	15
	0%	2.1%	8.3%	58.3%	31.3%
Q5	0	0	5	25	18
	0%	0%	10.4%	52.1%	37.5%
Q6	7	10	8	14	9
	14.6%	20.8%	16.7%	29.2%	18.8%
Q7	6	5	9	17	11
	12.5%	10.4%	18.8%	35.4%	22.9%
Q8	4	9	14	14	7
	8.3%	18.8%	29.2%	29.2%	14.6%
Q9	1	0	5	21	21
	2.1%	0%	10.4%	43.8%	43.8%
Q10	6	9	12	9	12
	12.5%	18.8%	25.0%	18.8%	25.0%

Chua [3] indicated that data follow a normal distribution when the skewness and kurtosis values fall within the range of -1.96 to +1.96. As demonstrated in Table 7, the skewness and kurtosis values are within the specified range. Hence, the data distribution in this research exhibits good normality.

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Table 7: Skewness and kurtosis values

Item	Skewness		Kurtosis	
	Skewness	SE	Kurtosis	SE
Q1	-0.458	0.343	-0.612	0.674
Q2	-0.429	0.343	-0.706	0.674
Q3	-0.477	0.343	-1.146	0.674
Q4	-0.677	0.343	1,198	0.674
Q5	-0.315	0.343	-0.631	0.674
Q6	-0.209	0.343	-1.202	0.674
Q7	-0.626	0.343	-0.645	0.674
Q8	-0.220	0.343	-0.721	0.674
Q9	-1,520	0.343	1,895	0.674
Q10	-0.159	0.343	-1.147	0.674

A pilot study was conducted to assess the trustworthiness of each item in the research questionnaire and to determine the degree of consistency and accuracy of the measurement instrument. A highly reliable instrument provides consistent results or nearly the same results each time it is used in equivalent situations. The analysis results for assessing trustworthiness internally through the overall Cronbach's Alpha value for each factor are presented in Table 8.

Table 8: Value of Cronbach's Alpha coefficient

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. Of Items
0.728	0.768	10

According to Table 8, the overall Cronbach's Alpha of this questionnaire is 0.768 for all 10 items. This indicates a high level of reliability for the items. However, it's also important to consider the Cronbach's Alpha If Item Dropped, which is presented in Table 9. This value may increase if a particular item is dropped from the questionnaire. A higher value might suggest that the dropped item was causing confusion or misunderstanding among respondents. Despite this, the researcher has chosen to retain all items since the overall reliability value of Cronbach's Alpha remains high, at 0.728. Generally, a Cronbach's Alpha value between 0.65 to 0.95 is considered acceptable for an instrument [3].

Table 9: Cronbach's Alpha Value If Item Dropped

Item	Cronbach's Alpha If Items Dropped
Q1	0.705
Q2	0.706
Q3	0.681
Q4	0.712
Q5	0.707
Q6	0.653
Q7	0.678
Q8	0.783
Q9	0.737
Q10	0.666

Table 10: Mean score level of input, process and output (Source: Adaption Creswell, 2005 [6])

Min Score	Interpretation of Min Score
1.00 to 1.80	Very low
1.81 to 2.60	Low
2.61 to 3.40	Medium
3.41 to 4.20	High
4.21 to 5.00	Very high

A. Discussion

This study aimed to assess students' motivation towards entrepreneurship subjects among Logistics Service Certificate students at KKKLCSG. The questionnaire used in this study was developed based on a review of previous literature on students' inclinations towards entrepreneurship. With a total of 10 accepted items, the instrument demonstrated high reliability during the pilot study, achieving a Cronbach's Alpha value of 0.768. The analysis revealed a very high level of student motivation towards learning entrepreneurship subjects. Students expressed excitement about learning this subject and consistently received positive encouragement from their lecturers. Notably, almost 95.8% of respondents agreed or strongly agreed that they received positive encouragement from lecturers to learn entrepreneurship subjects.

Lecturers are pivotal figures in higher education, nurturing students' interests from their initial stages with limited natural inclination. Effective lecturer engagement can deepen students' interest, thereby enhancing learning and academic achievements. The research findings affirm that lecturers have successfully provided encouragement for student engagement in entrepreneurship, signifying progress in this regard. As purveyors of current knowledge, lecturers play a crucial role in realizing national developmental goals, particularly in fostering entrepreneurship culture among Bumiputera students.

Moreover, student motivation significantly influences academic achievement, as highlighted by Noor Erma Abu [18], suggesting that high motivation correlates with better outcomes. Therefore, efforts to enhance student motivation are paramount, stemming from internal drive but also bolstered by external support systems and environmental factors.

The study's findings also indicate a strong student interest in and understanding of entrepreneurship subjects, with a considerable percentage agreeing that they comprehend both theory and practice well. Additionally, a significant

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portion expressed enjoyment in learning entrepreneurship subjects. Lecturers' experiences, teaching methods, and instructional techniques further contribute to shaping student achievement [17].

V. CONCLUSION

Based on the study's findings, it can be concluded that KKLSCG students exhibit a very high level of motivation towards entrepreneurship subjects. This underscores their strong interest in entrepreneurship and their preparedness for entrepreneurial endeavors. These findings hold implications for the implementation of teaching and learning methods for entrepreneurship subjects at KKKLCSG. Adopting experiential learning strategies necessitates support from lecturers and appropriate infrastructure. It also requires commitment in terms of time, finances, and a departure from traditional teaching methods to ensure that knowledge and skills align with current needs. Highly motivated and entrepreneurial-minded students should be nurtured and can serve as role models for their peers.

Government ministries and departments must reassess student education curricula to ensure relevance. Entrepreneurship education should be integrated into curricula from the early stages of education. Equipping students with technical and entrepreneurial skills is essential to foster their willingness and confidence to pursue business ventures. Mere motivation and entrepreneurial mindset without specific skills and foundational knowledge in entrepreneurship are insufficient to actualize entrepreneurial intentions.

Consideration of student motivation is crucial, as high motivation positively impacts student achievement. Students with high interest and motivation in entrepreneurship are expected to have promising entrepreneurial futures, thus supporting the National Entrepreneurship Policy 2030 (DKN 2030). This endeavor is vital for realizing the government's vision of making TVET institutions centers for nurturing entrepreneurial human capital, fostering independent and successful entrepreneurs, improving the societal economy, and addressing increasing unemployment rates.

Given the study's limited duration and resources, the findings are confined to the sampled group. However, the research instrument can be applied in future studies with similar objectives involving larger and more diverse populations. Additionally, further research on digital entrepreneurship, particularly within the Community College context, could explore students' motivation levels across various fields of study. Furthermore, investigating hindering factors to student motivation towards entrepreneurship subjects warrants deeper exploration.

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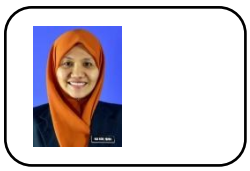
First Author: Wan Nurul Hidayah Wan Mohamad Akil 	Kuala Langat Community College Sepang Branch, Ministry of Higher Education Email: wnhkkhl@gmail.com
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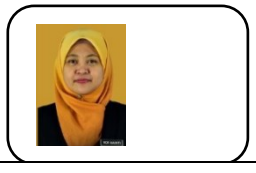
Fourth Author: Siti Nor Hayati Binti M.Yusop 	Kuala Langat Community College Sepang Branch, Ministry of Higher Education Email: wnhkkhl@gmail.com

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Towards Sustainability: Unveiling Insights from a Systematic Review of Green Accounting Practice Literature

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Abstract

In recent years, there has been a growing recognition of the urgent need for sustainable practices across various sectors to mitigate environmental degradation and promote long-term ecological balance. This has led to an increased focus on green accounting as a means of integrating environmental considerations into financial decision-making processes. This study uses a systematic review to contribute to advancing our understanding of green accounting literature from 2019 to 2023 by adhering to the PRISMA guidelines. The methodology for this systematic review encompassed a thorough search of academic databases, specifically Scopus and Web of Science (WoS), utilizing pertinent keywords associated with green accounting. Through the synthesis of findings from eligible articles, the review illuminates the trends, key themes, sustainability factors, and implications in the field of green accounting. Key themes that emerged from the analysis include the role of green accounting in influencing organizational decision-making processes. It sheds light on how green accounting influences the sustainability of economic viability, social equity, environmental protection, ecological balance, and technological innovation, particularly in shaping organizational decision-making processes. For conclusion, the findings of this systematic review highlight the growing importance of green accounting in promoting sustainable practices and shaping organizational decision-making processes, underscoring the need for further research and policy development in sustainability accounting.

Keywords **:** *Green Accounting, Sustainability, Systematic Reviews*

I. INTRODUCTION

The adoption of green accounting signifies a significant evolution in modern financial methodologies by seamlessly integrating environmental considerations and sustainability principles into traditional accounting and reporting systems. This progressive approach involves the systematic measurement, quantification, and transparent disclosure of the environmental impact stemming from business activities. The overarching aim is to champion environmental sustainability and instill a sense of corporate responsibility within the framework of financial practices [31]. The essence of green accounting lies in integrating environmental costs and benefits into economic decisions and financial reporting [80]. Research indicates that the implementation of green accounting significantly enhances the sustainable development capabilities of heavily polluting companies, showcasing a positive correlation between the quality of social responsibility information disclosure and sustainable development capabilities [28].

II. LITERATURE REVIEW

Green accounting emerges as a comprehensive framework that integrates environmental considerations into various facets of contemporary business practices. It encompasses the evaluation of environmental costs, the implementation of corporate sustainability management systems, and the assessment of economic value derived from sustainable initiatives [3]. Additionally, the practice involves the transparent disclosure of sustainability reports, influencing both firm values and the overall perception of the company among stakeholders [36].

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Moreover, green accounting extends its reach to evaluate environmental performance, reduce costs through activity-based costing, and impact company profitability [44].

Green accounting has a significant positive effect on environmental disclosure, which in turn influences the achievement of Sustainable Development Goals (SDGs) positively. This indicates that incorporating green accounting practices can lead to environmental sustainability and contribute to the achievement of SDGs [72]. By implementing green accounting practices, organizations can accurately report their environmental impacts, including carbon emissions, pollution, and resource use. This transparent reporting allows stakeholders to better understand the environmental risks and opportunities related to the organization's activities. Additionally, the importance of corporate social responsibility in implementing green accounting is highlighted, aligning business practices with sustainable development objectives [79]. By integrating green accounting principles and corporate social responsibility initiatives, organizations can play a crucial role in advancing the SDGs and promoting sustainable development.

Moreover, green accounting positively influences environmental performance, with energy efficiency acting as a partial mediator in the relationship between green accounting and environmental performance [82]. This underscores the pivotal role of green accounting in promoting environmental sustainability and addressing ecological challenges. Additionally, green accounting is viewed as an embodiment of corporate social responsibility, aiming to mitigate the impact of business activities on the environment [18]. It is evident that green accounting plays a crucial role in fostering sustainable business practices and environmental stewardship. Aligned with the principles of triple bottom line accounting, which assesses economic, social and environmental performance [17], green accounting plays a pivotal role in fostering sustainable lifestyles, ethical consumer behaviors, and responsible business practices [48]. Furthermore, green accounting is intricately connected to the advancement of sustainable logistics, the selection of environmentally conscious suppliers, and the assessment of urban green areas, underscoring its relevance across diverse sectors and industries [75].

Furthermore, the application of green accounting has been correlated with business sustainability, impacting the financial performance and sustainable development of companies [45]. The adoption of green accounting principles by listed companies has been identified as a contributor to sustainability, aligning with the green economy and sustainable accounting practices [27]. This emphasizes the significance of integrating green accounting into business operations to achieve sustainability goals. In essence, green accounting stands as a holistic and proactive approach to accounting, aiming to align business operations with environmental and social responsibility, thereby contributing significantly to sustainable development and societal well-being.

The paper is intended to explore the literature review focusing on emerging studies related to green accounting and sustainability between the years 2019 and 2023. This time frame is particularly significant when examining rapidly evolving fields such as green accounting. The methodology employed is a systematic literature review (SLR), and the analysis is conducted within empirical studies available in the Scopus and WOS databases. The SLR aims to identify and analyze key themes within the literature, specifically pertaining to sustainable practices and environmental stewardship within the context of green accounting. The objective is to provide insights that contribute to a deeper understanding of green accounting and its implications for sustainability. It is anticipated that this paper will offer a fresh perspective on the integration of environmental considerations and sustainability principles, uncovering potential gaps and emerging findings within the field.

III. RESEARCH METHODOLOGY

The systematic literature review (SLR) utilized in this study strictly follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which are a well-suited methodology for synthesizing research findings from the most impactful selected studies in this research field. The PRISMA guidelines, delineate four main steps: identification, screening, eligibility assessment, and identification of findings [71]. This method ensures transparency in the data collection process and offers a clear account of the final number of papers included in the review. The SLR was conducted to analyze relevant papers and identify the factors associated with green accounting. This paper presents a comprehensive protocol that assists researchers in specifying the criteria for data search. This process includes selecting reliable databases, identifying search terms, determining inclusion and exclusion criteria, establishing quality standards, and emphasizing sustainability.

Furthermore, this study expands its scope by highlighting existing limitations and identifying knowledge gaps in the current literature. It also aims to establish a research agenda for the future. Therefore, the objective is to address the following questions:

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(1) What are the current trends in the literature on green accounting?
(2) How have previous studies categorized the primary research themes related to the intersection of green accounting?
(3) What are the main findings of the selected studies that analyze the sustainability factors of green accounting?
(4) What are the implications for the practice of green accounting?

By addressing these objectives, this study aims to contribute valuable insights to academia, practitioners, and policymakers alike, fostering a deeper understanding of the transformative potential of sustainability through green accounting. Numerous studies have undertaken comprehensive literature reviews on green accounting, identifying gaps and limitations in the current body of work while pinpointing areas for additional advancements in knowledge within this research domain [104].

Database selection is a crucial aspect of research, especially when gathering publication metadata and bibliometric indicators. These selections are the most commonly utilized tools in research assessment. The choice of a reliable data source significantly affects the credibility of a study.

It also crucial to guarantee the accuracy and reliability of the information employed in research and decision-making [99]. Scopus and Web of Science (WoS) in high-ranking English journals are widely used bibliographic databases and considered primary sources [66]. It is important to note that relying solely on one database may not be sufficient for a systematic literature review [38]. These databases are considered commonly used in systematic reviews across various domains [22]. Therefore, for this study, the primary data sources chosen are Scopus and Web of Science.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Year	2019-2023	Any previous year of 2019
Language	English	Any other language
Document Types	Final journal article	Book, book chapter etc.
Journal Types	Accounting, Business management, Economics, Social Science and Sustainability Journal	Other than Accounting, Business management, Economics, Social Science and Sustainability Journal

In the identification phase, researchers expand basic keywords to optimize the database's retrieval of relevant articles. Employing a broader range of keywords enhances the likelihood of obtaining more pertinent articles. Before selecting effective based keywords, it is essential to establish several fundamental concepts [35]. The identification process initiates by identifying keywords or phrases with precise or nearly synonymous meanings and related terms, covering all word variations. Sources for keyword exploration include keywords from previously related articles, database-recommended keywords, online repositories of synonymous words, and expert-provided keyword suggestions [60]. Hence, the search string keywords for Scopus and Web of Science are: TITLE-ABS-KEY (“green accounting” OR “environmental accounting”) AND (“sustainability” OR “sustainable” OR “sustainable development”).

The search procedure effectively detected an aggregate of 180 articles. This included 94 articles from Scopus and 86 articles from Web of Science (WoS). The search covered a 5-years inclusion period spanning from 2019 to 2023, excluding books, book chapters, and similar sources. The language criterion for inclusion was restricted to English. Utilizing an exact search string, restrictions and filters were implemented following the guidelines presented in Table 1 of the checklist to guarantee the thorough inclusion of all PRISMA items. This checklist offers directives on systematic review reporting, delineating methods for determining study inclusion, eligibility criteria, and evaluating reporting bias [67]. Notably, the search string filter focuses on final and article document types within the domains of Accounting, Business management, Economics, Social Science and Sustainability Journal.

Following the identification of articles, a meticulous screening process was initiated to identify and exclude duplicated articles. A total of 41 duplicated articles were identified and subsequently excluded. The next stage involved screening based on titles, with 7 articles excluded as were not pertinent to the study. The third stage focused on eligibility, where 62 full articles were accessed. After thorough examination, 31 articles were excluded due to issues accessing the full article and a lack of alignment with the research objectives in the abstract.

The conclusive phase of the examination revealed that a total of 62 articles were employed in the ultimate analysis. As depicted in Figure 1, the evaluation procedure involves identification, screening, eligibility, and inclusion stages, following the framework [71]. The review encompasses 61 selected articles to facilitate a comprehensive synthesis of academic literature on green accounting. This synthesis will adhere to the systematic review approach [70].

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The articles underwent a thorough evaluation and analysis, emphasizing transparency and traceability. Specific studies were scrutinized meticulously to grasp the underlying interests and associated factors. The researchers aimed to formulate pertinent themes, and comprehensive reviews were conducted based on the entirety of the

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Figure 1.
A PRISMA Flow Diagram for Systematic Review based on Matthew J. et al., (2021)

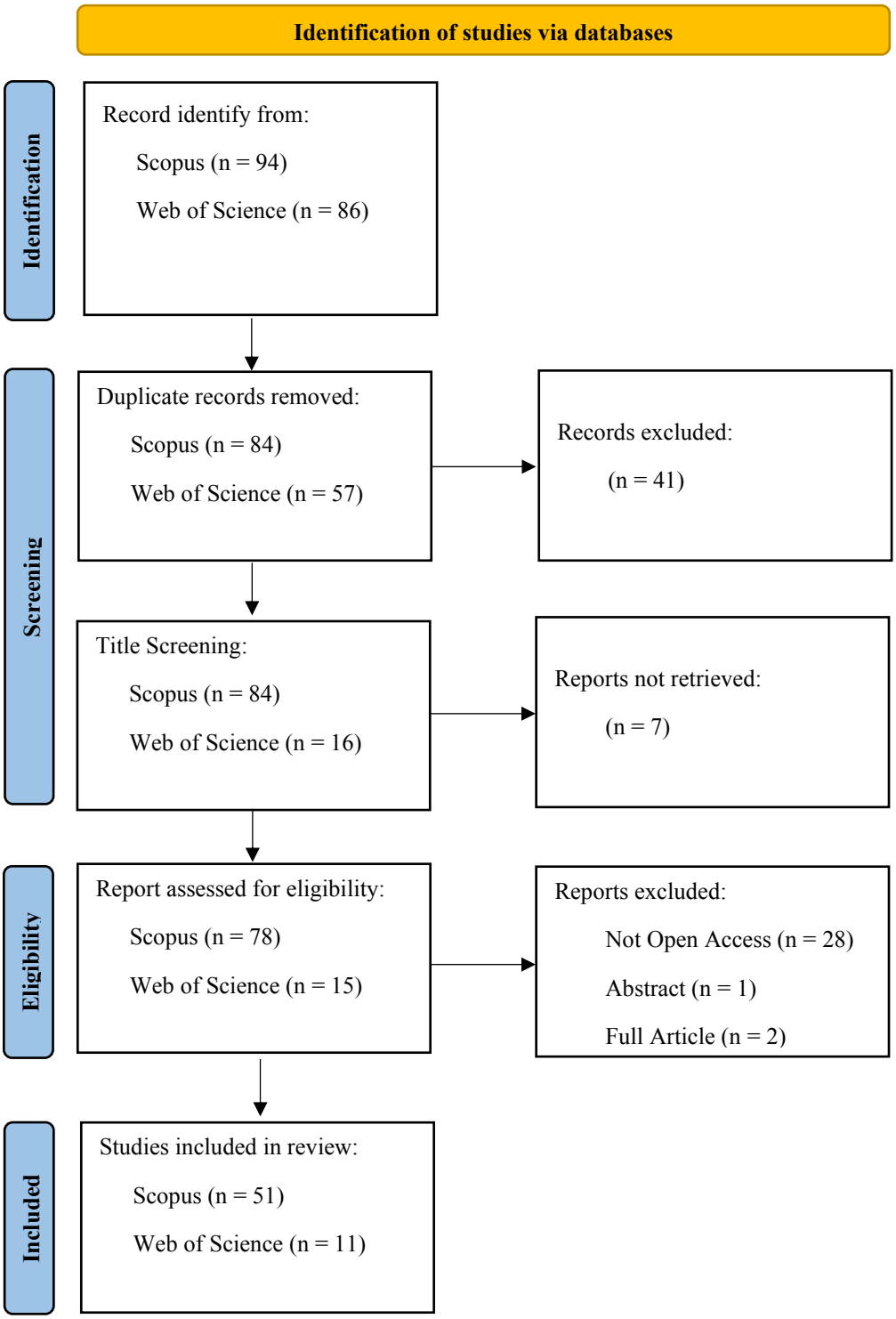

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Table 6. Descriptive Summary of the Selected Studies

Sr	Authors	Titles	Year	Journals	Country	Method
1	Ma, J., & Ma, J.	A Research Review of Corporate Green Accounting Information Disclosure	2019	Earth and Environmental Science	China	Mixed
2	Zhao & Liu	Analysis on Industrial Correlation of China: Considering the Energy Resources Based on Green Accounting	2019	Earth and Environmental Science	China	Quantitative
3	McGrath et al.	Augmenting the World Bank's Estimates: Ireland's Genuine Savings Through Boom and Bust	2019	Ecological Economics	Ireland	Quantitative
4	Tobing et al.	Designing A Sustainable Green Accounting System Based on Enterprise Resource Planning for Leather Tanning Industry	2019	Research of Information Technology and Intelligent Systems	Indonesia	Quantitative
5	Dutta et al.	Green Accounting in Achieving Higher Corporate Profitability and Sustainability in Ready Made Garment Industry in Bangladesh. A Conceptual Analysis	2019	Advanced Journal of Accounting and Finance	Bangladesh	Qualitative
6	Hasan et al.	Green Business Value Chain: A Systematic Review	2019	Sustainable Production and Consumption	Global	Qualitative
7	Tu & Huang	Relationship Between Green Design and Material Flow Cost Accounting in The Context of Effective Resource Utilization	2019	Sustainability	Global	Mixed
8	S. Singh et al.	Revolution of Green Accounting: A Conceptual Review	2019	Power Energy Environment and Intelligent Control	India	Qualitative
9	Addicott & Fenichel	Spatial Aggregation and The Value of Natural Capital	2019	Journal of Environmental Economics and Management	Global	Quantitative
10	Chu et al.	Top Management Attributes, Psychological Capital, and Green Accounting Effectiveness in Public-Private Partnership Context	2019	Frontiers in Psychology	Taiwan	Mixed
11	Kabir M	Valuation of Subsoil Minerals in Bangladesh: An Application of The System of Environmental-Economic Accounting	2019	Resources Policy	Bangladesh	Quantitative

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12	Ulupui, Maruhawa, et al.	Carbon Emission Disclosure, Media Exposure, Environmental Performance, Characteristics of Companies: Evidence from Non-Financial Sectors in Indonesia.	2020	Journal of Accounting and Auditing	Indonesia	Quantitative
13	Brooks & Schopohleen	Accounting and Finance: Advancing Research on Environmental Disclosure, Value Impacts and Management Control Systems	2020	British Accounting Review, Forthcoming	Global	Mixed
14	AAl-Dhaimesh	Green Accounting Practices and Economic Value Added: An Applied Study on Companies Listed on The Qatar Stock Exchange	2020	International Journal of Energy Economics and Policy.	Qatar	Quantitative
15	Ulupui, Murdayanti, et al.	Green Accounting, Material Flow Cost Accounting and Environmental Performance	2020	Accounting	Indonesia	Mixed
16	Raka et al.	Green Reputation of Hotel Improvement Through Green Accounting and Harmonious Culture	2020	UOW Library	Indonesia	Quantitative
17	Lee' et al.	Intellectual Capital for Green Accounting in Agribusiness	2020	International Food and Agribusiness Management Review	Global	Qualitative
18	Wu & Han	Sectoral Changing Patterns of China's Green GDP Considering Climate Change: An Investigation Based on The Economic Input-Output Life Cycle Assessment Model	2020	Journal of Cleaner Production	China	Quantitative
19	Riyadh et al.	The Analysis of Green Accounting Cost Impact on Corporations Financial Performance	2020	International Journal of Energy Economics and Policy	Global	Quantitative
20	Jardim et al.	The Effect of Compliance with Environmental Standards on Informational Content of Foundational Figures of Accounting (Case Study of Automobile Manufacturing Companies)	2020	Revista De Direito Da Cidade-City Law	Global	Mixed
21	Endiana et al.	The Effect of Green Accounting on Corporate Sustainability and Financial Performance	2020	The Journal of Asian Finance, Economics and Business	Global	Mixed
22	Sudaryati et al.	The Mediating Role of Green Innovation on The Effect of Environment-Based Culture on Company Performance	2020	International Journal of Innovation, Creativity and Change	Indonesia	Mixed

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23	Lusiana et al.	A Review of Green Accounting, Corporate Social Responsibility Disclosure, Financial Performance and Firm Value Literature	2021	Industrial Engineering and Operations Management	Global	Qualitative
24	Saputra et al.	Combining the Concept of Green Accounting with The Regulation of Prohibition of Disposable Plastic Use	2021	International Journal of Energy Economics and Policy	Indonesia	Qualitative
25	Purnomo et al.	Green Accounting Study: Twenty-Seven Years Lesson of Scientometric Mapping	2021	Industrial Engineering and Operations Management	Global	Quantitative
26	Verma S	Green Economy and Sustainable Development: A Macroeconomic Perspective	2021	Environmental Sustainability and Economy	India	Mixed
27	Pekanov Starčević etl.	Investing in CHP Plants: Estimating External Costs and Benefits	2021	Ekonomski Vjesnik	Croatia	Quantitative
28	Iskandar etl.	Student's Literacy on Green Accounting Concept and Its Challenges Ahead	2021	Journal of Educational and Social Research	Global	Qualitative
29	Maama & GMa	Carbon Accounting, Management Quality, And Bank Performance in East Africa	2022	Environmental Economics	East Africa	Quantitative
30	Baharloo et al.	Developing and Presentation of Appropriate Tools to Measure the Level of Compliance with The Criteria Affecting the Environmental Performance of Industries Using the Fuzzy DANP Approach	2022	International Journal of Nonlinear Analysis and Applications	Global	Quantitative
31	S. M. F. Islam & Hossain	Eco-Affecting Reporting Practices of Publicly Traded Engineering Companies in Bangladesh	2022	Journal of Environmental Accounting and Management	Bangladesh	Quantitative
32	Kartikasary et al.	For the Better Future: The Green Movement and Indonesia Manufacturing Performance	2022	Sustainable Islamic Business and Finance	Indonesia	Mixed
33	Bąk & Strojek-Filus	Impression Management in Reporting Environmental Information in Groups of The Energy, Raw Materials and Fuel Sectors. Evidence from Poland	2022	Ekonomia I Srodowisko-Economics and Environment	Poland	Qualitative
34	A. Singh et al.	Interpretive Structural Modelling (ISM) Of Enablers Affecting Green Accounting in Indian Manufacturing Sector: A Conceptual Model	2022	Nature Environment and Pollution Technology	India	Qualitative
35	Padhan & Das	Physical and Monetary Asset Accounting of Mineral Resources in India	2022	Resources Policy	India	Quantitative

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36	Cairns & Hartwick	Reconciling Hotelling Resource Models with Hotelling's Accounting Method	2022	Energy Journal	Global	Quantitative
37	Buric et al.	Research of Attitudes Toward Implementation of Green Accounting in Tourism Industry in Montenegro-Practices, and Challenges	2022	Sustainability	Montenegro	Mixed
38	Andrian & Pangestu	Social Responsibility Disclosure: Do Green Accounting, CEO Power, Board Gender, And Nationality Diversity Matter?	2022	Corporate Governance and Organizational Behavior Review	Indonesia	Quantitative
39	McGrath et al.	The Air We Breathe: Estimates of Air Pollution Extended Genuine Savings for Europe	2022	Income and Wealth	Europe	Quantitative
40	Yang & Zhong	The Combined Effect of Environmental Policies on China's Renewable Energy Development: A Multi-Perspective Study Based on Semiparametric Regression Model	2022	International Journal of Environmental Research and Public Health	China	Quantitative
41	Agyemang et al.	Assessing the Impact of Environmental Accounting Disclosure on Corporate Performance in China	2023	Environmental Engineering & Management Journal	China	Quantitative
42	Gonzalez & Peña-Vinces	A Framework for A Green Accounting System-Exploratory Study in A Developing Country Context, Colombia	2023	Environment, Development and Sustainability	Colombia	Mixed
43	Çil Koçyiğit et al.	Bibliometric Mapping of Studies on Green Accounting in Health	2023	Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences	Worldwide	Qualitative
44	Nguyen & Ngo	Determinants Influencing the Application of Lean Accounting: The Case of Vietnamese Garment Firms	2023	Journal of Risk and Financial Management	Vietnamese	Quantitative
45	Nguyen et al.	Determinants Influencing the Application of Green Accounting: The Case of Emerging Market Constructions Firms	2023	Corporate Governance and Organizational Behavior Review	Vietnamese	Quantitative
46	Wiguna et al.	Determinants of Sustainable Development: The Role of CSR Disclosure	2023	Problems and Perspectives in Management	Global	Quantitative
47	Orbaningsih	Distribution Financial Performance of Corporate as An Impact of Green Accounting Regulation	2023	Journal of Distribution Science	Global	Quantitative

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48	Sukmadilaga et al.	Does Green Accounting Affect Firm Value? Evidence from ASEAN Countries	2023	International Journal of Energy Economics and Policy	ASEAN	Quantitative
49	Wiredu et al.	Does Green Accounting Influences Ecological Sustainability? Evidence from A Developing Economy	2023	Cogent Business & Management	Global	Quantitative
50	S. Islam et al.	Evaluating the Success of Green Accounting Practices in The Banking Sector of Bangladesh	2023	International Journal of Applied Economics, Finance and Accounting	Bangladesh	Mixed
51	Astari et al.	Green Accounting and Disclosure of Sustainability Report on Firm Values in Indonesia	2023	EDP Sciences	Indonesia	Quantitative
52	Mansour Stoian & Spătariu	Green Accounting and Reporting - Achievements So Far and Opportunities Ahead: Critical Research of Sustainability Reports of Romanian Companies	2023	Proceedings of The International Conference on Business Excellence	Romanian	Qualitative
53	Lestari D	Green Accounting, Environmental Accounting, and Carbon Accounting: Is It the Same?	2023	Kurdish Studies	Global	Qualitative
54	Chircop et al.	Learning to Be Green: Accounting Comparability and Environmental Violations	2023	The British Accounting Review	Global	Qualitative
55	Sardana & Simpson	Mainstreaming Biodiversity into Policy–Do the Numbers Add-Up?	2023	Environmental and Sustainability Indicators	Global	Mixed
56	Chen et al.	Research on The Outgoing Audit and Evaluation of Water Resource Assets of Leadership Cadres in City Y	2023	Sustainability	China	Quantitative
57	Fezzi et al.	The Economic Value of Coral Reefs: Climate Change Impacts and Spatial Targeting of Restoration Measures	2023	Ecological Economics	Global	Quantitative
58	Yao et al.	The Evolution of Renewable Energy Environments Utilizing Artificial Intelligence to Enhance Energy Efficiency and Finance	2023	Heliyon	Global	Mixed
59	Rahman & Islam	The Impact of Green Accounting on Environmental Performance: Mediating Effects of Energy Efficiency	2023	Environmental Science and Pollution Research	Bangladesh	Quantitative
60	Jumaah F	The Impact of Green Activity-Based Costing in Reducing Costs in The Oil Refinery in Southern Iraq	2023	Kurdish Studies	Iraq	Quantitative
61	Sidarta et al.	The Influence of Green Accounting on The Company Profitability	2023	Revista De Gestao E Secretariado-Gesec	Indonesia	Quantitative

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62	Srouji A	The Mediating Role of Green Disclosures on The Relationship Between Sustainability and Financial Performance in an Emerging Market	2023	Springer Nature Switzerland	Jordan	Quantitative

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articles. Subsequently, NVivo R4 was employed for qualitative content analysis. It provides an intuitive interface and an extensive array of features crafted to support thorough exploration and comprehension of qualitative research data [59]. NVivo is a qualitative data analysis software that enables researchers to organize, analyze, and derive meaningful insights from unstructured data such as textual information.

In this context, NVivo has been utilized to process and analyze relevant documents, identifying the prevalence and significance of specific terms in the realm of green accounting. Qualitative analysis within textual data pertains to the structured interpretation of its content. This extends beyond mere word tallying, focusing instead on discerning meanings, themes, and patterns within the text via a methodical process of coding and classification [52]. Therefore, crucial activities such as coding and identifying themes and patterns emerging from the content analysis were integral to this process, promoting transparency and traceability in the study's findings.

IV. RESULT AND DISCUSSION

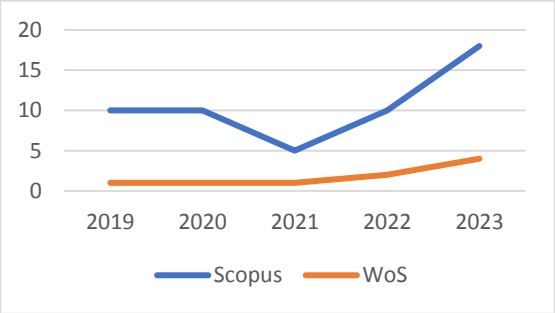
This study presents the results of this Systematic Literature Review (SLR) in three main sections: i) descriptive quantitative analysis, ii) thematic content analysis, and iii) implications.

Descriptive Quantitative Analysis

This section presents the descriptive statistics of research publications in the existing green accounting literature. Table 6 reveals that all 62 articles selected in this systematic literature review (SLR) were published between 2019 and 2023. It is worth noting that all criteria outlined in the SLR were successfully met. Figure 2 illustrates the trend in green accounting literature from 2019 to 2023, as indicated by the number of publications in Scopus and Web of Science. In 2019 and 2020, there were 11 publications each year, while in 2021, the number slightly decreased to 6. However, there is a noticeable upward trend in 2022 and 2023, with 12 and 22 publications respectively. This indicates a growing interest and involvement in green accounting research during these years. The cumulative total demonstrates a consistent increase, with 62 publications by the end of 2023. Significantly, the Scopus database contributes significantly to the overall count, highlighting the active exploration and contribution of the academic community to the discourse on green accounting. The increase in both Scopus and Web of Science (WoS) publications over the years reflects a broader recognition and emphasis on sustainability concerns within the accounting literature.

Researchers and scholars have actively participated in debates and discussions surrounding the growing importance of green accounting, as shown in Table 2. Notable journals in this field include the "International Journal of Energy Economics and Policy" and "Sustainability," which have a significant influence in disseminating research on green accounting topics. The inclusion of a wide range of journals highlights the interdisciplinary nature of green accounting, extending beyond accounting-focused publications to encompass economic, social, and environmental aspects. The collaborative efforts of researchers and scholars within these journals collectively contribute to the advancement in understanding and implementing environmentally conscious accounting practices across different sectors.

Figure 2. The Trend of Green Accounting Literature in Scopus and WoS Database



Additionally, the analysis revealed a significant number of citations linked to the term 'performance' as a key indicator, particularly within the domain of research policy and systems. It is essential to recognize that citation counts play a crucial role in gauging the quality and impact of research. Presented in Table 3 are the most cited articles among the 62 extracted from Scopus and WoS. Notably, the article authored by Hasan et al. (2019) stands out as the most highly cited, with 77 citations.

Table 2. Journal Names and Number of Papers

Journal Name	Papers
International Journal of Energy Economics and Policy	4
Sustainability	3
Corporate Governance and Organizational Behaviour Review	2
Earth and Environmental Science	2
Ecological Economics	2
Industrial Engineering and Operations Management	2
Kurdish Studies	2

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Resources Policy	2
Accounting	1
Advanced Journal of Accounting and Finance	1
British Accounting Review, Forthcoming.	1
Cogent Business & Management	1
Economics and Environment	1
EDP Sciences	1
Ekonomski Vjesnik	1
Energy Journal	1
Environment, Development and Sustainability	1
Environmental, Sustainability and Economy	1
Environmental and Sustainability Indicators	1
Environmental Economics	1
Environmental Engineering & Management Journal	1
Environmental Science and Pollution Research	1
Frontiers in psychology	1
Heliyon	1
Income and Wealth	1
International Food and Agribusiness Management Review	1
International Journal of Applied Economics, Finance and Accounting	1
International Journal of Environmental Research and Public Health	1
International Journal of Innovation, Creativity and Change	1
International Journal of Nonlinear Analysis and Applications	1
Journal of Accounting and Auditing	1
Journal of Cleaner Production	1
Journal of Distribution Science	1
Journal of Educational and Social Research	1
Journal of Environmental Accounting and Management	1
Journal of environmental economics and management	1
Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty	1
Journal of Risk and Financial Management	1
Nature Environment and Pollution Technology	1
Power Energy Environment and Intelligent Control	1
Problems and Perspectives in Management	1
Business Excellence	1
Research of Information Technology and Intelligent Systems	1
Revista De Direito Da Cidade-City Law	1
Revista De Gestao E Secretariado-Gesec	1
Springer Nature Switzerland	1
Sustainable Islamic Business and Finance	1
Sustainable Production and Consumption	1
The British Accounting Review	1
The Journal of Asian Finance, Economics and Business	1
UOW Library	1
Total	**62**

Table 3. Most Cited Articles

Title	Authors	Citations
Green business value chain: A systematic review	(Hasan et al., 2019)	77
Sectoral changing patterns of China's green GDP considering climate change: An investigation based on the economic input-output life cycle assessment model	(Wu & Han, 2020).	28
Spatial aggregation and the value of natural capital	(Addicott & Fenichel, 2019)	12
Combining the concept of green accounting with the regulation of prohibition of disposable plastic use	(Saputra et al., 2021)	12
Augmenting the World Bank's Estimates: Ireland's genuine savings through boom and bust	(McGrath et al., 2019)	8
The effect of green accounting on corporate sustainability and financial performance	(Endiana et al., 2020)	8
The air we breathe: Estimates of air pollution extended genuine savings for Europe	(McGrath et al., 2022)	7

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Assessing the Impact of Environmental Accounting Disclosure on Corporate Performance in China	(Agyemang et al., 2023)	7
Green economy and sustainable development: A macroeconomic perspective	(Verma, 2021)	6
Does green accounting influences ecological sustainability? Evidence from a developing economy	(Wiredu et al., 2023)	6
The economic value of coral reefs: Climate change impacts and spatial targeting of restoration measures	(Fezzi et al., 2022)	6
The impact of green accounting on environmental performance: mediating effects of energy efficiency	(Rahman & Islam, 2023)	6

Table 4 presents an overview of the various theories utilized in this study, along with the corresponding number of studies that have employed each theory. Legitimacy Theory emerges as the most frequently utilized framework, with nine studies dedicated to exploring how organizations navigate and maintain legitimacy in the eyes of stakeholders. Stakeholder Theory follows closely behind, with eight studies focusing on the intricate dynamics of organizational-stakeholder relationships. Economic Theory is also prominent, with six studies delving into the economic factors shaping organizational behaviors and decision-making processes.

Additionally, Institutional Theory, Accounting Theory, and a range of other theories each receive attention in varying degrees, highlighting the multifaceted approaches to understanding organizational phenomena. Notably, the inclusion of Green Accounting Theory in one study underscores a growing interest in environmental sustainability within accounting practices, reflecting a broader recognition of the importance of integrating environmental considerations into organizational strategies and decision-making processes.

Table 4. Theories Used in the SLR articles

Theories Used	Number of Studies
Legitimacy Theory	9
Stakeholder Theory	8
Economic Theory	6
Institutional Theory	3
Accounting Theory	2
Green Accounting Theory	1
Green Input-Output Theory	1
Agency Theory	1
Contingency Theory	1
Intellectual Capital Theory	1
Grounded Theory	1
Natural Capital Asset Pricing Theory	1
Endogenous Growth Theory	1
Green Institutional Environment Theory	1
Renewable Energy Investment Theory	1
Signalling Theory	1
Management Accounting Theory	1

The graph in Figure 3 illustrates the trend in green accounting literature from 2019 to 2023, showing a significant increase in the use of quantitative research methods. The number of quantitative articles consistently rose from 5 in 2019 to 14 in 2023. In contrast, the number of qualitative articles varied, with 3 in 2019, 1 in 2020, 3 in 2021, 2 in 2022, and 4 in 2023. Mixed-method articles remained relatively stable, with 3 in 2019, 5 in 2020, 1 in 2021, 2 in 2022, and 4 in 2023. This trend suggests a growing preference for quantitative approaches in studying green accounting practices, while qualitative and mixed-method approaches remain relevant but show less consistent trends. This pattern indicates a maturation of reporting practices, possibly driven by the need for more measurable and comparable data for decision-making and accountability purposes in the context of sustainability.

Figure 3. The Methodology Trend in Green Accounting Literature

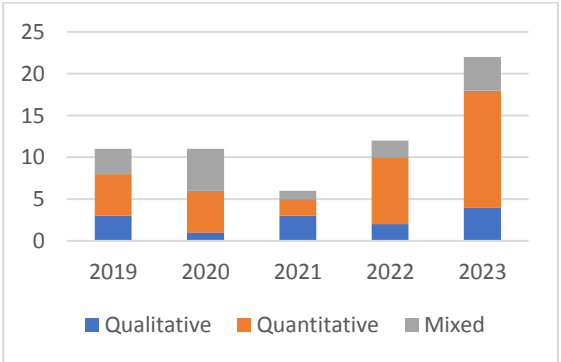

Figure 4 presents the distribution of green accounting articles among different countries,

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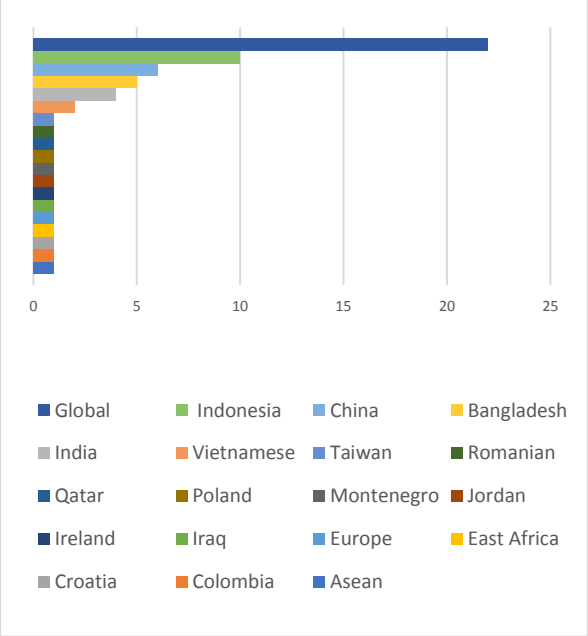
highlighting the top influential countries in this field. Among the ASEAN region, Vietnam stands out with 2 articles, while Indonesia leads with 10 articles, indicating a significant focus on green accounting practices in these countries. India and Bangladesh are also notable contributors, with 4 and 5 articles respectively. China, with 6 articles, demonstrates substantial interest in green accounting, reflecting its efforts towards sustainability and environmental management. Other countries like Qatar, Iraq, and Jordan show only a single article each, indicating a nascent but emerging interest in green accounting practices. Overall, the distribution of articles suggests a global interest in green accounting, with various countries contributing to the advancement of sustainable accounting practices.

Figure 4. Top Influential Countries related to Green Accounting Practice



The distribution of articles across different sectors in green accounting practice, as depicted in Figure 5, reveals varying levels of focus and research interest. Manufacturing emerges as the most prominent sector with 5 articles, indicating a strong emphasis on enhancing resource efficiency and sustainability within manufacturing processes. Energy resources follow closely with 3 articles, suggesting a concerted effort to address sustainability challenges in energy-related industries. The financial sector is represented by 3 articles, underscoring a growing awareness of the need for financial institutions to integrate environmental considerations into their accounting practices.

Other sectors, such as garment, hotel, renewable energy, and agribusiness, also show notable interest in green accounting, each with 2 articles. Sectors like automobile, banking, ceramic, chemical, commercial, construction, corporate, disposable plastic use, distribution, engineering, health, leather tanning, mineral resources, mining, natural resources, palm oil, petroleum, pharmaceutical and chemical, tourism, and water resource management are represented by 1 article each. The remaining 23 articles, which make up a substantial number, highlight a broader, more generalized focus in a significant portion of the research. Together, these findings reflect a diverse and evolving landscape of green accounting practices, indicating a widespread recognition of the importance of sustainability across various industries.

Figure 5. Prominent Sector in Green Accounting Practice

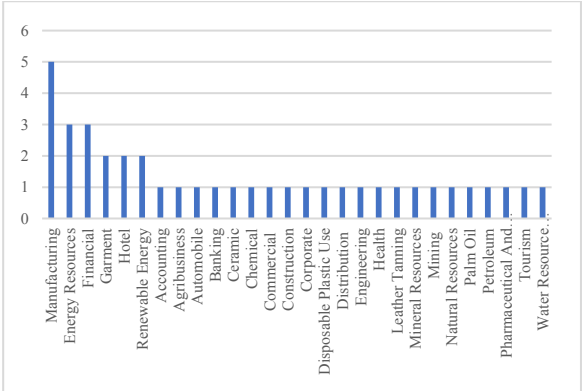


Figure 6. Word Cloud Analysis

The findings presented in Figure 6, which showcase the Word Cloud Analysis and the weighted percentages associated with green accounting themes, originate from data analysis conducted using NVivo. The analysis reveals the prominence of certain keywords and their respective weighted percentages in the context of green accounting themes. The term "accounting" holds the

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highest weight at 0.93, indicating its central role in discussions related to green accounting. Other significant terms include "environmental" (0.89), "green" (0.74), and "energy" (0.59), underscoring the focus on environmentally conscious and sustainable practices within the accounting domain. Additionally, terms such as "research," "development," and "value" suggest an emphasis on innovation and value creation in the context of green accounting. The inclusion of terms like "social," "sustainability," and "economic" highlights the multidimensional nature of green accounting, reflecting considerations beyond purely environmental factors. Overall, this word cloud provides insights into the key thematic areas and priorities within the field of green accounting, shedding light on the interconnectedness of accounting practices with environmental, social, and economic dimensions.

Thematic Content Analysis

In line with recent SLRs, this study conducted a thematic content analysis to synthesize the existing literature on green accounting [33]. The study employed an abductive approach, which combines the strengths of both inductive and deductive methods, to delineate research themes in the existing green accounting literature. The study categorizes the existing body of knowledge on green accounting into four main themes: i) green accounting and sustainability, ii) economic viability, iii) social equity, iv) environmental protection, v) ecological balance and vi) technological innovation. Table 6 provides a list of the main papers discussed in this section.

Green Accounting and Sustainability

In the field of management accounting, it is widely recognized that companies tend to align their organizational structures and processes with their strategic goals, which increasingly include sustainability initiatives [8]. This alignment reflects a growing understanding of the importance of integrating environmental and social considerations into business strategies. With concerns about pollution and the effectiveness of current measures mounting, sustainability and sustainable development have become significant societal concerns [28]. This heightened awareness has led to a greater emphasis on the need for businesses to incorporate sustainable practices into their operations, driving the need for tools and frameworks like environmental management accounting and green human resource management to support these efforts.

One key aspect of this shift towards sustainability is the role of green accounting, which goes beyond traditional accounting practices by incorporating environmental factors into decision-making processes [61]. Previous study investigated the role of green accounting in tackling global challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs) [82]. Green accounting is seen as essential for managing value and achieving a balance between economic growth and environmental preservation [85]. By integrating accounting principles with environmental considerations, green accounting offers a pathway for businesses to contribute to environmental sustainability while maintaining economic viability. It is also a crucial tool for promoting sustainability within organizations by integrating environmental considerations into financial decision-making processes.

The beneficial effects of implementing green accounting practices on both business sustainability and firm value have been demonstrated [98]. Incorporating environmental and social benefits into economic decision-making through green accounting can enhance the overall sustainability and financial performance of organizations. Furthermore, green accounting has evolved into a strategic concept where companies prioritize efficiency and effectiveness in utilizing resources sustainably to align their development with environmental functions and benefit the community [24], [31]. Through the integration of green accounting practices, companies can showcase their dedication to environmental sustainability, enhance their reputation among stakeholders, and potentially increase sales and profits [6], [82]. This approach not only addresses social and environmental protection but also encourages companies to embrace sustainable practices. The implementation of green accounting can pave the way for a sustainable future for enterprises by fostering a balance between economic growth and environmental preservation [28], [85].

Regarded as a new independent branch of science with a broader scope than other forms of accounting, green accounting emphasizes the significance of sustainability reporting and economic impacts [98]. Moreover, the application of green accounting in public hospitals has demonstrated positive effects on environmental sustainability and community welfare, particularly in waste management and reducing environmental impact [7].

The nexus between sustainability, corporate green accounting, and firm financial performance posits that green accounting positively impacts firm performance without significantly moderating this relationship based on country-specific variables [108]. Overall, green accounting is indispensable for businesses striving to achieve sustainable development goals, as it aids in measuring the environmental impact of human activities and contributes to the well-being of society and the

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environment [15]. By embracing green accounting practices, companies can progress toward a more sustainable future while meeting the expectations of regulatory authorities and society [49].

Green Accounting and Economic Viability

The ability of a project or organization to remain financially sustainable over an extended period of time is known as economic viability. At the intersection of economic viability and sustainability, businesses are increasingly recognizing the importance of integrating environmental costs and benefits into their decision-making processes [103]. This shift towards incorporating sustainability considerations into economic strategies is crucial for promoting environmentally responsible practices within organizations [12]. By aligning their operations with sustainable practices, companies can contribute to creating an environment that supports their long-term viability and the well-being of the communities they operate in.

The philosophy of sustainable development provides a guiding framework for green accounting and sustainability indicators, steering businesses towards environmentally viability practices [109]. As a part of accounting development, green accounting emphasizes non-monetary factors and quality considerations, reflecting a broader perspective on economic activities [89]. It serves as a proactive response from the accounting field to address environmental degradation caused by business operations.

In the context of economic viability, green finance plays a significant role in promoting sustainability. There is a mutually reinforcing relationship between green finance and high-quality economic viability, with green industries and optimized industrial structures contributing to reducing carbon emissions [111]. Green financial development aligns financial activities with environmental protection, providing a solution for sustainable development [56]. The concept of green GDP integrates ecological and natural resource consumption into national economic accounting systems, emphasizing the importance of balancing economic growth with environmental protection.

Green credit policies, such as green credit, can facilitate economic viability and environmental protection through the efficient allocation of credit resources [54]. These financial tools contribute to achieving a win-win scenario for economic growth and environmental conservation [91]. The necessity of incorporating economic considerations into green accounting practices to ensure the lasting viability of sustainable development initiatives [68]. Elaborate on the economic efficiency advantages that firms can gain from adopting green accounting practices, such as cost savings and enhanced financial performance [107]. The economic factors play a pivotal role in determining the success of green accounting initiatives, as they influence firms' willingness to embrace sustainable practices [81]. It was corroborating the findings of the research conducted found that there is systematically examined the impact of green accounting on the profitability of firms [42]. The study revealed a significant correlation between green accounting practices and the return on assets within companies operating in the food, beverage, and tobacco sectors.

The economic ramifications of green accounting, highlighting its potential to propel economic growth by encouraging sustainable business practices [90]. Moreover, the evolution of green accounting as an emerging facet of accounting science, shaping enterprise performance and steering the economy towards viability [95]. Lastly, the objective of green accounting, encompassing the assessment of the concept's theoretical foundation and the adjustment of national accounts to encompass the value of nature's goods and services treated as a connection to economic sustainability [108].

These earlier studies cumulatively underscore the significance of economic factors in green accounting and sustainability, emphasizing the necessity for firms to integrate economic considerations into their sustainability strategies. The integration of green accounting practices and green finance into economic viability strategies is crucial for fostering sustainable growth. By incorporating environmental considerations into financial decision-making processes, businesses can contribute to both economic prosperity and environmental preservation, ultimately leading to a more sustainable future.

Green Accounting and Social Equity

In green accounting, social equity refers to the equitable allocation of environmental gains and costs among various socioeconomic groups. Integrating environmental considerations into financial decision-making processes can drive social equity. By actively promoting practices that prioritize sustainability, companies can enhance their sustainable development capabilities, contributing to a more environmentally conscious and socially responsible business environment [29]. The increasing discussions on sustainability and environmental protection on social media platforms highlight the growing pressure from regulatory authorities and society to prioritize environmental sustainability in business practices [50].

The concept of green accounting addresses the limitations of conventional accounting by emphasizing sensitivity to social and environmental issues in the accounting process [40]. It offers a new system of sustainable accounting that can lead to

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positive social and environmental impacts [87]. By actively engaging with local communities, promoting social responsibility, and fostering sustainable energy practices, green accounting can contribute significantly to creating a more sustainable, equitable, and energy-efficient future [83].

Additionally, the adoption of green accounting principles can lead to greater transparency and accountability in reporting practices, further bolstering corporate performance and sustainability efforts [110]. The interconnection of green accounting, corporate social responsibility, and sustainability has been shown to improve corporate performance and contribute to business sustainability [100]. Green accounting practices, such as incorporating environmental management principles into reporting practices, play a vital role in enhancing corporate performance and promoting sustainability [28]. The significance of integrating environmental and social aspects into financial operations through green accounting. They emphasized its pivotal role in cost reduction, profit increase, and bolstering a company's image [62].

Collectively, all these studies suggest that green accounting is instrumental in advancing sustainability and driving social change by incorporating environmental costs into financial reporting and decision-making processes. Green accounting serves as a catalyst for social change by encouraging businesses to adopt environmentally responsible practices, prioritize social responsibility, and contribute to sustainable development. By incorporating green accounting principles into financial strategies, companies can not only improve their performance but also drive positive social and environmental outcomes.

Green Accounting and Environmental Protection

The core of green accounting is environmental protection, which entails evaluating and controlling how an organization's operations affect the environment. Research suggests that nurturing such responsibility can enhance green consumption behavior by cultivating environmental concern [114]. Encouraging companies to adopt environmentally responsible practices not only benefits the environment but also has the potential to positively influence consumer behavior, leading to more sustainable consumption patterns. The impact of green accounting on firm profitability, highlighting the importance of sustainable practices and environmental protection for long-term business success [110].

Beyond standard accounting's shortcomings, which frequently ignore environmental factors, green accounting has become essential [40]. By quantifying the environmental impact of business activities, green accounting provides a more comprehensive understanding of the true costs and benefits of different actions. This information is crucial for making informed decisions that balance economic growth with environmental sustainability.

Studies have shown that environmental protection positively impacts firm value, with corporate innovation playing a mediating role [58]. This underscores the importance of integrating environmental considerations into corporate strategies to enhance overall business performance. Companies that prioritize environmental protection are not only better positioned to mitigate environmental risks but also to identify new opportunities for growth and innovation.

Furthermore, environmental protection can lead to increased intentions for environmentally friendly behaviour [93]. This indicates that by fostering environmental protection, businesses can influence broader societal behavior towards sustainability. Companies that are seen as environmentally responsible are likely to attract environmentally conscious consumers and employees, further enhancing their reputation and competitive advantage.

Understanding the interplay environmental protection in between corporate and governmental is essential for promoting collaboration between businesses and governments to achieve sustainable development [21]. This collaboration is crucial for implementing effective policies and initiatives that address environmental challenges at both the corporate and governmental levels. By working together, businesses and governments can create a more sustainable future for all.

Moreover, environmental accounting plays a crucial role in helping societies understand resource usage and in shaping policies for sustainable resource management [115]. It offers organizations benefits such as cost savings, improved management effectiveness, and opportunities for environmental audits [32]. Green accounting and environmental protection are key elements in tackling environmental challenges, promoting sustainable practices, and enhancing organizational performance. By incorporating environmental considerations into accounting practices and fostering environmental protection, businesses can contribute significantly to a more sustainable future.

Green Accounting and Ecological Balance

Sustaining ecosystem health and diversity is referred to as ecological balance. The fusion of green accounting with ecological balance efforts is crucial for advancing sustainable practices. The significance of green development in highway construction and its role in enhancing slope ecological balance, demonstrating the practical application of green accounting principles in infrastructure projects [58]. Accounting for

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environmental costs and benefits can lead to more environmentally friendly design and construction practices. This concept is further reinforced by the impact of green accounting on ecological sustainability, utilizing environmental costs as a mediator between green accounting and ecological sustainability [5].

The comprehensive evaluation of geo-ecological balance post-earthquake, emphasizing the need for restoration efforts in disaster-affected regions [4]. This highlights the broader application of green accounting beyond specific industries, showing its relevance in post-disaster recovery and environmental rehabilitation efforts. Together, these studies underscore the significance of integrating green accounting practices with ecological balance initiatives to achieve sustainable development goals and enhance environmental conservation efforts.

The integration of green accounting practices with ecological sustainability initiatives is essential for achieving long-term environmental goals. By incorporating environmental considerations into financial decision-making processes, organizations can enhance their ecological footprint and contribute significantly to sustainable development [84]. This integration enables businesses and policymakers to account for the true cost of their activities on the environment, leading to more informed decisions that prioritize sustainability and reduce negative environmental impacts.

Moreover, securing regional development from ecological threats requires a comprehensive understanding of environmental impacts and the implementation of sustainable practices [19]. Building models to achieve this involves integrating green accounting principles to assess the environmental costs and benefits of development projects. This approach ensures that development is sustainable and resilient to ecological challenges, ultimately contributing to the long-term health and viability of ecosystems. By integrating green accounting practices with ecological sustainability initiatives, stakeholders can work towards a more sustainable future where economic development is balanced with environmental preservation.

The alignment between green accounting and ecological sustainability is essential for fostering environmental stewardship, promoting sustainable development, and ensuring the long-term health of ecosystems. By incorporating environmental considerations into financial practices and decision-making processes, organizations can contribute to a more sustainable future for both business operations and the natural environment.

Green Accounting and Technological Innovation

Exploring technological innovation involve with the integration mechanism of science and technology innovation service platforms, aiming to achieve rapid and healthy development [58]. Their research underscores the importance of leveraging technological advancements to drive sustainable growth and development. Additionally, the link between environmental management accounting and green organizational behavior, emphasizing the mediating role of green human resource management in promoting sustainable practices within organizations [61]. This highlights the interconnected nature of various sustainability practices within organizations, where environmental management accounting can influence and be influenced by green organizational behavior and practices.

By integrating green accounting practices with technological innovation, organizations can enhance their environmental performance, promote sustainability, and drive positive organizational change. This integration enables businesses to leverage technology to improve their environmental impact assessments, optimize resource usage, and implement more sustainable practices throughout their operations.

Implications

The study thoroughly examines the nuanced interpretation of findings from a systematic review of the green accounting literature, emphasizing key themes, the role of green accounting in sustainability, and its implications for practice. This analysis offers insights into the interconnected nature of these themes and their contribution to the broader field of sustainability accounting. Additionally, the study discusses theoretical implications, such as how green accounting aligns with stakeholder theory and legitimacy theory.

Practically, the study underscores the importance of green accounting in enhancing organizational transparency and accountability for environmental impacts. It also highlights the role of green accounting in supporting sustainable decision-making and driving innovation towards more environmentally friendly practices. Future research directions could include exploring the effectiveness of different green accounting practices in different organizational contexts, as well as investigating the role of green accounting in promoting sustainable development goals. Identifying these gaps in the literature and suggesting avenues for future research is crucial for advancing knowledge in the field of green accounting and sustainability.

Theoretical Implications

Theoretical implications are significant for understanding how green accounting practices can be adapted to incorporate environmental considerations. One key implication involves integrating environmental costs into financial

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reports. This integration can improve the transparency and quality of financial reporting by providing stakeholders with a more complete picture of an organization's environmental impact and performance. This study contributes to refining existing theories or concepts in green accounting.

Legitimacy theory is highly relevant to green accounting, particularly in understanding why organizations choose to adopt environmental practices and report on their environmental performance. According to Legitimacy Theory, organizations seek to maintain their legitimacy and social acceptance by conforming to societal norms and expectations. In the context of green accounting, this theory suggests that organizations may adopt environmentally friendly practices and report on their environmental performance to enhance their legitimacy and reputation with stakeholders. By implementing green accounting practices, organizations demonstrate to stakeholders, such as customers, investors, and regulatory bodies, that they are committed to environmental sustainability. This can enhance their reputation and credibility, leading to increased legitimacy in the eyes of stakeholders.

Stakeholder theory also plays a crucial role in green accounting, emphasizing the importance of considering the interests of all stakeholders, including the environment. Theoretical implications in this context involve examining how accounting practices can better reflect stakeholder interests in environmental sustainability, potentially leading to more sustainable business practices. The sustainability reporting frameworks offer organizations a structured approach to reporting their environmental performance.

Theoretical implications include evaluating these frameworks and proposing improvements or adaptations specific to green accounting, which could enhance the effectiveness and relevance of sustainability reporting. From a resource-based view perspective, green accounting can contribute to the strategic management of environmental resources, potentially leading to sustainable competitive advantages. It involves exploring how green accounting practices can be strategically aligned with resource management goals to enhance organizational performance and sustainability. The theoretical implications help advance the theoretical understanding of green accounting and provide a foundation for future research in the field.

Practical Implications

Practical implications refer to how the results can be applied in real-world situations. Green accounting has important practical implications for businesses and the environment. One key aspect is its role in providing a more accurate depiction of a company's financial status by incorporating environmental costs into financial reports. This enables businesses to gain a better understanding of the true costs associated with their operations, including those related to pollution, waste disposal, and resource depletion. By identifying these costs, companies can make more informed decisions about resource allocation and investments, ultimately improving their overall efficiency and profitability.

Furthermore, green accounting can assist businesses in identifying areas where they can reduce their environmental impact. For instance, by analyzing their resource usage and emissions, companies can identify opportunities to enhance efficiency and minimize waste. This not only benefits the environment but can also result in cost savings for the business through lower energy and resource expenses.

Additionally, the adoption of green accounting practices can help companies comply with regulatory requirements related to environmental reporting. Many jurisdictions require businesses to report on their environmental performance, and green accounting provides a structured framework for meeting these obligations. By fulfilling these requirements, businesses can avoid fines and penalties and enhance their reputation among environmentally conscious consumers and investors. Overall, the practical implications of green accounting are significant. By integrating environmental considerations into financial decision-making, businesses can become more sustainable, reduce their environmental impact, and enhance their long-term profitability.

Future Directions and Knowledge Gaps in the Literature on Green Accounting

While the existing literature on green accounting has provided valuable insights into its principles and applications, several knowledge gaps and opportunities for future research remain. One key area that warrants further exploration is the integration of green accounting practices into different organizational contexts and industries. Existing studies have primarily focused on large corporations in developed countries, leaving a gap in our understanding of how green accounting can be applied in small and medium-sized enterprises, emerging markets, and non-profit organizations.

Another important gap in the literature is the lack of standardized frameworks and guidelines for green accounting. While various frameworks and guidelines exist, such as the Global Reporting Initiative and the Sustainability Accounting Standards Board, there is no universal framework that is widely accepted and adopted by organizations globally. Future research could focus on developing and evaluating standardized frameworks to enhance the comparability and reliability of green accounting practices.

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Additionally, there is a need for more empirical studies that examine the effectiveness of green accounting practices in achieving sustainability goals. Existing research has largely focused on the adoption and implementation of green accounting, with limited empirical evidence on its impact on environmental performance, financial performance, and stakeholder perceptions. Future studies could use longitudinal data and quantitative methods to assess the long-term effects of green accounting practices on organizational outcomes.

Furthermore, the role of technology in advancing green accounting practices is an area that has received limited attention in the literature. Emerging technologies such as blockchain, artificial intelligence, and big data analytics have the potential to transform green accounting by improving data collection, analysis, and reporting processes. Future research could explore the implications of these technologies for green accounting and how organizations can leverage them to enhance sustainability. Addressing these knowledge gaps and exploring these future research directions could contribute to a more comprehensive understanding of green accounting and its potential to promote sustainability and environmental protection in organizations worldwide.

V. CONCLUSION

In conclusion, the systematic review of the green accounting literature provides valuable insights for businesses and policymakers seeking to promote sustainability. Integrating green accounting principles into operations is crucial for aligning organizational structures and processes with sustainability goals. This involves considering the environmental impact of business activities and making informed decisions to reduce it. This study contributes to advancing the understanding of the green accounting literature and provides valuable insights to inform future research and policy development in sustainability accounting. It is hoped that this review will stimulate further research in the field and encourage the adoption of sustainable practices in organizations worldwide.

Sustainability reporting plays a key role in enhancing a company's reputation and potentially increasing sales and profits. Moreover, integrating green accounting into economic viability strategies can promote sustainable economic growth by prioritizing environmental conservation and resource efficiency. Green accounting also has the potential to drive social equity by encouraging businesses to adopt more sustainable practices that benefit communities and future generations. Nurturing environmental protection through green accounting practices involves quantifying environmental impact and making decisions that prioritize sustainability.

Collaboration for ecological balance is another important aspect of green accounting, involving working with stakeholders to restore ecosystems and promote biodiversity. Leveraging technological innovations can significantly contribute to achieving long-term environmental goals by improving efficiency and reducing environmental impact. Overall, embracing sustainability in green accounting practices and integrating them into business strategies can lead to a more sustainable future, benefiting both organizations and the environment.

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Linguistics Behind the Readability of Arabic Texts in the Teaching and Learning Process

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Abstract

Efforts to empower Arabic language subjects can further strengthen Malaysia's teaching and learning process. Along with the development of the language, Arabic has become the second most important language after English. Meanwhile, mastery of the Arabic language subject can be measured based on the readability of the student's text. Readability measures the difficulty level of a reading material, such as a school textbook. This concept paper discusses the linguistics behind the readability of Arabic texts through the teaching and learning process at school. In Malaysia, the study of the readability of the Arabic language is still in its early stages, and researchers still need to do more research on this. Therefore, the purpose of writing this concept paper revolves around the definition of linguistics in Arabic language learning, the readability of Arabic texts, and past studies related to linguistics in readability. These issues arise regarding the readability of Arabic reading materials and suggestions for further studies regarding the readability of Arabic texts.

Keywords **:** *Arabic texts; Linguistics; Readability; Teaching and Learning Process*

I. INTRODUCTION

Arabic is one of the most essential languages in the world. It is proven that the Arabic language is the national language of hundreds of millions of Arabs and is used by 20 countries for speech. Arabic is also not a foreign language for the Muslim community in Malaysia because most of the Malaysian community is Muslim. However, the use of Arabic among the Malaysian community is more focused on reading activities, i.e., readers learn to understand the order of sentences and the meaning of each word found in the reading text to understand Islamic sciences. This is because the Muslim community in Malaysia uses Arabic for worship and religious knowledge. This is different from speech and communication.

Arabic reading texts are a teaching and learning medium for deepening religious knowledge. Textbooks for learning Arabic are an essential aspect and element in the teaching and learning process at school because they contain facts, information, and various titles that describe and detail the curriculum subjects. The use of textbooks in the national education system in Malaysia is still ongoing. The selection of textbooks and reading materials that suit the target reader needs to be taken seriously to ensure the survival of Islamic civilization through reading culture. Interest and awareness of the importance of gaining knowledge through reading materials in Arabic should always be instilled by choosing textbooks and reading materials suitable for the student's level of language proficiency [1], mainly non-native readers.

This is important because the students in this country are non-native speakers from non-Arab countries. Their skills in speaking Arabic are also different from those of Arab students or students studying in Arab countries. Therefore, this level of language proficiency requires an emphasis on selecting appropriate texts to help their understanding of the language. Readability can be related to the study to determine the subject and the text's difficulty for students. Therefore, the selection and writing of reading texts that are appropriate for the reader should be given priority so that the reader can stimulate and relate the information in the text to existing knowledge during reading and after reading. It is proven that the appropriateness of the reader's level of language mastery and the linguistic characteristics of the reading material need to be studied because difficulty in reading skills can interfere with the learning process.

This is to ensure that the teaching and learning process of the Arabic language does not end in the classroom or lecture room only but continues outside the classroom and wherever they are. Therefore, the readability level of the textbook

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should be appropriate to the student's reading ability, and the content presentation should be good to attract the interest and motivation of the students involved [2].

II. LITERATURE REVIEW

The readability of texts plays a crucial role in the teaching and learning process, particularly in Arabic, a language known for its rich linguistic complexity. Understanding the factors contributing to the readability of Arabic texts is vital for ensuring effective communication and comprehension between educators and learners. One of the critical linguistic aspects that influence the readability of Arabic texts is the morphological structure of the language. Arabic is a highly inflected language, with words undergoing various morphological changes to convey grammatical information such as gender, number, case, and tense. This intricate system of inflexions can challenge learners, particularly those from non-Arabic backgrounds [3]. Researchers have explored the impact of morphological complexity on text readability, suggesting that texts with higher morphological density tend to be more difficult to comprehend [4].

One of the concepts of readability is the level ease or difficulty of reading material to read and understand. Researcher Klare [5] explained in his study that the term readability is essential in showing its three uses, namely:

1. To show the readability of a written text.

2. To show the ease of reading caused by the interest value of the reading material.

3. To show the ease of understanding caused by the writing style of the reading material.

The readability of Arabic texts is also influenced by the level of coherence and cohesion present in the discourse. Arabic employs various cohesive devices, such as reference, substitution, ellipsis, and conjunctions, to establish logical connections between ideas [6]. Texts that lack sufficient cohesive ties can hinder comprehension, as students may struggle to follow the flow of information and grasp the relationships between concepts.

Furthermore, the readability of Arabic texts can be impacted by the presence of rhetorical devices and figurative language, which are prevalent in Arabic literature and discourse [7]. Metaphors, similes, and other rhetorical figures can add an additional layer of complexity, requiring students to interpret the intended meaning beyond the literal sense. Appropriate instructional support and scaffolding may be necessary to facilitate the comprehension of such linguistic elements.

It is also worth noting that individual differences among students, such as prior knowledge, language proficiency, and cognitive abilities, can influence their perception of text readability [8]. Texts that may be deemed readable for one student may pose challenges for another, highlighting the importance of considering student characteristics and tailoring instructional materials accordingly.

Researchers in Malaysia have also explored the use of technology to assess and enhance the readability of Arabic texts. For instance, Abdul Karim Al Tamimi et al. [9] developed an automatic readability index (AARI) specifically for Arabic texts, which considers factors such as word length, sentence length, and grammatical complexity. Such computational tools can assist educators and material developers in evaluating the readability of texts and making informed decisions about their suitability for different learner groups.

Crossley, Greenfield, and McNamara [10] stated that understanding the text becomes more accessible for readers at a low level if there are no relatedness signals between ideas because the reader has limited prior knowledge. The complex sentence structure is revealed at the initial stage for students to combine ideas in memory and facilitate the comprehension session of the language text. In addition, studies by Kamarulzaman [11] and Zulazhan [12], and Abdul Karim Al Tamimi et al. [13] showed that texts for students at higher levels are longer because of increased learning levels.

III. RESULTS AND DISCUSSION

Issues with the readability of Arabic texts still need to be explored. This is proven by Kamarulzaman Abdul Ghani et al. [14], who explained that from the perspective of Arabic language studies in Malaysia, studies on the readability of textbooks are not much researched and very rare, unlike the measurement of English language readability, which has been explored for a long time and continues to develop until now [15]. This is a weakness because studying the readability of Arabic texts can be beneficial and help students master the Arabic language effectively. Among the challenges that can be discussed are: i) a lack of effort to measure the level of readability of reading materials, ii) students need help understanding the Arabic text, iii) a lack of effort to assess the appropriateness of the text.

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A. Lack of effort to measure the readability level of reading materials

The issue in the readability of Arabic texts that was detected was that there needed to be more effort to measure the level of readability of reading materials used as subject texts. Therefore, the linguistic features used in the reading text need to be considered by the language level of the target reader to aid understanding [16]. The appropriateness of the text's language and the reader's language level are essential to ensure that the reader understands what is being read which is stated by Badgett [17]. This is because, according to Rumelhart [18], reading involves a process of interaction between the reader and the text that involves cognitive activities, namely recognizing words and automatically understanding the meaning of words, analyzing the grammatical structure and position of words by translating the meaning of words in sentences, connecting the meaning between sentences and sentences, connecting between paragraphs and the entire text and relating it to existing knowledge in the process of understanding the text. The reader's existing knowledge also interacts with linguistic features in the text to construct meaning.

B. Students need help understanding Arabic texts

In the context of Malaysian students who learn Arabic as a second language or a foreign language, they try to gain knowledge of religious knowledge from Arabic texts, face difficulties when they do not understand the text, and subsequently, this will remove interest in studying it. This happens because there is too little effort to measure the difficulty and ease of difficulty levels used as subject texts, which students initially compiled and then used by Malaysian students [19]. This leads to the significant role of teachers in choosing the right and good books to achieve the learning process goals in the classroom [20].

C. Lack of effort to evaluate text appropriateness

The incompatibility between the linguistic features in the text and the language level of the reader can affect their motivation to read and deepen the Arabic text even though they have a high awareness of the importance of reading Arabic reading materials, as stated by Grabe and Stoller [21], that motivation is an essential factor in reading development. The effort to evaluate the suitability of the text with the level of the reader's ability to understand the reading material is still decreasing and marginalizing the importance of individual diversity [22] especially in evaluating the reading text in Arabic.

Textbook writers must prepare appropriate texts or rewrite textbooks or reference books in a simple version, especially for non-Arabic speaking students.

IV. IMPLICATION

The teaching and learning process in education depends on several factors, such as the selection of teaching materials. The selection of books or reading materials that suit the student's level of understanding will allow students to master the information they want to convey well. The implications of readability on the teaching and learning process are far-reaching and extend beyond the classroom setting. Providing students with texts that are comprehensible and tailored to their proficiency levels can foster a positive attitude towards language learning and increase their motivation to engage with the material [23]. Conversely, texts that are overly complex or beyond the students' current abilities may lead to frustration, disengagement, and a reluctance to continue studying the language [24].

Teachers should be exposed to face problems in selecting and preparing reading materials for students. According to Khadijah Rohani [25], the time has come for teachers, parents, and book writers to focus on the problem of adapting reading materials to students' reading abilities. Therefore, it is necessary to produce suitable reading materials so students can go through the learning process more effectively and smoothly. This can be linked to the role of textbooks as the central aspect directly involved in student learning. Thus, textbooks can determine student achievement in the subject, and they are the only reference recognized by the Malaysian Ministry of Education (KPM) and owned by all students.

Furthermore, the readability of instructional materials has implications for inclusive education and addressing the diverse needs of students. Students with special needs, such as those with learning disabilities or limited language proficiency, may face additional challenges in comprehending texts that are not carefully designed with their needs in mind [26]. Ensuring that materials are accessible and appropriately leveled can help create an equitable learning environment and support the academic success of all students. In the context of Arabic language education, the readability of texts can also have cultural and social implications. Arabic is not only a language but also a carrier of cultural and religious values [27]. Texts that are overly complex or inaccessible may hinder students' ability to engage with and appreciate the rich cultural heritage embedded within the language,

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potentially leading to a disconnect from their cultural roots or a lack of understanding of important societal and religious concepts [28].

V. FUTURE WORKS

This proposal for further research on the readability of Arabic texts hopes that more and more researchers will research this topic. Among them are a study on the construction of Arabic text readability formulas for non-native speakers in Malaysia, a study on the construction of an index of word and sentence patterns according to students' learning levels as a basis for writing school textbooks, and a study of linguistic characteristics involving all levels of learning, i.e. primary, secondary, and higher education alike there are primary or secondary textbooks. Studies like this are needed so that they can help improve the quality of writing and publishing Arabic textbooks as learning materials and subsequently improve the level of Arabic literacy among students in Malaysia. From another point of view, the potential of this readability study has been widely applied worldwide in various comprehensive field scopes. Studying in the field of readability is a significant field that is very wide and of great importance in education. The role of this study is crucial for a group of parties who care about the success of aspects of the world of education, even though studies related to the readability of Arabic language reading materials in Malaysia are still in a new stage and are rarely studied by researchers.

VI. CONCLUSION

The effectiveness of reading interaction between the target reader and the reading material influences the effectiveness of reading materials through the linguistic characteristics used to convey content. It needs to be compatible with the reader's competence, which involves the target reader's existing knowledge, maturity, and language skills. Linguistic features in the text must be paid attention to match the student's language proficiency development. A study of linguistic features that contribute to the readability of texts for non-native Arabic students, especially students who are in non-Arab countries, needs to be conducted. This is because readers of a second or foreign language need texts whose content, vocabulary and topics reflect their reality, everyday experience and language style that matches their language type. Therefore, suitable materials should be given attention to encourage the Malaysian community to a culture of reading, especially reading materials in Arabic based on Islamic knowledge. This is to help improve reading skills, make reading materials in Arabic familiar among the Muslim community, and become the primary source of knowledge for building a civilized society.

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Digital Fashion Show: Metaverse Unveiling Designer Expression Through Digital Runways

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Abstract

Technology use was contested in 2013, but after the pandemic struck in early 2020, Malaysia began to realize how important technology was. In the absence of the pandemic, individuals would need to embrace technology due to the demands of civilization and advanced technology. The field of fashion in virtual runway appeared after the COVID-19 pandemic where all physical activities were changed to digital and virtual. The application advancements in technology fashion designers rethink new methods not just photos or pre-recorded videos but together with online audiences and 3D imagery which brings them closer than ever. Other than that, attendees of the virtual reality fashion show experienced the sensation of being in an exquisitely adorned space, with stunning models gracefully presenting before them. The advancement of technology with AI, VR, and AR makes fashion shows easy to access and more convenient. This study aims to investigate the future era of fashion shows on the virtual runway. This study uses qualitative research with applied one-to-one interviews with eight Malaysian fashion designers in Malaysia. The data can be analysed using thematic analysis that forms three major elements of a show performance or fashion show that include clothing, model, and scene. By using these elements, it covers 1) Virtual clothing production, 2) Virtual runway show, and 3) Design and production of virtual models. The study's findings showed the designers could launch a digital clothing item in the metaverse with a variety of color variations, using sales data to determine which colors to incorporate into the physical version. Digital fashion trends have culminated in the establishment of virtual runways that attract fashion fans internationally. The virtual runways don't need to mirror real-life conditions, particularly concerning accessibility. The usage of AI and 3D avatar models, design, and rig-wearing digitally created clothing reflects the diversity and inclusivity of the target audience. The underscore the necessity for designers to stay abreast of emerging trends to maintain competitiveness in the industry. With technology's pervasive reach enabling access to information anytime and anywhere, virtual fashion emerges as a crucial technique for the future. Moving forward, the insights gleaned from this study prove invaluable in aiding Malaysian fashion students and designers in adopting digital fashion shows and virtual runways as part of their repertoire. In conclusion, the integration of AI and virtual runways is in its early stages, yet the possibilities are immense. The designers are able to develop and exhibit their collections without being bound by financial or geographical barriers.

Keywords: *Virtual runway, digital fashion show, advancement of technology, and fashion designers.*

I. INTRODUCTION

Technology use was contested in 2013, but after the pandemic struck in early 2020. The fashion industry is undergoing a rapid digital evolution following the epidemic. Brands and designers have notably embraced digital transformation in 2020 and 2021, with initiatives such as cross-border gaming, 3D fashion, virtual models, and online fashion weeks gaining prominence [1]. Malaysia began to realize how important technology was. In the absence of the pandemic, individuals would need to embrace technology due to the demands of civilization and advanced technology. Since then, a new normal has emerged while we have survived the fear of a pandemic. Technological advancements have a pervasive impact on all facets of human existence. Presently, digital or virtual runways have replaced

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traditional runways. Runway displays, often known as "Fashion Shows" or "Catwalk Shows," typically entail physically presenting clothing on the runway [2]. According to [3] fashion shows are a communication and marketing tool to gain the fashion brands, brand image, values, culture, and personality to marketing strategies and commercial goals. In a new era of technology, the virtual runway appeared after the COVID-19 pandemic where all physical activities were changed to digital and virtual. The application advances in technology and fashion designers rethink new methods not just photos or pre-recorded videos but together with online audiences and 3D imagery which brings them closer than ever [4]. The attendees of the virtual reality (VR) fashion show experienced the sensation of being in an exquisitely adorned space, with stunning models gracefully presenting before them. VR involves the utilization of computer-generated simulations allowing users to interact within a virtual, three-dimensional visual setting via digital representation. Typically, users immerse themselves in this digital environment using a Head-Mounted Display (HMD), though physically, they remain separate from the objects or environments reconstructed in VR [4]. According to [6] they agree that the advancement of technology with AI, VR, and AR makes fashion shows easy to access and more convenient. VR impacts fashion shows, which serve as platforms for presenting fashion and facilitating communication between fashion brands and audiences. However, spatial aspects have not received comparable attention to clothing in the context of fashion shows [7]. The traditional fashion shows served as a primary avenue for advertising and promoting fashion brands, maintaining loyalty among current customers, and attracting new ones by evoking consumer emotions through conveying information [8]. Digital fashion shows incorporating interactive elements and VR environments prove beneficial for assessing apparel, promoting fashion events, and facilitating apparel purchases [9]. According to [4], the digital fashion show represents a novel approach to showcasing fashion, integrating digital imagery and advanced technology instead of traditional analog methods. Digitally, the user interface must be tailored to accommodate the visual, auditory, and tactile sensations of the user, encompassing sensory experiences. Additionally, the UX interaction module should incorporate data transformation elements including virtual stage, lighting, music, effects, and animation, pertinent to the digital fashion show [4]. A digital fashion show involves virtual models showcasing 3D-rendered digital attire on the runway. Collaborations between fashion brands and tech companies are bringing forth these innovative displays, presenting digital garments within tailored virtual environments [10].

In Malaysia, several events related to digital fashion like KL Fashion Week (KLFW) in 2021 have 12 virtual shows (featuring Andy Bandy, Celeste, Cassey Gan and more) [11]. In addition, TryitOn successfully launched their 3D Virtual Fitting Room that digitizes any fashion garment into high-quality 3D Virtual Assets and allows fashion e-commerce businesses to incorporate this technology seamlessly with just a plug-in [12]. So, this study aims to investigate the future era of fashion shows on the virtual runway.

A. Metaverse Runway Show

The metaverse denotes an expansive virtual realm existing alongside reality, where individuals interact via digital representations known as avatars. This virtual space is characterized by its three-dimensional (3D) environment, facilitating seamless interaction and exchange between real-world entities and users [13]. The potential for a Malaysian Metaverse Runway Show to usher in a new era of accessible, creative, and technologically advanced fashion shows is immense [14]. In order to conceptualize the event, organizers would work with designers, technologists, and VR specialists. Their focus would be on finding ways to combine digital and physical components in a seamless manner.

The researcher outlined in Figure 1 stated that the primary technological components of the metaverse are the outer ring of the organizing framework. It contributes to establishing the fundamental structure of the metaverse. The interface devices in the central concentric ring

symbolize users' access and interaction with the metaverse world. In the framework, the metaverse environment where users can interact is represented by the innermost concentric ring.

Figure 1 Operating Metaverse framework by [15]

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The user experience in the metaverse environment depends on its level of immersiveness, environmental fidelity, and sociability [15]. Based on the concept by [15], the "Metaverse Runway Show" brings together aspects of virtual reality, fashion, and digital innovation in a single concept. Individuals are able to engage in real-time interaction with one another and with digital items within the metaverse, which is effectively a communal virtual shared area [16].

Another scholar [17] said a Metaverse Runway Show is a virtual event where designers exhibit their latest creations through avatars or digital representations. Guests could join globally via virtual reality goggles or their personal computers or smartphones.

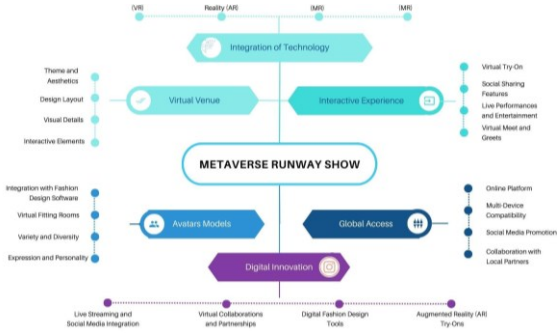

Figure 2 Metaverse Conceptual theory by [15]

Hence, in Malaysia especially, technology use was contested in 2013, but after the pandemic struck in early 2020, Malaysia began to realize how important technology was. In the absence of the pandemic, individuals would need to embrace technology due to the demands of civilization and advanced technology. Since then, a new normal has emerged while we have survived the fear of a pandemic. Technological advancements have a pervasive impact on all facets of human existence.

Presently, digital or virtual runways have replaced traditional runways. Runway displays, often known as "Fashion Shows" or "Catwalk Shows," typically entail physically presenting clothing on the runway [2]. In addition, [18] defines fashion shows as platforms for sharing new qualitative insights, which I term 'enclothed knowledge.' This knowledge is experiential and cannot be fully conveyed through static or verbal descriptions alone. Additionally, fashion shows empower participants to influence the circulation of knowledge and provide researchers with opportunities to engage with diverse audiences. The fashion show provides designers and couture brands with the opportunity to influence the meaning associated with particular clothing items and the identities they represent [19].

II. LITERATURE REVIEW

In the study conducted by [20], an interactive virtual runway show system was implemented utilizing Unity3D and MySQL. The research encompassed scientific analysis as well as the design of the virtual runway's functionality and database structure. Furthermore, the company incorporated the runway function and standardized the model production process. In addition, they demonstrate a technique for integrating models with dynamic apparel models in order to improve the simulation of a wide range of fabrics, thereby providing more extensive reference materials for professional designers.

According to [2] in their research about digital fashion shows, there are four main elements which designers can use in order to make a unique and wonderful show like model, theme, location, and finale. In addition, the Spectacle effect with other implicit elements such as music and lighting. Other than that, the brand also presented its digital show across various social channels. The landscape of emerging technologies intertwines with the fashion world, evident even behind the scenes of the show, amplifying its impact and, importantly, heightening anticipation for the collection.

The study evaluated how different interactive features affect the user experience (UX) of a digital fashion show in a virtual reality (VR) environment. An IVR fashion show concept and prototype were created to enhance user experience. User testing revealed that interactive experiences had a greater positive influence on key aspects of UX, such as curiosity, enjoyment, immersion, and usability, compared to passive experiences. To conduct a study on VR fashion show production and user evaluations for UX analysis, a carefully prepared design that matches certain research objectives is required throughout the production phase. The design and implementation methodology detailed in this study are expected to provide a guiding framework for planners and developers during the planning, production, and testing phases of future VR fashion show preparations [4].

Additionally, [21] discovered that all physical live fashion presentations were canceled amidst the COVID-19 pandemic, which not only disappointed but also perplexed the global community. Virtual events were the only choice for

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designers in this scenario. Organizers quickly worked with experienced event planners to create the best virtual event platform. Social media platforms like Instagram and Facebook have become easily accessible from any location. Virtual fashion shows and events allow fashion companies and designers to interact with clients without being physically present at the event or on the catwalk.

Furthermore, [7] revealed that the VR fashion industry could be divided into three categories, each of which produced a distinct VR experience in the areas of cognitive presence, sensory immersion, emotional immersion, and aesthetic interaction. Different VR experiences may be correlated with differences in VR spatial characteristics. Based on the research, three key conclusions can be drawn: first, the experiential aspect of virtual space is influenced by predefined elements like sociocultural contexts and personal backgrounds; second, VR fashion shows create a psychologically engaging environment for brands and consumers; and third, immersive fashion spaces that depart from the original source can greatly encourage user creativity and exploratory engagement.

B. Elements of Fashion Show Performance

In this research, researchers used three major elements of show performance or fashion show that include clothing, model, and scene. By using these elements, it covers 1) Virtual clothing production, 2) Virtual runway show, and 3) Design and production of virtual models [20].

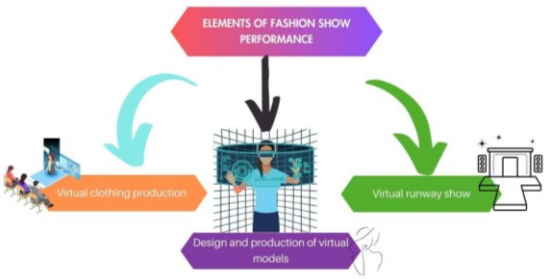

Figure 3: Elements of Fashion Show Performance by [20]

C. Virtual Clothing Production

The process of creating clothing designs completely digitally utilizing computer software and 3D modelling techniques, without the need for actual materials, is known as virtual clothing production, often referred to as digital fashion design or virtual fashion. Other scholars such as [22], also agree that this novel method of garment design provides various advantages, such as sustainability, cost-efficiency, and the opportunity to explore endless creative options. Here is a summary of the virtual apparel making process. The process begins with conceptualizing the design of the virtual apparel. This involves determining the style, silhouette, colors, and materials. Designers either sketch the apparel on paper or use digital design software such as Adobe Illustrator or CorelDRAW to create detailed digital designs. Once the design is finalized, 3D artists create a virtual 3D model of the apparel using specialized software like Blender or Marvelous Designer. This step involves shaping the garment in three dimensions, considering factors like fit, drape, and texture. Texturing involves applying digital textures to the 3D model to give it realistic colors, patterns, and surface details. Shading is used to simulate how light interacts with the fabric, creating effects like highlights and shadows. Virtual fitting sessions may be conducted to ensure that the apparel fits properly on the virtual model. Adjustments such as resizing, repositioning, or tweaking the design may be made based on feedback. Simulation software can be used to visualize how the apparel will behave in different conditions, such as when the wearer moves or when different types of fabrics are used. This helps ensure that the virtual apparel looks realistic and functions as intended. The final step involves rendering high-quality images or videos of the virtual apparel. Rendering software is used to generate photorealistic visuals that showcase the design from different angles and perspectives. The virtual apparel may be integrated into virtual platforms or environments; such as virtual fashion shows or e-commerce websites. This could involve optimizing the apparel for real-time rendering and ensuring compatibility with the platform's technical requirements.

D. Virtual Runway Show

Fashion labels and designers can digitally present their collections in an innovative manner with a virtual runway show, which enables viewers to experience the intricacy and innovation of a traditional fashion show from the convenience of their personal residences. According to [20], the virtual runway show is broadcast live or made available on digital platforms like fashion websites, social media channels, or specialized virtual event platforms. Global viewers can watch the show live or access it on-demand at a later time. As stated by [23], these occasions employ technological

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advancements such as live streaming, virtual reality (VR), augmented reality (AR), and 3D rendering in order to provide attendees with engaging and immersive experiences.

E. Design and production of virtual models

Begin by conceptualizing the virtual fashion model. This entails identifying its physical attributes, temperament, and traits. The purpose of the model (e.g., runway show, virtual assistant, gaming character) and the intended audience are factors that impact this stage. The designer utilizes specialized tools like Blender, Maya, or ZBrush to sculpt and mold the virtual object in three dimensions [24]. They design the model's anatomy, clothing, accessories, and any further aspects completely from the beginning.

The primary requirement for female models in the worldwide fashion industry is a height of 178cm, with a tolerance of plus or minus 2 cm. Therefore, female models with heights that range from 176-180 cm meet these criteria. The term "three dimensions" pertains to the measurements of a model's bust, waist, and hip circumference. Typically, for Eastern female models, the bust circumference ranges from 83-90cm, waist circumference from 60-62cm, and hip circumference from 88-90cm [20].

III. RESEARCH METHODOLOGY

This study used qualitative research with applied one-to-one interviews with eight Malaysian fashion designers in Malaysia. This interview was conducted face to face with the designers at their boutique or their shops and it took around 1 hour to 1 hour and 30 minutes. This research used purposive sampling based on the criteria: 1) Attended any virtual fashion show, 2) Established Fashion designer brand, and 3) The designer must have any digital media accounts. There are six semi-structured questions that were formed as a guide for the interview and two additional questions during the interview. The data can be analyzed using thematic analysis that forms three main themes parallel to the objective.

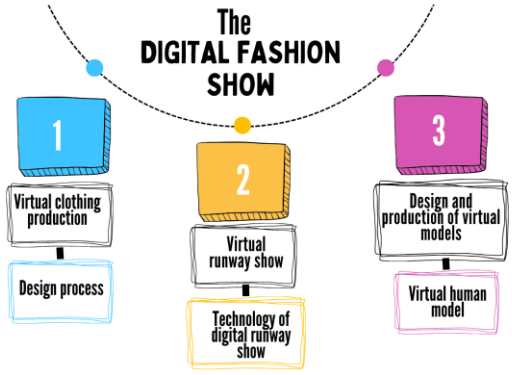

Figure 4: The Digital Fashion Show adaptation from [20]

IV. DATA ANALYSIS

The data can be analysed using thematic analysis that form three main themes adaptation from [20]: 1) Virtual clothing production, 2) Virtual runway show, and 3) Design and production of virtual models (see figure 4). The first theme refers to virtual clothing production and its consist of one sub-theme is design process. The virtual clothing combines traditional fashion with cutting-edge technology with the design process. Most of the designers said the virtual clothing blend of fashion and digital innovation, garments no longer exist physically; rather, they are visually created using 3D software, Auto Computer-aided design (CAD), and augmented reality (AR) technologies. In addition, its influence on the future of fashion suggests it could become the upcoming major trend. The designers could launch a digital clothing item in the metaverse with a variety of color variations, using sales data to determine which colors to incorporate into the physical version. At the same time usage of 3D is a more sustainable approach because designers have no requirement for mass production instead, but the items are created only upon order placement. This essentially adopts an on-demand model, effectively reducing fashion waste. This is also agreed by other designers:

> *"...I've been utilising 3D software to create virtual apparel since the 2021 covid epidemic. Meanwhile, participate in KLFW 2021 to develop a digital clothing named Iridescence. I used 3D software. Using 3D software for such a project probably allowed me to explore textures, colours, and designs in ways that older approaches would not have allowed. Furthermore, presenting my work at a major event like KLFW would have surely brought vital exposure for my ability and innovative approach to fashion design.","" (D4).*

> *"... I think virtual clothing is emerging as a groundbreaking innovation in the realm*

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of fashion. So, the garments no longer exist physically in the future, we can use AR as an illusion that real and digital worlds exist in the same space. I'm now personally using digital clothing in the metaverse adding a variety of colors for customers…" (D6).

"...employing 3D technology is a more sustainable approach compared to traditional fashion methods. By designing prototypes digitally, there is no requirement for mass production, instead the items are created only upon order placement,…" (D7).

"...we started with the design process using technology like auto CAD for fashion sketches as a technical drawing. So, a technical sketch includes the design, construction, and stitch details of my garment,…" (D8).

The second primary information is that virtual runway events encompass a transformational power, offering an alternative to conventional fashion presentations that is more immersive, convenient, and environmentally friendly. The digital runway show is the sub-theme that falls under this overall topic. Consequently, this has led to the development of digital fashion, which is a trend that is characterised by the unique combination of technology and style. This trend has culminated in the establishment of virtual runways that attract fashion fans internationally. It is not necessary for the virtual runways to mirror real-life conditions, particularly with regard to accessibility. It is no longer necessary for the event to have a physical place in order to accommodate guests; rather, numerous accessibility features, such as audio descriptions and subtitles, can be effortlessly integrated into digital shows. In addition, according to [25] VR spaces provide humans with virtual spaces, with social functions that are similar to space in reality. The virtual runway was created using technology like CGI, motion capture, etc. This is in line with the designer's view:

"...through a live stream, my viewers had the opportunity to observe my collection from any of social media platforms because with the emergence of technology and style can create captivating addicts,…" (D1).

"...for me the good things for virtual runway shows are good things because we no longer need physical space for accommodating attendees for fashion shows events,…"(D3).

"...I think the benefits of the virtual runway shows are a convenient, transformative force, providing an immersive, and environmentally sustainable alternative to traditional fashion shows,…" (D5).

The third main theme is the design and production of virtual models refers to designing and creating virtual models for virtual fashion shows. In addition, most of the designers design a virtual environment that reflects the fashion show's theme and concept, keeping in mind user experience elements like navigation, interaction, and visual appeal. Other than that, the usage of AI and 3D avatar models, design, and rig wearing digitally created clothing that reflect the diversity and inclusivity of the target audience. The designer looks into the details and attention to garment textures to ensure the models are ready for animation to bring a realistic touch to the virtual fashion show. The designers add the virtual scene is composed of geometric surfaces and the more surfaces, the finer the model will be and the more resources will be occupied.. This is also agreed by other designers:

"...I crafted AI-generated ensembles, developed virtual models, and simulated the entire runway atmosphere, including lighting effects and music, at the same time the model to bring a realistic touch to your virtual fashion show." (D2).

"...I think the virtual audiences can engage with fellow avatars, explore immersive 3D environments, and forge connections like never before,..." (D4).

"...we design the movements, pacing, and timing of our models to craft an engaging runway experience. Utilize motion capture or keyframe animation methods to animate our models, ensuring synchronization with music and other audio components for a polished showcase," (D7).

V. DISCUSSION

The study's findings underscore the necessity for designers to stay abreast of emerging trends to maintain competitiveness in the industry. With

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technology's pervasive reach enabling access to information anytime and anywhere, virtual fashion emerges as a crucial technique for the future. Moving forward, the insights gleaned from this study will prove invaluable in aiding Malaysian fashion students and designers in adopting digital fashion shows and virtual runways as part of their repertoire. The virtual clothes have been recognized to be very similar to actual clothes and facilitate creative expressions that are hard to be presented in actual fashion shows. Virtual fashion shows tailored to different body types showcase suitable and unsuitable outfits for each physique. Additionally, developing educational programs or applications tailored to consumers can aid in helping them discover ideal clothing options based on their body types and personal preferences [26]. The adaptation of 3D virtual clothes to the real fashion industry in the future can make new content through the innovation of distribution and industry [20]. AI assumes a crucial role in fashion evolution. It serves as the unseen force behind the creation of virtual models, dressing them in digital attire, and animating the simulated runway ambiance. The AR-enhanced store appears to stimulate brand engagement, increasing consumers' desire to shop at the retailer, which provides managerial opportunities to reinforce brand positioning [27]. The augmented fashion show introduces a novel immersive experience, allowing consumers to generate personalized 3D models of themselves. These models can then be adorned with a range of purchasable clothing options using Augmented Reality technology [28]. The fashion industry is fully embracing digital transformation and experiencing a growing adoption of technology at each point of its value chain as it increasingly recognizes it as a crucial source of value creation in order to compete and thrive in such a complex market [27][29]. The digital revolution has influenced every aspect of the fashion industry. Specifically, in fashion communication and marketing, the adoption of digital tools provides a fertile environment for enhancing business operations and fostering stronger customer relationships [30].

VI. CONCLUSION

The integration of AI and virtual runways is in its early stages, yet the possibilities are immense. Envision a future where fashion presentations transcend geographical limitations, becoming accessible to anyone with an internet connection. The designers are able to develop and exhibit their collections without being bound by financial or geographical barriers. The virtual runway may be a novel experience for some, but its numerous benefits cannot be overlooked. The adaptation of 3D virtual clothes to the real fashion industry in the future can make new contents through the innovation of distribution and industry.

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Learning Communicative English Using Flipped Classroom Approach via Curriculum Information Document Online System (CIDOS)

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Abstract

Flipped learning or flipped classroom has been introduced and applied in teaching and learning. Some may realize the concept while some are simply implementing it without knowing the term. This approach is introduced to encourage active learning and to attract students to interact with others. Flipped classroom suits students at higher learning institute because it develops critical thinking and problem-solving skills. Hence, this approach was introduced to enable students to learn at their own pace while hands-on activities are done in the classroom. The objective of this paper is to investigate perceptions of Malaysian polytechnic engineering students on learning Communicative English using flipped classroom approach via a learning management system called CIDOS. Specifically, the current study explored engineering students' views, benefits, and challenges of learning through flipped classroom approach. This study utilized an online reflection questionnaire consisting of both close and open-ended questions with 140 semester three engineering students undertaking Communicative English 2 course at a Malaysian polytechnic. The finding was analysed using SPSS and based on the analysis, the results indicated most engineering students had positive attitudes on the use of flipped classroom approach, preferred flipped classroom approach to traditional teaching approach and would like to continue learning through the flipped classroom approach. Although the analysis of results indicated positive outcomes, attention to possible challenges was also highlighted. In brief, flipped classroom has been well received by the respondents but, there are challenges and other aspects to be investigated prior to applying the approach in teaching.

Keywords **:** *Flipped classroom; Views, Benefits; Challenges; Communicative English, Technical*

I. INTRODUCTION

Communicative competence is a crucial skill required for working purposes[25]. It gives benefits to students when attending interviews and this separates them from other candidates. In addition, excellent communicative competence hinders employees from misinterpretation and negative impact related to communication[31]. It also smoothens international communication[29]. The responsibility to develop proficient future workforce are mainly shouldered by the English language lecturers. Thus, it is paramount for English language lecturers to use the most effective teaching and learning approaches to prepare their students for future workplace expectations. Integration of technology is seen as an essential feature of educational settings in this 21st century and flipped classroom approach is an approach that supports blended learning by integrating technology. Flipped classroom is one of the modern methods of teaching, which has recently been implemented as an alternative method of teaching[47]. However, previous studies have indicated that there is still lack of studies focusing on flipped classroom learning in English as Second Language (ESL) at higher learning institute setting[21],[12]. There are three types of flipped learning which are traditional flip, in-class flip and mastery flip[1]. For traditional flip, videos are provided for the students to acquire basic knowledge of specific lessons, while the in-class activities focused on critical and creative thinking, and problem-solving skills[23]. The second type is in-class flip with the same elements of traditional flip, but students watch videos in class and work with other students and complete the task too[5]. As for the third type, mastery flip allows students to

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work in small group or individually at suitable pace and being summatively assessed[2]. It is hoped that implementation flipped classroom in teaching of Communicative English may encourage students to practice the language out of the classrooms. This approach allows students to study the topic given according to their own pace outside classroom time, while hands-on activities are conducted during class time in the classroom[15]. Flipped classroom provides flexibility because it allows many elements of learning including assessments and problem-based inquiries to be added. Sharing of videos is another element in flipped classrooms and YouTube videos have been used widely as public video sharing platform worldwide. With flipped classrooms, lectures can be done outside of class time, while focus has shifted to learning activities[41]. This approach suited the pedagogical situation during the recent pandemic of Covid-19.

II. LITERATURE REVIEW

In the 21st century, the possibilities offered by technology in pedagogical practices are limitless. As teaching and learning approaches today have incorporated the latest technology, flipped learning has also included the element of e-learning in its implementation. This element is used to encourage students to learn via technology. As mentioned by Bruniges[6], new and creative approaches need to be introduced via new technologies because students nowadays prefer to use them. Flipped classroom was introduced by Jonathan Bergmann and Aaron Sams with the objective to help trainees who missed their training session, which video and other learning materials were prepared for them to learn[20]. This approach was introduced by Jonathan Bergmann and Aaron Sams for trainees who had missed class; they used live video recordings and screen casting software to record lectures, demonstrations, and slide presentation with annotations and posted them for the trainees to watch and read[20]. Furthermore, with proper use of video, it can be an effective tool for learning[22]. Among the most referred definition of flipped classrooms is from Butts[7] which the focus is on moving the way teaching material is delivered from in class to outside of class via video recorded lectures, and other suitable means, while learning activities are organized in class with the objective of collaboration and interactive among students. Commonly, lectures and learning activities are organized in class, however, for flipped classrooms, students are given the task to study the topic before the class. The materials which can be in the form of video and other formats are prepared by instructors. During class, lectures might be replaced with activities, but students are still allowed to enquire for any explanation on the topic. However, Bishop and Verleger[4] have narrowed down the definition of flipped classrooms which divided it to interactive group learning activities inside classroom and direct computer-based individual instruction outside classroom. Learning in the classroom is no longer sufficient as nowadays students are eager to explore learning themselves using technology. Hence, flipped classroom has been implemented to enable students to guided self-exploratory learning. A study which involved students in South Korea found that they scored significantly higher as compared to students who were non-flipped classrooms, and they also enjoyed learning in flipped classroom[28]. In another study with students from University of Maeau found positive attitude of flipped classroom[11]. It might also enhance student learning achievement and satisfaction[32]. Apart of that, flipped classroom gives more satisfaction to students and they may be more satisfied with the method[33]. However, flipped classroom challenges instructors and students. Instructors have to prepare the materials including recorded lecture materials[37], and apart of that, they have to guide, facilitate, support, give feedback, and evaluate the learning process[48], while some students have difficulty adjusting their own learning time[26]. In another study, it was found that students enjoyed learning in flipped classrooms[24]. In another study with a class of students from University Malaya discovers that the students gave positive perceptions on flipped classroom and positive impact to shy and quiet students[46]. Rajesh (2015) has proved that flipped classrooms have transformed the shy students, the ones with lack of confidence and motivation to communicate in English and they seemed to enjoy hands-on activities[34]. In another study, students reported that flipped learning is effective for their learning[9]. A study with Jordanian private universities also found that the students have high perception on flipped classroom[1], thus, it can improve students' interest to learn English and in addition it is expected that this approach could solve TVET trainees' issues[30].

In flipped classroom, teacher functions as facilitator[15], while content is shared via video on online platforms[2]. This approach enables the learning process to be more individualized and personalized[40]. It means that students can design

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and arrange their schedule according to their preference of time and method. Many studies have been done which discover that student achievement and satisfaction in learning have improved[10], [16], 39]. Nevertheless, there is also study which found opposite finding which students were less satisfied in flipped classroom because they felt that they have extra work in flipped classroom[32]. Flipped classrooms have received well acceptance, nevertheless there are challenges to investigate such as the quality of video, and training for instructors[21].

So, the impact is students enhanced their interaction with classmates and lecturers[14], [43], 42]. Wilson (2013) also found that flipped classrooms increased students' interaction as well as performance[44]. Flipped learning also instills good relationship between instructors and students[38]. In brief, this approach is said to be student-centered[20], improve learning experience and capture students' attention to learning[35] and it transforms instructors' role to be facilitator[18].

With the development of technology, flipped classrooms can be a standardized teaching and learning approach at higher learning institute (McKnight & Arfstrom, 2013) as students nowadays are fully exposed to use of the easy access technology. In a study conducted, it was concluded that flipped learning are beneficial such as students are able to manage their own learning according to their ability, they can be prepared before they go to class, they are able to solve their learning issues in class and increase their participation when they are in class, while in another study with diploma students from Sunway University, Malaysia, flipped classrooms have successfully developed higher-order thinking skills and increase their motivation to learn English[21].

Considering the significance of the flipped classroom approach and the lack of research on the use of flipped classroom approach in the teaching and learning of Communicative English courses at Malaysian polytechnic context, this study aims to gain insights of Malaysian polytechnic engineering students views in terms of the use of flipped classroom approach via CIDOS platform. In addition, the benefits and challenges of utilizing flipped classroom approach were also explored.

III. RESEARCH METHDOLOGY

The participants in this study were composed of 140 diploma students from two engineering departments namely Mechanical and Aircraft Maintenance engineering departments at a Malaysian polytechnic. Among these participants, all 140 engineering students responded to the questionnaire while 112 students provided their responses to the open-ended questions which required them to write a brief reflection pertaining to the benefits and challenges of learning Communicative English through a flipped classroom approach.

The 140 engineering students were undertaking Communicative English 2 course where they are required to attend face to face classes regularly and complete four main assessments namely oral presentation, assignment, test, and a role play. In addition, the Department of Polytechnic Education has standardized that 70% of the courses offered at Malaysian polytechnics must implement blended learning. Therefore, a Learning Management System (LMS) called The Curriculum Information Document Online System (CIDOS) which was developed by the Instructional and Digital Learning Division (BIPD), the Department of Polytechnic Education was used as a pedagogical tool to implement and facilitate flipped classroom approach.

At the beginning of the semester students were introduced to the flipped classroom approach and the use of CIDOS to support their learning practices. Students were taken to the computer lab for the first week and were guided by the lecturer to join the CIDOS platform. In the flipped classroom approach, the students use of CIDOS platform lasted for 10 weeks. The lecturer uploaded materials consisting of lesson videos, YouTube videos related to the topics, website links and articles each week to the CIDOS platform one week prior to the face-to-face class session. For instance, in the first week the lecturer carefully selected resources such as lecture videos, YouTube videos, relevant websites, posters and advertisements related to the first topic Products and Services. Students were then asked to come up with their own product description and review videos and post it on the CIDOS platform. The lecturer would facilitate by providing feedback and encouraged their peers to make comments on their friends' product or service description and review videos in the CIDOS forum platform before the class. In this way, it is aimed that students and their peers could have an opportunity to observe, analyse and comment on the way products and services are described. This will then further lead to active discussion and constructing knowledge session in the classroom. Upon the completion of the first topic, students are required to take charge of preparing their own oral presentation videos for assessment and upload it in the CIDOS platform. Similarly, in the following weeks, the resources related to other remaining topics in Communicative English 2 course were provided in the CIDOS

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platform, a week ahead. This will be followed up with interactive and collaborative activities in the classroom to enrich their content knowledge regarding the topics.

Upon the completion of 10 weeks of flipped classroom approach, data were collected through a questionnaire developed using Google Docs. The questionnaire was adapted from the study exploring students' perception on flipped classroom approach among community college students carried out by Fathilah Begum and Siti Shuhaida (2021)[15]. The 15 items specifically explored students' views in terms of their attitudes, experience, and motivation towards learning Communicative English through the flipped classroom approach. The participants were asked to indicate their agreement on a five-point Likert scale ranging from strongly agree, agree, neutral, disagree and strongly disagree. In addition, participants were required to write a brief reflective response to two additional open-ended questions related to the challenges and benefits of the flipped classroom approach. The Google Docs questionnaire link was provided to the students through CIDOS platform.

To ensure reliability of the questionnaire item, Cronbach Alpha Internal consistency was computed. Based on Cronbach's Alpha reliability method, an alpha value of .65 to .95 is satisfactory. If the alpha value is < .65, this means that the ability of the instrument to measure the variable is low, and if the alpha value is > .95, means that the items overlap with one another. Figure 1 shows the results of the Cronbach Alpha reliability test for the questionnaire is .952. This means the instrument used in this research is highly reliable with 15 items.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.952	.952	15

Figure 1 Reliability Test

IV RESULT AND DISCUSSION

In this section of the study, the analysis of results is discussed in two main sections based on the research questions. The first section presents Malaysian polytechnic engineering students' views of learning Communicative English using flipped classroom approach, while the second section outlines excerpts of the responses related to the benefits and challenges of using the flipped classroom approach.

Table 1 Student's views on learning Communicative English through flipped classroom approach

Item	Mean	Standard Deviation
1. I have heard about flipped classroom approach before.	3.757	.77619
2. I understand the concept of flipped classroom approach.	3.835	.76441
3. I find the flipped classroom approach easy to adapt and more engaging than traditional learning approach.	3.957	.71843
4. I prefer the flipped classroom approach to the traditional learning approach (teacher controlled).	4.150	.66706
5. I understand the videos and online articles shared by my lecturer.	4.007	.68379
6. I find the flipped classroom allows me to control my own learning.	3.914	.70441
7. The flipped classroom approach helped me to understand the content/topic easily.	3.857	.68458
8. I am more actively engaged in the activities given by my lecturer using the flipped classroom approach.	3.885	.71051
9. I am able to keep up with my lessons in Communicative English classes using flipped classroom approach.	3.914	.69412

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10. I learn Communicative English course better when I have a positive attitude.	3.914	.66230
11. My attitude in learning Communicative English has improved when flipped classroom approach is used.	3.885	.71051
12. I feel that I am more motivated to learn Communicative English when flipped classroom approach is used	3.907	.71868
13. Flipped classroom approach gives me greater chance to communicate and collaborate confidently with my lecturer and friends.	4.007	.68379
14. I feel happy to learn Communicative English using the Flipped classroom approach.	3.993	.73452
15. I want to continue learning using the flipped classroom approach.	4.014	.68892

	Mean	Min	Max	Range	Max / Min	Variance	N of Items
Item Means	3.926	3.757	4.150	.393	1.105	.008	15

Figure 2 Summary Item Statistics

Table 1 depicts the analysis of results in relation to Malaysian polytechnic engineering students views on learning Communicative English through the flipped classroom approach. As shown in Table 1, the means of 14 items out of 15 items in the questionnaire are considered high because it was above 3.80 (refer to Table 2). Based on Figure 2, the overall mean value of all the 15 items is M=3.926, with the minimum mean value was 3.757 (Item 1) while the maximum mean value was 4.150 (Item 4). Thus, it can be inferred that the participants have positive views in relation to learning Communicative English through flipped classroom approach.

Specifically, Item 4 (M=4.150) obtained the highest mean score indicating that the participants prefer the flipped classroom approach compared to the traditional teaching approach. Besides, it also important to highlight Item 15 (M=4.014) and Item 13 (M= 4.007) in which the participants reported that they want to continue learning using the flipped classroom approach and the flipped classroom approach has provided them better opportunity to communicate and collaborate confidently with their lecturer and peers. A similar study analysed student teachers' perceptions towards flipped classroom approach and the results supported the findings of the present study by reporting the flipped classroom model is well received positively by the student teachers and they were willing to continue learning using the approach. On the other hand, the mean value for Item 1 (M=3.757) was recorded as the lowest mean score compared to other items. It suggests that the flipped classroom approach might have been a new concept of learning approach for some students.

Next, qualitative data collected through two open-ended questions pertaining to the benefits and challenges faced by Malaysian polytechnic engineering students in learning Communicative English through flipped classroom approach were analysed and grouped according to the in Table 2. The most mentioned beneficial aspect of the flipped classroom approach was related to access to a variety of learning resources. Students have mentioned "practical way to obtain course materials" and "we don't have to waste time to find relevant resources". Therefore, CIDOS can be regarded as an excellent platform that supported the implementation of flipped classroom approach.

In addition, the flipped classroom approach has encouraged students to take control of their own learning and promoted a more student-centred learning experience. For instance, some students commented that "I can study and revise anytime at my own pace" and "I can be independent and decide when the best time is for me to study" and "flipped classroom method is more student-centred compared to traditional method". This is in agreement to finding form other study which flipped learning provides student-centered learning[49]. Besides, flipped classrooms are found to be promoting a more collaborative learning situations by providing students the opportunity to interact actively with their peers and lecturer and boosted their confidence and motivation in learning. For example, some participants stated that "I come to class more prepared and motivated" and "I am more confident to communicate with my lecturer and friends." In short, the respondents showed positive views on flipped classroom and it is in line with finding from previous studies with positive perception and attitude as compared to traditional classroom[54]. Although previous studies explained that

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students had a positive perception and attitude toward flipped

classrooms than traditional instruction (Onojah et al., 2019),

Table 2 The benefits and challenges of learning through flipped classroom approach

Benefits	Challenges
• Access to a variety of learning resources • Student-centred learning experience • Collaborative learning situation • Enhanced confidence and motivation to learn	• Slow internet connectivity • Lack of time to study the resources before class

Table 2 also listed the challenges faced by the students in terms of learning Communicative English through flipped classroom approach. Firstly, since the flipped classroom approach via CIDOS platform requires students to use the internet, barriers regarding slow internet connectivity were highlighted by most of the students. Some of the students indicated that "the internet line is very slow and frustrating" and "we can't access internet at all the places around campus - only at certain place and it is slow". This finding is similar to other studies which highlighted financial investment to develop flipped classroom[50]. Next, lack of time to study the resources before class was also reported as a challenge for students. Students reported that "we are busy with lots of assignments and lab work" and "no time to study earlier because our timetable is packed". This is in line with the limitation reported by Danker (2015) whereby students come to class unprepared for flipped classroom. Students with difficulty to complete the pre-task given before the classes might not find this approach is suitable to them [51],[52],[53].

Therefore, these challenges should be evaluated carefully, and lecturers should take proactive measures to eliminate these barriers. They could request better internet connectivity at their institution to support as sustain the use of flipped classroom approach. At the same time, it is essential for lecturers to check on their students whether they have completed their online tasks and try to integrate them in the classroom in a way.

IV. CONCLUSION

The current study explored the views, benefits, and challenges of polytechnic engineering students in relation to learning Communicative English course at a Malaysian polytechnic. The analysis of data carried out in this study suggested that the flipped classroom approach is well received and beneficial for students. Although majority of the students found that flipped classroom approach is better than the traditional teaching approaches and are interested to continue learning using the flipped classroom approach, slow internet connectivity and lack of time were the two main challenges highlighted by them. Therefore, efforts to eliminate the challenges are vital to provide a more successful and sustained flipped classroom learning experience for students. Future studies could focus on exploring the lecturers' flipped classroom teaching practices, experiences and whether it impacts their future pedagogical practices. In addition, students personality and their preferred learning strategies may be looked into towards flipped learning.

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The Effects Of Problem-Based And Collaborative Learning On Students' Higher-Order Thinking Skills

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Abstract

The Standard Secondary School Curriculum introduced in 2017 places a greater emphasis in Additional Mathematics on applying the elements of higher-order thinking skills (HOTS). However, students showed poor performance in the application of HOTS in solving Additional Mathematics problems. Therefore, this study examined the effects of Problem-Based Learning (PBL) and Collaborative Learning (CL) with the help of Geometer's Sketchpad on the four levels of HOTS of Form Four students namely Applying, Analysing, Evaluating and Creating. A PBL-CL module was developed as a guide for teachers to foster HOTS among students. A HOTS test was developed to assess the level of HOTS of students. This study used a quasi-experimental pre-test and post-test control group research design involving 270 Form Four students in Sabah, Malaysia. The assessment of HOTS involved three intervention groups namely PBL-CL, PBL and Conventional Learning (Conv) group. Statistical analysis employing MANCOVA, ANCOVA, and Effect Size techniques were conducted. The results showed that the PBL-CL group produced a significantly higher post-test mean scores compared to the PBL and Conv groups in all four levels of HOTS. This shows that the PBL-CL method has a positive effect in helping the development of HOTS. Therefore, Additional Mathematics teachers are strongly recommended to integrate PBL-CL in their TL practice to increase the level of HOTS among students.

Keywords: *collaborative learning, form four students, higher-order thinking skills, problem-based learning.*

I. INTRODUCTION

Mathematics is one of the most important fields in the development of human capital in the 21st century. In line with that, the transition in mathematics education from emphasizing cognitive algorithm skills to higher-order thinking skills (HOTS) has an impact on the implementation of Mathematics teaching and learning[1]. Therefore, at the school level in particular, the introduction of HOTS in the subject of Additional Mathematics as an elective subject is seen to help realize this aspiration. Compared to Mathematics, Additional Mathematics places a greater emphasis on mathematical applications and real-world problem-solving which is closely related to solving non-routine problems. This coincides with the change of the Malaysian Integrated Secondary School Curriculum to the Standard Secondary School Curriculum which has been implemented since 2017 so that students not only to improve students' knowledge, skills and interests but also to apply elements of HOTS in the curriculum[2]. However, the results of the Additional Mathematics subject in the Malaysian Certificate of Education (MCE) since HOTS was introduced by the Ministry of Education are of great concern to all parties, especially in the state of Sabah. It was found that 46.67% of students have poor application skills while 37.36% have poor analytical skills[3]. In addition, the weak categories of evaluating and creating skills showed 52.49% and 39.48% respectively. In conclusion, there are more than 40% of students out of all MCE candidates who are still weak in answering HOTS questions.

Several approaches such as problem-based learning (PBL), collaborative learning and the use of technology in teaching should be highlighted to overcome this problem. PBL is an authentic (real) problem-learning approach so that students can organize their knowledge, develop high skills and

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inquiry and increase their self-confidence[4]. PBL is designed to provide students with real-life situations to solve real-world problems through a series of activities and investigations based on the theories, concepts and principles they learn, as well as helping students build their thinking needed to succeed[5]. Through this method, relevant and meaningful real-world problems are presented to students. Students actively work in groups to solve problems, communicate, and argue for the best solution and the instructor only plays a role in facilitating student knowledge-building activities[6].

A collaborative learning approach is also seen as one of the ways to deal with this problem. However, [7] stated that the main problems in the implementation of teaching at the secondary school level are collaborative learning that is practised less effectively, the lack of students' HOTS skills and less satisfactory academic performance. According to[8], collaborative learning methods are difficult and rarely implemented because teachers think that collaborative learning methods are a waste of time. Teachers take the easy way out by telling students the answers without explanation to save time and be able to finish the syllabus quickly. As a result, collaborative learning methods that can train students about HOTs are neglected. In conclusion, the success of improving students' HOTS depends on the teacher's role in planning and preparing group learning activities that involve all students[9].

Based on the problems above, this study was conducted by focusing on learning strategies in the classroom. One of the alternatives to existing learning strategies is a collaborative problem-based solution method. Past studies show that problem-based solution methods are needed by students to train critical thinking to create skills that help in understanding concepts in depth[10]. In addition, [11] stated that the interaction between students which is the main feature of collaborative learning can improve student performance and student interest. However, research on the use of collaborative problem-based solution methods is less conducted at the secondary school level. Thus, the researcher sees a need to develop a learning module using elements of problem-based solution methods and collaborative learning with the help of technology such as Geometer's Sketch Pad (GSP) to encourage active learning in the classroom. According to [12], students' enjoyment while learning Mathematics by exploring using GSP shows that students must know how to use technology. Therefore, a suitable module guided by technology such as GSP needs to be produced to encourage students to think of problem-based solutions in a collaborative approach to improve students' HOTS and collaborative skills.

II. LITERATURE REVIEW

A. Problem-Based Learning

In general, problem-based learning known as PBL is defined as a teaching and learning method where students are involved in solving real-world problems and with sufficient knowledge to solve problems. [13] stated that PBL learning has the following cognitive effects on student learning, namely, activation of existing knowledge, elaboration of existing knowledge through small group discussions, restructuring of knowledge to suit the problem presented, learning according to context and the emergence of a desire to know. Therefore, [13] introduced seven steps of the PBL model which are 1) Clarifying of terms and concepts that are not easy to understand, 2) Defining the problem, 3) Problem analysis, 4) Draw a systematic inventory of the explanations deduced from step 3, 5) Formulate learning objectives, 6) Gather additional information outside the group, and 7) Synthesize newly acquired information.

In Malaysian schools context, PBL is designed to prepare students to learn in real-life situations to solve real-world problems through a series of activities and investigations based on the theories, concepts, and principles learned, helping students develop their thinking and communication skills needed to succeed[5]. Unstructured problems in PBL can improve students' cognitive processes accompanied by good studies[14]. In mathematics education in particular, several studies show that students have a positive effect on their achievement scores in learning Mathematical thinking skills through PBL[15].

B. Geometer's Sketch Pad

Geometer's Sketch Pad (GSP) is one of the dynamic geometry software systems for creating, exploring, and analysing various mathematical concepts in algebra, geometry, trigonometry, calculus and other fields. GSP is also a dynamic geometry software that allows teachers and students to build and change geometric objects or object components, by dragging different objects onto the computer screen. According to [16], GSP is an interactive tool that encourages a discovery process where students first describe and analyse problems and then draw conclusions. GSP allows students to work through many examples and allows them to discover patterns by constructing their own sketches[17]. The study by [18] showed that there was a significant difference between the mean evaluation of secondary students' interest in teaching geometry using GSP software compared to students who were taught without GSP. According to [19], the use of technology increases students' enjoyment and

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interest. Therefore the use of technology can be one of the steps taken to increase secondary school students' interest and achievement in geometry.

C. Higher-Order Thinking Skills (HOTS)

HOTS is the main component of creative and critical thinking ability and is the highest level of cognitive process[20]. In Bloom's Taxonomy, thinking levels can be classified according to six levels of cognitive thinking, where the three lowest levels are Knowledge, Understanding, and Application, while the three highest levels are Analysis, Synthesis and Evaluation. Following the formation of 21st-century learning in all schools in Malaysia, the revised edition of Bloom's Taxonomy was introduced in 2001. This revised edition of [21] has updated the six levels of Bloom's thinking into verbs and also divided the top four levels into the high-order thinking skills group (HOTS) and the two lowest levels into the low-level thinking skills group (LOTS). The HOTS assessed in Form Four Additional Mathematics is based on the top four levels of the revised edition of Bloom's taxonomy, which are Apply, Analyse, Evaluate and Create [2]. In a previous study, [22] identified several problems faced by teachers in the implementation of Mathematics teaching through the integration of HOTS. Students' basic knowledge, students' difficulties in understanding high-order questions and teachers' difficulties in constructing high- order questions are problems identified by teachers. Findings about teacher problems in the context of students' basic knowledge are in line with the study by [23] who stated that teachers believe that students need to first know all the facts and concepts of a subject before they can be encouraged to think. This is because students find it difficult to understand high-level questions even after being given prompt questions and only some students can continue learning while others encounter a dead end. In addition, the lack of modules or other reference materials that characterize HOTS makes it the main constraint of learning HOTS in the classroom[22].

D. Collaborative Learning

Collaborative Learning (CL) is a technique designed to make learning a fun and active process. It is also called cooperative learning or small group learning. According to [24], collaborative learning is a teaching method where students at various performance levels work together in small groups towards a common academic goal. Collaborative skills have been further defined as learning that occurs as a result of interactions between peers involved in completing tasks together. The focus is on what students can do to initiate and manage their learning through collaboration with others [25] (Ingleton et al., 2000). [26]'s study found that most students claimed to gain academic benefits such as better understanding and performance. In addition, students were also seen to acquire generic skills through improved communication and problem-solving skills.

E. Research Aim and Objectives

This study was carried out to determine the effects of problem-based learning and collaborative learning (PBL-CL) with the help of Geometer's Sketch Pad on the higher-order thinking skills of Form Four students. Specifically, the objective of this study was to determine the effects of problem-based learning and collaborative learning on the four levels of HOTS of Form Four students, namely Applying, Analysing, Evaluating and Creating.

III. RESEARCH METHODOLOGY

A. Design

The research employed a quasi-experimental pre-test and post-test control group design to examine the effects of three different TL methods on Form Four students' higher-order thinking skills. The implementation of TL groups was divided into three types, namely PBL-CL, PBL and Conventional Learning (Conv) methods. In the PBL-CL method, a module developed by the researcher was used as a teaching module. In the PBL-CL module, students were exposed to GSP-assisted problem-based learning that uses collaborative learning techniques. The collaborative learning techniques used were Think Aloud Pair Problem Solving, Send A Problem, Structured Problem Solving and Group Investigation. Meanwhile, Form Four students in the PBL group were exposed to problem-based learning with the help of GSP without using collaborative learning techniques. The students in PBL group are also given the same assignments as the PBL-CL and Conv groups but the group activities are more teacher-centered. As for the Conv method, students follow the conventional teaching and learning process with the help of GSP but without module, where almost all learning activities are fully controlled and guided by the teacher. All students were given the intervention in the same week but with different TL methods for eight weeks between November - December 2021.

B. Population and Sample

The research population consisted of 487 Form Four students in Lahad Datu district[3]. In this research, students from five out of 10 national secondary

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schools in the Lahad Datu district were ramdomly selected as sample to sit for the pre-test. The HOTS Test was used as an instrument to determine the research sample. Next, the HOTS Pre-Test and CS Pre-Test were administered to Form Four students for the five schools involved. From the test scores, students from three schools with the same or almost the same score values were selected as a sample in this research. The selected schools were then randomly divided into three groups, namely the PBL-CL, PBL and Conv group. In addition, the selection of three schools was also assessed from the aspect of the number of students taking the subject of Additional Mathematics at the school. Each selected school had a minimum of 90 students as research subjects. This means, three schools provided 270 students as research subjects. Next, each selected school was divided into three classes consisting of 90 students, with each group having 30 students. According to Chua (2008), the Multivariate Analysis of Variance is robust against violations of normality when the sample size is or greater than 30. The teaching methods namely the PBL-CL method (n = 30), the PBL method (n = 30) and the Conv method (n = 30) was implemented in each selected school.

C. Higher-Order Thinking Skills Test (HOTS-T)

The HOTS-T instrument [28] was used to measure higher-order thinking skills. The HOTS-T instrument developed by the researcher was guided by the top four levels in Revised Bloom's Taxonomy by [21], namely Applying, Analysing, Evaluating and Creating. All items were developed based on the Additional Mathematics Curriculum and Assessment Standard Document concerning the topics found in the Form Four Additional Mathematics textbook. Each HOTS level has two subjective type items with different question forms. In total, eight items were constructed representing all levels of HOTS: 1) Applying (2 items) 2) Analyse (2 items) 3) Assess (2 items), and 4) Creating (2 items)

The scoring criteria for the HOTS refer to the analytical scoring rubric that has been modified in assessing students' HOTS issued by [29]. It is based on the total marks obtained from two items according to the HOTS construct, where each item contains a total of four marks, which makes each level contain a total of eight marks. The following rubric details the student's achievement level based on the cognitive assessment of the student's HOTS level: 1) 1 - 2 marks: Inability to solve problems accurately; 2) 3 – 4 marks: Lack of ability to solve problems accurately; 3) 5 – 5 marks: Able to solve problems accurately; and 1) 7 – 8 marks: Very capable of solving problems accurately.

The validity of the HOTS-T instrument was analysed based on item fit analysis using Rasch Measurement Model. Three criteria were used to assess the appropriateness of items according to [30] and [31] namely: 1) Outfit Mean Square Values (MNSQ) – the value must be between 0.50 and 1.50; 2) Outfit Z-Standardized Values (ZSTD) – the value must be between -2.00 and 2.00; and 3) Point Measure Correlation (PTMEA-CORR) – the value must be between 0.40 and 0.85. If the item meets one of the three criteria, the item should be retained [32]. Findings from the assessment of item fit in Rasch analysis show that all items in the HOTS-T instrument meet all the criteria for Outfit MNSQ, Outfit ZSTD and PT-MEASURE CORR. Thus, all items are retained. Meanwhile, the reliability of the HOTS-T instrument which was also assessed using Rasch analysis reported good index values for item reliability (r = .98) and person reliability (r = .91).

D. Data Analysis

The data were analysed using inferential analysis to meet the objectives of the research. A multivariate analysis of variance (MANOVA) was used to examine whether there was a statistically significant difference between the mean scores of Form Four students in the Pre- HOTS-T test according to the construct. Multivariate Analysis of Covariance (MANCOVA) was used to evaluate the effect of three different teaching and learning groups on students' higher-order thinking skills and collaborative skills. Four covariates were identified namely pre-applying, pre-analysing, pre-evaluating, and pre-creating. This covariate served as a control variable for teaching and learning groups, which served to adjust for possible differences between groups. If the overall MANCOVA results were statistically significant, then a series of Univariate Analysis of Covariance (ANCOVA) was performed to determine the significant effect of teaching and learning groups on each dependent variable.

The next step of statistical analysis is if the ANCOVA results are statistically significantly different in the three teaching and learning groups, a post-hoc comparison technique is performed to determine which group is significantly different compared to the other group for each dependent variable. The level of significance was set at $p < .05$, which means that the researcher determined that there is a difference between the intervention groups. The preliminary analysis was carried out by the researcher where the prerequisite assumptions of the MANOVA/MANCOVA, namely the identification of outliers, normal distribution, equality of covariance, linearity of variables,

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multicollinearity, and homogeneity of variance must be met before assessing multivariate statistical findings [34]. All prerequisite assumptions of MANOVA/MANCOVA had been met except the assumption of equality of covariance where the assumption of equality of matrices in this research had been violated in the HOTS-T pre-test [Box's M = 125.551, $F(20, 255895.975) = 6.142$, $p < .01$], and the HOTS-T post-test [Box's M = 207.763, $F(20, 255895.975) = 0.164$, $p < .01$]. According to [48], violations of the covariance equality of group members are common and easily overcome by using Pillai's Trace. In addition, the effect size (ES) was also used to measure the strength of the effect and provide important information in statistical analysis based on the value suggested by [39].

IV. RESULT

Table 1 shows the comparison of pre-test and post-test mean scores for the four levels of high-order thinking skills, namely Applying, Analysing, Evaluating and Creating. Overall, there was an increase in the mean score at the post-test for each HOTS construct in each TL method.

Table 1 Descriptive Statistics for the Higher-Order Thinking Skills Test in the Pre-test and Post-test

Construct	TL method	*N*	Pre-test		Post-test	
			M	*SD*	*M*	*SD*
Applying	PBL-CL	90	4.12	1.279	6.49	1.343
	PBL	90	4.22	1.695	4.79	1.764
	TR	90	4.06	1.692	4.22	1.701
Analysing	PBL-CL	90	4.07	1.512	5.96	1.398
	PBL	90	4.12	1.585	4.49	1.782
	TR	90	3.88	1.621	4.21	1.532
Evaluating	PBL-CL	90	3.73	1.766	5.86	1.678
	PBL	90	3.69	1.771	4.10	1.601
	TR	90	3.50	1.711	3.64	1.801
Creating	PBL-CL	90	3.33	1.722	4.89	1.394
	PBL	90	3.37	1.940	3.54	1.657
	TR	90	3.14	1.726	3.87	1.745

Through MANCOVA analysis, the results of Pillai's multivariate test (Table 2) show that overall there is a significant effect of the independent variable (teaching method) on the dependent variable [$F(8, 522) = 29.458$, $p < .05$]. While the findings also show that there is no effect between the covariate that is Pre-Test on the dependent variable Pre-Applying [$F(4,260) = 4.140$, $p > .05$], Pre-Analysing [$F(4, 260) = 6.282$, $p > .05$], Pre-Evaluating [$F(4, 260) = 4.103$, $p > .05$] and Pre-Creating [$F(4, 260) = 9.598$, $p > .05$]. The teaching method is a factor in achieving HOTS (Applying, Analysing, Evaluating and Creating) by controlling pre-test for each construct of HOTS.

Further, the researcher conducted an ANCOVA test to identify whether there is an effect of the independent variable (teaching method) on the dependent variable which is the construct of Applying, Analysing, Evaluating and Creating. ANCOVA analysis shows that there is a significant effect of the teaching method on the construct of Applying [$F(2, 266) = 81.780$, $p < .05$, $\eta^2 = .311$], Analysing [$F(2, 266) = 90.185$, $p < .05$, $\eta^2 = .383$], Evaluating [$F(2, 266) = 104.291$, $p < .05$, $\eta^2 = .440$], and Creating [$F(2, 266) = 65.025$, $p < .05$, $\eta^2 = .246$]. A high relationship was found between the teaching method and the dependent variable showing that 31.1%, 38.3%, 44.0% and 24.6% of the variance obtained in Post-Applying, Post-Analysing, Post-Evaluating, and Post-Creating respectively were contributed by the teaching method.

Post-Hoc analysis was also performed to determine the effect of the independent variable on the dependent variable. Table 3 shows the pairwise comparison test results and effect sizes for the effect of teaching methods on the Applying, Analysing, Evaluating and Creating constructs. Pairwise comparison shows that the PBL-CL method is significantly higher than the PBL method for all constructs in high-otfer thinking skills ($p < .05$). Meanwhile, the pair comparison also shows that the PBL-CL method is significantly higher than the Conv method for all constructs ($p < .05$). The same finding is also seen in the pair comparison between the PBL and Conv method where the PBL method is significantly higher than the Conv method in all constructs ($p < .05$) except for the Analysing construct. For effect size analysis, students who followed the PBL-CL method showed a large effect size compared to the PBL method for each construct namely Applying ($d = 1.084$), Analysing ($d = 0.918$), Evaluating ($d = 1.073$) and Creating ($d = 0.882$). Statistically, it can be concluded that the PBL-CL method is effective in improving the four levels of high-order thinking skills.

Table 2 Summary of MANCOVA and ANCOVA Results for the TL Methods and the Covariates

Effect	MANCOVA			ANCOVA			
	Pillai's Trace *F*	*df*	*p*	*F*	*df*	*p*	η^2
TL method	29.458	8, 522	$p < .05$	81.780	2, 266	< .05	.311
Pre-applying	4.140	4, 260	.487	90.076	1, 266	.086	.473
TL method	29.458	8, 522	$p < .05$	90.185	2, 266	< .05	.383
Pre-analysing	6.282	4, 260	.631	150.787	1, 266	.042	.550

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TL method	29.458	8, 522	$p < .05$	104.291	2, 266	< .05	.440
Pre-evaluating	4.103	4, 260	.577	126.858	1, 266	.074	.609
TL method	29.458	8, 522	$p < .05$	65.025	2, 266	< .05	.246
Pre-creating	9.598	4, 260	.603	80.243	1, 266	.081	.543

Table 3 Pairwise Comparison Test Results and Effect Size for the Effect of the TL Methods on Higher-Order Thinking Skills

Construct	Pair Comparison	*MD*	*p*	ES	Interpretation
Applying	PBL-CL vs PBL	1.791	< .05	1.084	Big
	PBL-CL vs TR	2.206	< .05	1.481	Big
	PBL vs TR	.389	.416	.328	Small
Analysing	PBL-CL vs PBL	1.518	.062	.918	Big
	PBL-CL vs TR	1.570	< .05	1.193	Big
	PBL vs TR	.052	< .05	.169	Small
Evaluating	PBL-CL vs PBL	1.217	< .05	1.073	Big
	PBL-CL vs TR	1.508	< .05	1.275	Big
	PBL vs TR	.291	< .05	.270	Small
Creating	PBL-CL vs PBL	1.372	< .05	.882	Big
	PBL-CL vs TR	1.556	< .05	1.082	Big
	PBL vs TR	.185	< .05	.212	Small

V. DISCUSSION

In principle, the PBL-CL, PBL and Conventional learning (Conv) method have an overall positive effect on the four levels of higher-order thinking skills for Form Four students, namely Applying, Analysing, Evaluating, and Creating. The results of the analysis also found that the mean scores of Form Four students who were taught through the PBL-CL method were significantly higher compared to their peers who were taught through the PBL and Conv method in all levels of higher-order thinking skills. Through PBL-CL method, students learn to do activities actively in a collaborative learning environment. To master the level of Applying in the topic of quadratic functions in particular, students need to master algebraic factoring, using the correct formula and the method of perfecting the square in solving non-routine problems [36]. Therefore, through the activities in PBL-CL Module, students write in their sentences about the process of the square completion method and apply in the various forms of graphs given. The activity is optimally implemented to encourage students of the PBL-CL group to think, communicate, and write. As a result, effective learning occurs as each group member helps each other and participate actively to criticize and complement each other in completing the given task [37].

In this research, four activities in the PBL-CL module require students' exploration outside the classroom to strengthen students' understanding of quadratic graphs in real life. Students are asked to take a parabola-shaped picture and enter it into the GSP software to investigate and analyse the characteristics of quadratic graphs learned previously. Indirectly, the use of this GSP medium can be a good link in understanding concepts related to real life in learning Mathematics by the visual learning style [38]. Because of that, analysing skills through exploration and investigation in the formation of mathematical concepts can increase the level of analysing of students [39]. Therefore, the formation of mathematical concepts linked to the students' experience based on the activities that happen around them needs to be given priority in the process of learning and teaching Mathematics. In addition, the implications of the seven-step PBL Schmidt process approach applied in the PBL-CL module encourage students in PBL-CL group to explore non-routine problems given in a systematic and planned manner. This can help students identify and analyse the solution to the given problem and be able to confidently answer questions based on the given problem or situation. This is supported by [40] who stated that problem-based learning is a suitable approach to stimulate students' critical thinking in analysing information. As a result, the mean score of Form Four students who were taught through the PBL-CL method was significantly higher than the students who were taught through the PBL and Traditional method in the analysing level of thinking.

The students of the PBL-CL group share ideas in making conclusions and hypotheses through a systematic problem-based learning process. During the problem-solving process, students are more able to justify and share ideas systematically and more easily integrate the thoughts that occur to make evaluations and conclusions [41]. For example, the activity of solving problems in the evaluating level is done inductively such as identifying the shape and characteristics of graphs that are applied in real life. Next, students draw conclusions based on investigative methods by relating specific situations to make an assessment [42]. To achieve this objective, students make and prove conjectures, provide logical explanations, analyse, make judgments, and evaluate and justify the mathematical activities carried out. As a result, this process indirectly increases the thinking

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level of evaluating. In this research, the activities in the PBL-CL module also encourage productive interaction among Form Four students who have different knowledge backgrounds to improve the thinking level of evaluating. Intelligent and proactive students acting as experts explain solution methods by including clear and accurate mathematical concepts to be shared among group members in making conclusions and evaluations. Through positive interaction and effective communication among group members, students generate ideas and this social process affects their creativity, cognition, and potential [43].

The activity of the PBL-CL module encourages the students of the PBL-CL group to pitch their creative ideas in solving problems in the form of questions through group presentations. During the presentation session, the reciprocal process from the responses of other groups refreshes and further expands their ideas [44]. This causes students to always think about producing the best method to be highlighted among them and further fosters the thinking level of creativity among the students of the PBL-CL group. In addition, the PBL-CL method can provide a learning environment where real experience helps Form Four students to produce logical problem-solving methods because they think abstractly and have a clear understanding of concepts [45]. In the fourth activities of the PBL-CL module, for example, students carry out activities outside the classroom by exploring graph-shaped objects. Next, they investigate the shape of the graph in a creative way using GSP. Student in groups are given the freedom to choose their methods to determine the characteristics of their chosen graph with accurate mathematical justification to be presented in a later presentation. Indirectly, students also learned to produce quadratic graph sketches creatively in their minds and represented through the shape and characteristics in each graph. Furthermore, the mutual interaction of students with their environment and daily routine has a positive effect on developing their higher-level of thinking [46].

Compared to students who learnt via the Conv method, students carry out conventional and teacher-centred learning activities where all activities have been planned by the teacher. Tasks are completed individually with the help of GSP, however, no task specialization is given to each student. Students are also exposed to routine problem-solving. As a result, students in this group could not apply the formula well because peer guidance was limited. This is because group interaction in Traditional groups is not emphasized with positive interdependence, individual responsibility, dealing with positive interactions, and social skills in groups [47], as evidenced in the PBL-CL group.

VI. CONCLUSION

The research shows that the PBL-CL method is able to improve the four levels of higher-order thinking skills, namely Applying, Analysing, Evaluating, and Creating better than the PBL and Traditional learning methods. This shows that the integration of PBL and GSP-assisted collaborative learning into the TL process can make teaching more effective with non-routine investigation, exploration and problem-solving activities and presentations conducted in a collaborative learning manner. The PBL-CL method allows students learn to integrate PBL and collaborative learning with the help of GSP which has an impact on students' high-order thinking skills while solving non-routine problems.

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The Trend in Fashion: Stylistic Options and Impact on the Dress Code for Fashion Students at Malaysian Polytechnic

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Abstract
Fashion influences lifestyle and has an impact on all stages of life. Fashion also reflects an individual's personality, allowing them to express themselves through the style of their clothing. Fashion and trends will develop swiftly each year, changing and not remaining stagnant. The dynamics of fashion trends and their impact on undergraduate fashion students from the third semester of the Diploma in Fashion Design, particularly concerning adherence to dress codes at Polytechnic Ibrahim Sultan. Fashion is not merely a superficial expression but a powerful tool for self-presentation and societal interaction. Understanding the intersection of style and effectiveness within the confines of dress codes is paramount in a professional and educational setting by Polytechnic Ibrahim Sultan guidelines. Based on the empirical research and qualitative analysis, this study explores the tendencies of the fashion trends influence the choices and the effectiveness of dress codes among undergraduate fashion students. Through surveys, interviews, and observation, insights are gathered into the factors that shape students' stylistic preferences and their compliance with institutional dress regulations. The findings reveal the multifaceted nature of fashion trends, with social media platforms playing a pivotal role in shaping students' sartorial decisions. Additionally, the study uncovers the intricate balance between adhering to dress codes and expressing individuality, highlighting the importance of self-presentation in academic and professional settings. Ultimately, this research contributes to the existing body of knowledge by shedding light on the intricate relationship between fashion trends, dress codes, and their impact on undergraduate fashion students' stylistic choices found that, the effect of social media is observed to dominate students' fashion choices, the effectiveness, and of fashion influenced by platforms such as Facebook, Twitter, Instagram, TikTok, and YouTube at Polytechnic Ibrahim Sultan. It underscores the need for institutions to recognize and accommodate the evolving nature of fashion while maintaining decorum and professionalism.

Keywords **:** *Fashion Trend, Fashion Influencer, Social Media, Code Dress.*

I. INTRODUCTION

Fashion influences lifestyle and has an impact on all stages of life. Fashion also reflects an individual's personality, allowing them to express themselves through the style of their clothing [1]. Fashion and trends will develop swiftly each year, changing and not remaining stagnant. The fashion trend among undergraduate students at Polytechnic Ibrahim Sultan is likely to encompass a blend of creativity, professionalism, industry relevance, and adherence to dress code guidelines [2]. By striking the right balance between these elements, students can effectively showcase their fashion expertise and individual style while preparing for careers in the dynamic world of fashion. Fashion is defined as the prevailing styles and garments that people wear, which reflect their propensity for change and inclination towards individuality [3]. Fashion primarily denotes the prevailing style of dress in a certain society. Apparel serves as a non-verbal means of conveying a range of information, such as membership in a certain group, financial status, gender, social status, and occupation [4]. This phenomenon grants individuals the capacity to communicate their personal identity to others by stating, "This is who I am." In addition to clothing, fashion encompasses beauty treatments, haircuts, accessories, and cosmetics.

Curiously, adolescents' tendency to utilise fashion as a means of distinguishing themselves from adults. However, fashion trends, particularly among adolescents, undergo annual transformations. This can be attributed to their age, attire, and lifestyle, particularly among students enrolled at the Institute

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of Higher Education (HEIs). Adolescents will endeavour to stay abreast with the contemporary fashion realm [5]. This condition is designed to prevent them from lagging in fashion trends. They have begun attempting to conform to the Code of Ethics of the Rules of Use to be fashionable in accordance with the most recent trends and preferences [6]. Consistent with the guidelines set forth by Polytechnic Ibrahim Sultan. Ethics, in essence, refers to a set of principles and conduct that guides individual in discerning right from wrong and adhering to societal norms and traditions. The term "ethics," derived from the Greek word "ethos," refers to the norms, values, methods, and criteria that guide proper human conduct [7]. Ethics is a theoretical framework that examines human actions from the perspective of their moral implications, as determined by rational analysis [8].

Higher Education Institutions (HEIs) provide students with greater freedom in their dressing manner, as opposed to the mandatory school uniforms that are worn by all students in traditional schools. Perhaps adolescents can express their yearning for independence through their sense of style. Nevertheless, the flexibility to choose one's attire does not grant Higher Education Institutions (HEIs) students' permission to disregard the ethical dress code when attending lectures. The dress code should specify the appropriate attire for the given occasion, location, and event.

A. Problem Statement

The study aims to assess the impact of fashion trends among Fashion Design Diploma students at Polytechnic Ibrahim Sultan on their adherence to the institution's Code of Ethics and Rules of Use. Despite dressing in line with contemporary fashion, students often disregard the guidelines set by the institution, leading to instances of immodest attire such as short hijabs paired with revealing clothing or tight shirts.

B. Research Objective

This research is to study the tendency of discrepancy between students' fashion choices and their compliance with institutional regulations, which is a recurring concern within the Higher Education Institutions (HEIs) towards the impact of cultural diversity, peer influence and social media, and fashion education curriculum and industry trends.

C. Limitation

The limitation of this study is its exclusive focus on third-semester students within the Fashion Design Diploma program at the Design and Visual Communication Department (JRKV) of Polytechnic Ibrahim Sultan. The sample size consisted of 52 respondents from this specific group. The selection of third-semester students was based on their prolonged exposure to the polytechnic environment.

II. LITERATURE REVIEW

A. The Impact of Cultural Diversity

Fashion plays a significant role in higher education, particularly within programs like Fashion Design, where students are not only consumers but also creators and influencers of trends [9]. Understanding the influence of fashion style on fashion students in Malaysian higher education is crucial for curriculum development, student engagement, and industry relevance. This research aims to explore existing research on this topic to provide insights into the factors shaping fashion students' style choices and their implications in Malaysian higher education. In Malaysia, cultural and societal factors greatly influence fashion preferences and style among students [10]. Other scholar highlights the impact of cultural diversity on fashion perceptions and practices among Malaysian youth. This diversity reflects in fashion education institutions, where students from various cultural backgrounds bring unique perspectives to their style choices [11]. Understanding these cultural influences is essential for educators to create inclusive learning environments that celebrate diversity while promoting professionalism.

B. Peer Influence and Social Media

Peer influence and social media play significant roles in shaping fashion trends and style preferences among students in higher education [12]. Studies by Lim et al. [13] emphasize the influence of peers and social media platforms like Instagram and TikTok on Malaysian youth's fashion choices. Fashion students are active participants in online fashion communities, where they seek inspiration, share ideas, and showcase their personal style [14]. Educators need to recognize the impact of social media on students' fashion consciousness and integrate digital literacy into the curriculum to foster

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critical thinking and responsible online behaviour [15].

C. Fashion Education Curriculum and Industry Trends

The alignment between fashion education curriculum and industry trends is essential for preparing students for professional careers. Research by [16] discusses the importance of integrating industry-relevant content, including trend forecasting, fashion marketing, and sustainable practices, into fashion education programs. By exposing students to real-world industry practices and emerging trends, educators can better equip them with the skills and knowledge needed to succeed in the competitive fashion industry [17]. Additionally, industry collaborations, internships, and guest lectures provide valuable insights into current market demands and facilitate industry connections for students [18].

Fashion education should foster students' creativity and encourage self-expression while maintaining professionalism and adherence to dress codes. Studies by [19] highlight the importance of balancing creative freedom with academic rigor in fashion design programs. Empowering students to develop their unique style identities while instilling discipline and respect for industry standards is essential for nurturing future fashion leaders. Educators can achieve this balance through project-based learning, portfolio development, and mentorship programs that encourage experimentation and critical reflection.

The influence of fashion style on fashion students in Malaysian higher education is multifaceted, encompassing cultural, social, educational, and industry-related factors [20]. By understanding and addressing these influences, educators can create enriching learning experiences that empower students to navigate the dynamic world of fashion with confidence and integrity [21]. Further research and collaboration between academia and industry stakeholders are essential for ensuring the relevance and effectiveness of fashion education in Malaysia[22].

The interpretation of fashion can be referred as a personal expression, and professionalism are well-articulated. Fashion indeed serves as a means of expression, and it's subjective, varying from person to person. However, in certain environments like educational institutions, there are often guidelines regarding dress code that students are expected to adhere to. By ensuring that students dress appropriately not only reflects their readiness to transition into the professional world but also contributes to the overall image of both the students and the institution. Students are often seen as ambassadors of their institution, and their appearance can influence perceptions of the school [23]. Generally, for students in public higher institutions, who may be aspiring leaders, paying attention to their appearance is particularly important. Leaders are often judged not just by their abilities but also by their demeanour and presentation, which includes their attire [24].

Other Scholar agree that they frequently try to make their style choices stand out. Furthermore, social status and social class can be delineated through fashion. Students from diverse socioeconomic situations may possess varied levels of access to fashion materials and exhibit distinct tastes [25]. Gaining a comprehensive understanding of these distinctions can contribute to the establishment of a fashion environment within the school that is more inclusive and diverse. Moreover, it is crucial for students to incorporate many cultural influences into their dress choices while maintaining a polite approach. This entails comprehending the cultural importance associated with specific attire or symbols and refraining from appropriating or misrepresenting them [26]. In Polytechnic Ibrahim Sultan (PIS), the rules can foster an environment conducive to dialogue and appreciation for diverse cultural perspectives by endorsing sartorial choices that demonstrate cultural sensitivity. Furthermore, fashion is an ever-changing industry that is impacted by technological advancements, global patterns, and shifting societal standards [27]. At PIS, students can utilize their creativity to modify fashion trends to fit the local environment, all while ensuring that the trends remain meaningful and original. The adaptability of fashion reflects its dynamic character and equips students to navigate the always evolving industry landscape[28].

III. RESEARCH METHODOLOGY

This research particularly involving 52 student of the third semester Diploma in Fashion Design at Polytechnic Ibrahim Sultan. This data can offer a quantitative understanding of the extent to which fashion trends influence students' choices in adhering to or deviating from dress codes. The questionnaire is divided into two parts, namely Part A is the demographics of the respondents, Part B contains four factors that influence the fashion style of clothing among students of the third semester Diploma in Fashion Design and researcher using the

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Excel Analysis to generate the data collection.

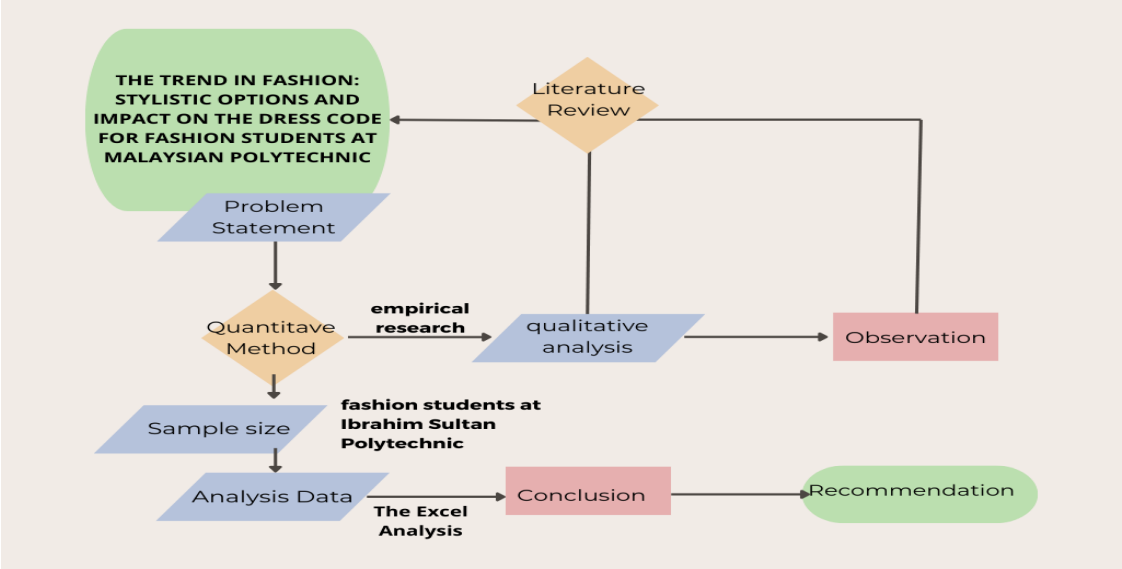

Figure 1: Research Methodology Framework

Exploring this intersection through empirical research and qualitative analysis can provide valuable insights into how students perceive and navigate dress codes considering evolving fashion trends. By conducting empirical research, such as surveys or observations, the study can gather quantitative data on students' attitudes, preferences, and behaviours regarding dress codes and fashion trends. By synthesizing both quantitative and qualitative findings, the study can offer comprehensive insights into the dynamics between fashion trends and dress code effectiveness among undergraduate fashion students. Additionally, the findings may contribute to broader discussions within academia and professional settings about the role of fashion in shaping identity, expression, and adherence to codes of conduct.

Strongly Agree	Agree	Neither Agree No disagree	Disagree	Strongly Disagree
5	4	3	2	1

Table 2: Interpreting Likert Table [29]

This section uses a Likert scale as shown in table 2 the division of scores is divided into five sections, namely score 1 is Strongly Disagree, score 2 is Disagree, score 3 is Neither Agree nor Disagree, score four is Agree and score 5 is Strongly Agree.

Frequently Score

Min Score	Level
1.01 - 2.00	Lower
2.01 - 3.00	Mid-Lower
3.01 - 4.00	Mid-Higher
4.01 - 5.00	Higher

Table 3: Interpreting Frequently Score source Norasmah (2002)

The interpretation of the mean score used is that for score 1, the mean score is at a level of 1.01-2.00 which is at a low level, score 2 is 2.01 - 3.00 is at a medium low level, score 3 which is 3.01 - 4.00 is a medium high level and score 4 is 4.01 – 5.00 with high level.

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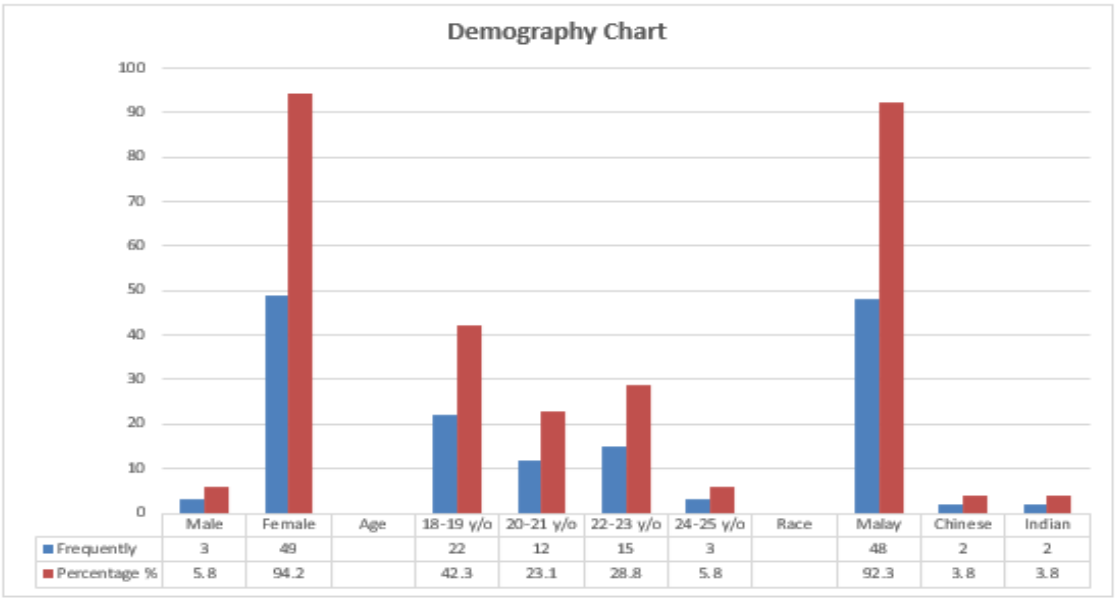
IV. DATA ANALYSIS



	Male	Female	Age	18-19 y/o	20-21 y/o	22-23 y/o	24-25 y/o	Race	Malay	Chinese	Indian
Frequently	3	49		22	12	15	3		48	2	2
Percentage %	5.8	94.2		42.3	23.1	28.8	5.8		92.3	3.8	3.8

Figure 4: The Analysis table of Demography Chart by Author

This section reports the demography analysis of the respondents consisting of gender, age and race. Based on the table above, 52 respondents were female students totalling 49 with a percentage of 94.2% and male students totalling 3 with a percentage of 5.8%.

While, showing the age distribution of respondents consists of 18-19 years with a percentage of 42.3%, 20-21 as many as 23.1%, 22-23 as many as 28.8% and 24-25 as many as 5.8%. for the race, malay percentage of 92.3%, Chinese and Indian student are same at 3.8%.

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Item	Frequacly Percentage											
MASS MEDIA FACTORS THAT INFLUENCE FASHION STYLE AMONG STUDENTS	Extremly Disagree				Not Sure		Totally Agree				Minimum Score	Interpretation
	STS	%	TS	%	TP	%	S	%	SS	%		
Influenced by tv shows related to the world of fashion	0	0.0%	1	1.9%	3	5.8%	**29**	55.8%	**19**	36.5%	4.62	Extremly High
Reading Interested of fashion magazines	1	1.9%	2	3.8%	11	21.2%	**28**	53.8%	**10**	19.2%	3.65	Medium High
Copy a lot of fashion styles from TV shows	1	1.9%	1	1.9%	13	25.0%	**23**	44.2%	**14**	26.9%	3.56	Medium High
Influenced by fashion styles from magazines	1	1.9%	8	15.4%	19	36.5%	**18**	34.6%	**6**	11.5%	2.31	Medium Low
Watch tv shows related to fashion	2	3.8%	2	3.8%	8	15.4%	**30**	57.7%	**10**	19.2%	3.85	Medium High
Fashion magazines giving a lot of guidelines about being fashionable	1	1.9%	2	3.8%	11	21.2%	**28**	53.8%	**10**	19.2%	3.65	Medium High
											3.61	Medium High

Table 5: The Analysis table of Mass Media Factors Affecting Clothing Fashion Styles Among Students of the Third Semester Diploma in Fashion Design.

Based on the provided data and analysis, Item 1, which pertains to being influenced by TV shows related to the world of fashion, received the highest score value of 4.62. This suggests that TV shows play a significant role in shaping the fashion style of clothing among students in the third semester of the Fashion Design Diploma program. It implies that students are particularly receptive to fashion trends and inspirations presented in television programs focusing on the fashion industry. Meanwhile, On the other hand, Item 4, which relates to being influenced by fashion styles from magazines, obtained a moderately low score value of 2.31. This indicates that magazines have a relatively weaker influence on the fashion style of clothing among the surveyed students compared to TV shows. It suggests that students may find other sources, such as television or digital media, more impactful in shaping their fashion preferences and style choices[30]. Overall, the analysis highlights the varying degrees of influence exerted by different mass media factors on the fashion style of clothing among students of the third semester Diploma in Fashion Design. The findings underscore the importance of considering multiple media channels and platforms when exploring the influences on fashion trends and styles among students. Additionally, this information can inform educators and industry professionals about the most effective channels for reaching and engaging with fashion students in higher education.

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Item	Frequacly Percentage											
LATEST TREND FACTORS THAT INFLUENCE FASHION STYLE AMONG STUDENTS	Extremly Disagree				Not Sure		Totally Agree				Minimum Score	Interpretation
	STS	%	TS	%	TP	%	S	%	SS	%		
The latest fashion trends awareness	0	0.0%	1	1.9%	15	28.8%	25	48.1%	11	21.2%	3.46	Medium High
very sensitive to the latest fashion trends and often research the latest fashion trends in Malaysia	0	0.0%	2	3.8%	15	28.8%	27	51.9%	8	15.4%	3.37	Medium High
The latest style makes it more trendy	0	0.0%	2	3.8%	11	21.2%	22	42.3%	17	32.7%	3.75	Medium High
Often follow the development of fashion, clothing, hair, hijab and accessories	1	1.9%	1	1.9%	10	19.2%	24	46.2%	16	30.8%	3.85	Medium High
Follow the latest trends to feel more confident and stylish	1	1.9%	2	3.8%	9	17.3%	22	42.3%	18	34.6%	3.85	Medium High
Willing to follow the latest trends every year	0	0.0%	7	13.5%	12	23.1%	21	40.4%	12	23.1%	3.17	Medium High
											3.57	Medium High

Table 6: Tendency of Latest Trend Factors Affecting the Fashion Style of Clothing Among Students of the Third Semester Diploma in Fashion Design.

The analysis of the two study questions revealed that items 4 and 5 had the same score of medium-high, with both items receiving a score of 3.85. This item received a score of 3.85, indicating a medium-high level of agreement among the surveyed students. It suggests that a significant proportion of students in the third semester Diploma in Fashion Design believe that following current trends contributes to their confidence and sense of fashion ability. This finding underscores the importance of staying up to date with contemporary fashion trends for students pursuing a career in fashion design. Similarly, item 5 also received a score of 3.85, reflecting a medium-high level of agreement among the respondents. This suggests that a substantial number of students in the third semester Diploma in Fashion Design are willing to adopt new trends on an annual basis. It indicates a proactive attitude towards embracing and adapting to evolving fashion trends, which is essential for aspiring fashion designers to stay relevant in the industry. the findings highlight the significance of current trend variables in shaping the clothing fashion style preferences of students in the Fashion Design Diploma programme. The medium-high scores for both items 5 and 6 suggest a strong inclination among students towards staying abreast of the latest fashion trends and incorporating them into their personal style choices. This information can be valuable for curriculum development, industry engagement, and student support initiatives within the Fashion Design Diploma programme.

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Item	Frequacly Percentage											
LATEST SOCIAL MEDIA FACTORS AFFECTING FASHION STYLE AMONG STUDENTS	Extremly Disagree				Not Sure		Totally Agree				Minimum Score	Interpretation
	STS	%	TS	%	TP	%	S	%	SS	%		
frequently encounter fashionable outfits on social media	0	0.0%	0	0.0%	1	1.9%	**20**	38.5%	**31**	59.6%	4.90	Extremly High
Purchase stylish clothing on Instagram and TikTok platforms.	1	1.9%	2	3.8%	5	9.6%	**20**	38.5%	**24**	46.2%	4.23	Extremly High
The apparel sold on Instagram and Tiktok platforms is very fascinating.	1	1.9%	1	1.9%	2	3.8%	**21**	40.4%	**27**	51.9%	4.62	Extremly High
Using social media as an online boutique to discover the latest fashions.	0	0.0%	0	0.0%	6	11.5%	**24**	46.2%	**22**	42.3%	4.42	Extremly High
Influence with the latest fashion on social media	0	0.0%	0	0.0%	7	13.5%	**19**	36.5%	**26**	50.0%	4.33	Extremly High
Fashion in social media is very current and updated.	0	0.0%	1	1.9%	3	5.8%	**14**	26.9%	**34**	65.4%	4.62	Extremly High
											4.52	Extremly High

Table 7: Analysis of the Frequency of Percentages for Social Media Factors That Are Fashion Styles of Clothing Among Students of the Third Semester Diploma in Fashion Design.

The provided data outlines the results of a study aimed at identifying social media elements influencing clothing fashion patterns among students of the third semester Diploma in Fashion Design. Table 6 summarizes the findings and based on the analysis of the third research question, several key insights emerge such as this item 1 received the highest score value of 4.90, indicating a strong agreement among the surveyed students. It suggests that students in the third semester Diploma in Fashion Design often come across fashionable outfits on social media platforms. This finding underscores the significant influence of social media in exposing students to diverse fashion trends and styles, shaping their perceptions and preferences. Furthermore, Item 3 received a score value of 4.62, indicating a high level of agreement among the respondents. It suggests that students find the apparel sold on Instagram and TikTok platforms to be highly appealing and captivating. This finding highlights the role of social media platforms as influential channels for showcasing and promoting fashion products, attracting the interest of fashion-oriented students. Similarly, item 6 also received a score value of 4.62, indicating a high level of agreement among the surveyed students. It suggests that students perceive fashion content on social media platforms to be current and regularly updated. This finding reflects the dynamic nature of social media platforms, where fashion trends emerge and evolve rapidly, keeping students engaged and informed about the latest developments in the fashion industry[31].

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Item	Frequacly Percentage											
PEER FACTORS THAT INFLUENCE FASHION STYLE AMONG STUDENTS	Extremly Disagree				Not Sure		Totally Agree				Minimum Score	Interpretation
	STS	%	TS	%	TP	%	S	%	SS	%		
influenced by the style of wearing peers.	0	0.0%	5	9.6%	14	26.9%	**19**	36.5%	**14**	26.9%	3.17	Medium High
Desire to observe the appearance style of other people	0	0.0%	3	5.8%	9	17.3%	**23**	44.2%	**17**	32.7%	3.85	Medium High
Peers have an important role in setting style and appearance.	2	3.8%	7	13.5%	9	17.3%	**21**	40.4%	**13**	25.0%	3.27	Medium High
Frequently make a friend as an idol	6	11.5%	9	17.3%	15	28.8%	**18**	34.6%	**4**	7.7%	2.12	Medium Low
Peers' fashion style is typically followed.	1	1.9%	9	17.3%	14	26.9%	**22**	42.3%	**6**	11.5%	2.69	Medium Low
More confidence when one's style and that of peers are the same.	1	1.9%	11	21.2%	20	38.5%	**9**	17.3%	**11**	21.2%	1.92	Low
											2.84	Medium Low

Table 8: Analysis of the Frequency of Percentages for Peer Factors That Influence the Fashion Style of Clothing Among Students of the Third Semester Diploma in Fashion Design.

Data presents the findings of a study aimed at identifying peer factors influencing the fashion style of clothing among students in the third semester of the Fashion Design Diploma programme. Table 8 summarizes these findings and based on the analysis of the fourth research question, several key observations. This item received the highest score value of 3.85, indicating a relatively strong agreement among the surveyed students. It suggests that students in the third semester of the Fashion Design Diploma programme have a desire to observe the appearance styles of their peers. This finding underscores the significant influence of peer observation and social comparison in shaping fashion preferences and style choices among students[32]. In contrast, item 6 received the lowest score of 1.92, indicating a reduced level of agreement among the respondents. It implies that among students of the third semester Diploma in Fashion Design may not necessarily feel more secure when their style is consistent with that of their peers. The study shows that students value originality and personal expression over following peer dress trends.

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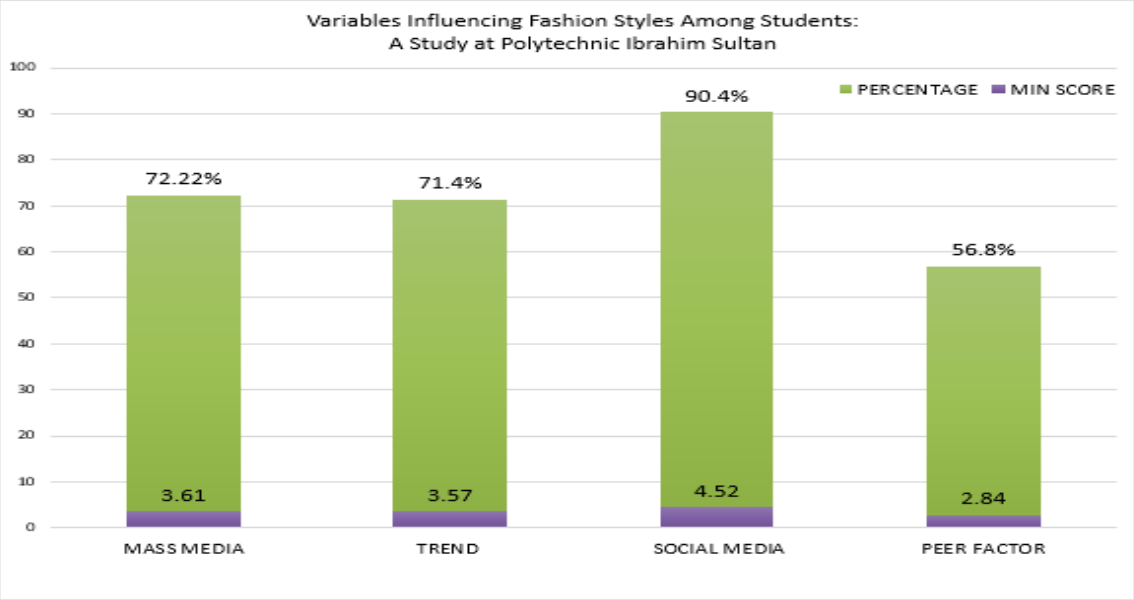

Table 9: Overall Analysis With Mean Scores For Factors Mass Media, Latest Trends, Social Media, And Peers Are Influencing Clothing Fashion Style Among Students Of The Third Semester Diploma In Fashion Design.

This study was carried out by 52 student from third-semester Diploma in Fashion Design students. According to table 9, the results of the mean score and the overall average for the research questions found that the factors that influence the fashion style of clothing among students in the third semester Diploma in Fashion Design are the social media factor, which shows the highest score value of 4.52 with the item Students are frequently exposed to fashion trends via social media. For mass media, students are more influenced by fashion-related television shows, and for the latest trend, students frequently follow the development of fashion, clothes, hair, hijabs, and accessories, and they feel more confident and stylish when they follow the latest trends[33]. The component with the lowest scoring value is 2.84, which represents the peer factor. Students like to see their classmates' appearance styles.

V. CONCLUSSION

Overall, the mass media component has had an impact on the fashion style of apparel among students of the third semester Diploma in Fashion Design, accounting for 72.2%. This demonstrates that students are encouraged by the media to seem more stylish in school. The item with the highest score (4.62 students) is more influenced by fashion-related television shows. For the following research question, the current trend element had the second highest average percentage of influence on the design style of the third semester Diploma in Fashion Design, at 71.4%. It may be inferred that the effect of trends is less appealing to students when it comes to styling this fashion, possibly because they must first conduct study. According to the findings of the study, the social media component received the highest score of 90.4%, with only an 18.2% difference between the mass media factors. The study's findings suggest that students spend more time on social media platforms such as Facebook, Twitter, Instagram, TikTok, and YouTube[34]. The total outcomes of the peer factor study suggest that the percentage position is as high as 56.8%, indicating that is the least influential component. The present research found that students are not easily affected by their peers' fashion choices while styling a piece of clothing.

VI. RECOMMENDATION

Overall, the researcher concluded that this study met its aims and provided answers to all four research questions. According to the findings of the study, social media has the greatest influence on the

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fashion style of among student of third semester Diploma in Fashion Design. This is since today's students are more exposed to social media and have unlimited access to information. The current platform makes it easy for them to get the most recent information and styles. In general, students can style their appearance[35]. According to their own preferences and fashion, but they must adhere to the Code of Ethics and Rules of Use established by Polytechnic Ibrahim Sultan. The enforcement of student discipline needs to be tightened to ensure that students comply with manners at the same time. The policy guidelines are updated in line with the current fashion but and do not violate the guidelines. this can be standardized in all Malaysian Polytechnics and the Higher Education Institutions (HEIs).

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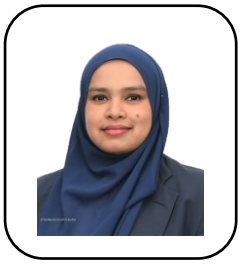
First Author: Siti Nurain Binti Abdul Rahim 	Design and Visual Communication Department, Polytechnic Ibrahim Sultan, Johor, Malaysia E-mail: sitinurain@pis.edu.my
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Enhancing the Teaching and Learning Process of Faraday's and Lenz's Laws in Electromagnetic Induction using EM-Kit

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Abstract

Faraday's and Lenz's Laws are two central concepts in Electromagnetic Induction that appears challenging to students due to difficult terms in their definitions in absence of any hands-on experimental tool. EM-Kit, utilizing magnet, copper coil, PVC pipe, multiple LEDs, and oscillation ruler level, is therefore developed as active learning strategy to enhance the teaching and learning process of this topic. A two-cycled action research was conducted in collaboration of five physics lecturers in Kolej Matrikulasi Labuan (KML) towards three classes of sixty-seven students undertaking one-year matriculation program. Data was collected through observation, document analysis, and interviews with lecturers and students. Result showed that students are able to explain qualitatively the working principles of these concepts via physical tools, such as LED lighting and ruler oscillation. Students could also relate them to real-life electric generator and household AC current. In conclusion, the activity succeeded in encouraging students to learn actively by having them apply their understanding of Faraday's and Lenz's Laws through practical experience rather than just listening to lectures.

Keywords **:** *Action Research; Active Learning; Electromagnetic Induction; EM-Kit; Faraday's Law; Lenz's Law*

I. INTRODUCTION

A common disheartening question students often ask is, "Why am I learning this?" Students are unable to recognize the value of the subject matter or apply them in real-life settings. This question highlights the need for innovation in education that engages students and assists them to contextualize their learning swiftly. Hands-on pedagogies based on constructivism and active learning are the focus of a sustainable future education [1]. Based on teaching experience, Electromagnetic Induction is a major topic that is widely viewed as abstract and challenging for most students [2], [3].

Electromagnetic Induction is the production of induced emf whenever the magnetic flux through a loop, coil or circuit is changed. There are two central concepts in this topic, namely Faraday's Law and Lenz's Law. Faraday's Law states that the magnitude of induced emf is directly proportional to the rate of change of magnetic flux, as described by Equation 1:

$$\varepsilon_{ind} = -N\frac{d\phi}{dt} \quad \text{…….. Equations 1}$$

Where:
ε_{ind} is the induced emf
N is the number of coil turns
$\frac{d\phi}{dt}$ is the rate of change of magnetic flux

The negative sign in the equation conveys the idea of Lenz's Law, which states that the induced current always flow in a direction that opposes the change in magnetic flux that causes it. Students are often confused about the definitions of these two laws, particularly the wording 'magnetic flux', 'change of magnetic flux', and 'oppose the change of magnetic flux' [2], [3], [4]. There is a lack of hands-on experimental tools in the laboratory to show how these two laws actually work. Therefore, this paper aims to enhance the students' visualization process of Faraday's and Lenz's Laws through hands-on experimental kit, namely the Electromagnetic Induction Kit (EM-Kit).

II. LITERATURE REVIEW

Active learning is considered as student-centred and focuses on construction of knowledge based on reflection and thinking [5]. In Physics, active

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learning encompasses any form of instruction that does not include traditional modes such as passive lecture or mathematical problem-solving [6]. It provides key opportunities for qualitative reasoning based on physics concepts, sense making of physics knowledge, engaging in the process of doing science, as well as application of knowledge across multiple contexts [6].

In the topic of Electromagnetic Induction, many new modern experimental tools had been developed as hands-on mediums to promote active learning among students. The all-time favourite demonstration of free-falling magnet in a conducting tube was further improvised by changing the thickness of the tube wall, which subsequently changes the amount of eddy current induced and drop time of the falling magnet [7]. The magnetic moment and terminal velocity of this falling magnet were also determined when its dynamic was tracked by using sound wave generated by a smartphone and the acoustic resonance in the pipe was detected [8]. A past researcher also derived several formulas to calculate the induced current in a circular loop by an oscillating magnet to compare with measured values from experiment when exploring Faraday's Law [9].

A low-cost experiment without using any permanent magnet was also developed to investigate the Faraday's Law in a creative way [10]. The inexpensive microcontroller Arduino was also utilised to measure the magnetic moments and eddy currents, confirming Faraday's and Lenz's Laws [11]. Tracker, the popular video-based physics modelling tool, was also used to graph the dynamics of magnetically damped oscillations of a simple pendulum magnet due to eddy current induced over an aluminium sheet [12]. A powerful electronic system employing two blinking LEDs was also designed as a visual manifestation of Lenz's Law [13]. There was also research that concluded superconductors do not abide by Lenz's Law whereby the superconducting coil no longer responds to the change of external magnetic field [14].

III. REFLECTIONS ON PREVIOUS TEACHING

Based on observation, the researchers found that most of their students have trouble understanding Faraday's Law and Lenz's Law. Students typically displayed a lack of responsiveness to the queries posed by lecturers regarding these laws. The learning atmosphere in the classroom was gloomy when the lesson was conducted via verbal instruction only, and students' engagement was low. A focused group interview was conducted with several students regarding their understanding of these concepts. Students responded that they could not visualise their definitions and descriptions as stated in the lecture note. They could not explain these concepts in their own words, provide other examples, or relate with daily life applications. In order to test the students' understanding, a pre-test on the topic of Faraday's and Lenz's Laws was given to the students. Students' feedback on several conceptual questions was analysed and discussed.

Based on Figure 1, 19.4% of students had a misconception about Lenz's Law definition, which states that the induced current will flow in a direction such that the magnetic field produced by the induced current will always oppose the changing magnetic flux that produces the induced current. This problem arose due to some students confused about the term "oppose the change of magnetic flux". They regarded it as "oppose the magnetic flux", or in other words "repels the magnet", which is a wrong alternative conception. In reality, the magnetic flux induced can sometimes be in the same direction with the original magnetic flux. So it is not always "oppose the magnetic flux". This finding goes parallel with past research which also observed that students in their study had a common confusion where the induced field is "opposite in direction to the field which induces it", rather than "opposite in direction to the change in the field inducing it" [4]. The term "oppose the change" could be so easily misinterpreted as meaning "being in the opposite direction" [3].

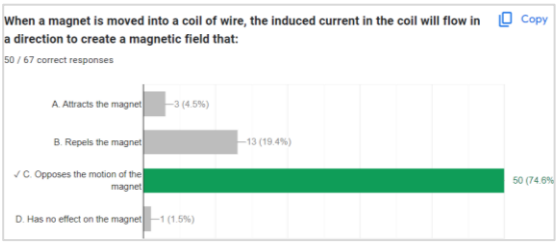

Figure 1. Students' feedback on question 1 regarding Lenz's Law.

Figure 2 also indicates that a considerable number of students (43.3%) were still unclear about how Lenz's Law works. They failed to find the actual direction of induced current as they did not understand how to apply Lenz's Law. This is also due to the term "oppose the change of magnetic flux" which confused most of the students.

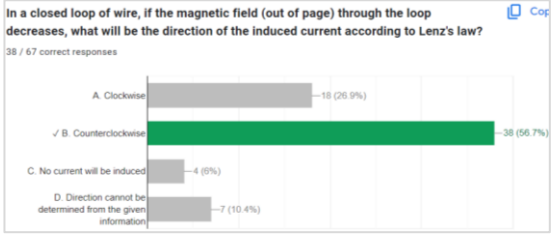

Figure 2. Students' feedback on question 2 regarding Lenz's Law.

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Figure 3 shows a lot of students (67.2%) had a misconception in Faraday's Law that induced current is produced due to the presence of magnetic flux. A focused group interview was conducted on these students to further assess their understanding on this matter. It was found that they had the wrong concept of induced current increasing when the magnet is moving closer to the coil, and induced current decreasing when the magnet is moving away from the coil. Even if the magnet is stationary right in between the coil, there is still induced current, and it will be at maximum value. This concept violates Faraday's Law of electromagnetic induction.

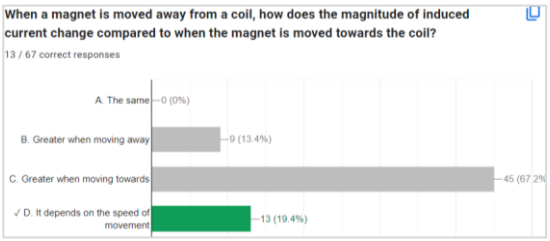

Figure 3. Students' feedback on question regarding Faraday's Law.

According to Faraday's Law, the current is not induced due to the presence of magnetic flux but is induced due to the change in magnetic flux. This means that the current is only induced when there is a relative motion between the coil and magnet. Therefore, induced current only increases if the magnet is moving faster and decreases if the magnet is moving slower. Magnet moving towards or moving away from coil only changes the direction of induced current but not the magnitude of induced current. Induced current is not increasing due to the presence of stronger magnetic flux but is due to faster change in magnetic flux when there is a larger relative movement between coil and magnet.

Figure 4 hinted that a fairly large (23.9%) number of students did not realise that the induced current is a type of alternating current (AC). They thought that it is direct current (DC) instead. The students are unable to relate the concepts in electromagnetic induction to real-life situations, such as how the electric generator in a power plant generates electricity. Therefore, this project is a good example to showcase physically for students how AC is generated when the magnet is oscillating through the coil.

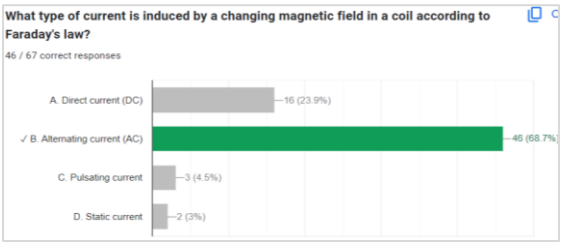

Figure 4. Students' feedback on question regarding application of Faraday's and Lenz's Laws.

In a nutshell, a lot of students seemed to have misconceptions about Faraday's Law and Lenz's Law. First, they thought that emf is induced due to the presence of magnetic flux but not the change in magnetic flux. Secondly, they were also confused about the term "oppose the change of magnetic flux" in Lenz's Law definition but considered it as "oppose the magnetic flux." These confusion and misunderstanding were largely due to lack of physical demonstration of these two laws themselves. Students learned these concepts only through lecture notes and verbal explanations by the lecturers. In the laboratory setting, there are no physical lab tools for students to experiment with these laws hands-on. It is also very difficult for lecturers to explain these laws verbally without physical teaching tools.

IV. STUDY FOCUS

The main objective of this study is to improve the teaching and learning process on the topic of Electromagnetic Induction. The specific objective is by the end of the lesson, students are able to explain qualitatively the working principles of Faraday's Law and Lenz's Law using the EM-Kit, instead of just stating their definitions in words. The other specific objective is students can even relate these laws into real-life situations. The research was conducted with one-year matriculation program students from Kolej Matrikulasi Labuan (KML) during their second semester of Physics subject (SP025). Three different classes of sixty-seven students taught by the researchers had been selected to implement the activity because the intervention was repeated and improved for two consecutive cycles.

Table 1. Target group composition.

Cycle	Practicum	Gender		Total
		Male	Female	
1	F13	9	13	22
2	F14 & F15	16	29	45
	Total	25	42	67

V. RESEARCH METHODOLOGY

A. Research Design

The research was implemented in the Action Research model which comprises of four stages: observe, plan, implement, and reflect for the following cycles [15]. Data was collected through observation, document analysis, and interviews with lecturers and students. Lesson worksheet documents, documents of students' work, questionnaire survey data, audio recordings of interviews, observation photos and video recordings

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during the intervention were also gathered. All these data significantly contribute to the narrative analysis [16]. Besides, the self-evaluation process can be enhanced within a community of critical friends. Therefore, the head of the physics unit, the subject matter expert (SME), and another two senior lecturers were invited to act as critical friends for the action research. The action research had been carried out for two consecutive cycles, incorporating any revisions between cycles.

B. Intervention

The EM-Kit consists of two separate projects which are adopted and adapted from past research [17], [18]. Figure 5 shows the experimental setup for the first project. This project aims to showcase the effect of Faraday and Lenz's Laws physically through the lighting of LEDs when a magnet slides through a copper coil. The copper coil is made of enamelled copper wire with thickness 0.35 mm and has 400 turns. The big magnet consists of five super strong neodymium magnets, each with diameter 20 mm and thickness 10 mm. The small magnet consists of ten neodymium magnets, each with diameter 10 mm and thickness 3 mm. A long white PVC pipe is used to wind the 400-turn copper coil and to allow the sliding of magnet through the pipe. Two green and red LEDs are soldered and connected to the copper coil in such a way that to investigate the direction of induced current flow in the copper coil. These dual-directional LEDs function almost the same as the center zero galvanometer.

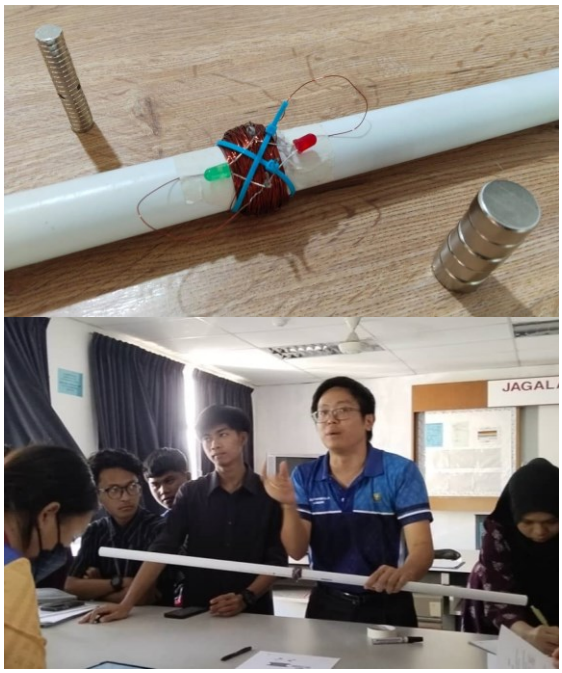

Figure 5. Experimental setup for first project of EM-Kit.

First, this project can show the relationship between strength or speed of moving magnet and magnitude of induced emf in order to understand Faraday's Law. When a magnet is let to slide through the pipe and the copper coil, the LEDs will light up. The LEDs only light up when the magnet is sliding, but do not light up if the magnet is stationary inside the copper coil. Students can compare the brightness of LEDs between using small and big magnets to slide through the copper coil. A long PVC pipe is also used to allow students to control the speed of the sliding magnet, so they can relate how the speed affects the brightness of the LEDs. These observations are important for students to understand how Faraday's Law works.

Secondly, before beginning the experiment, students are requested to guess which LED will light up if they slide down the magnet through the copper coil. They have to determine the directions of induced current through the coil when the magnet is approaching or moving away based on Lenz's Law and Right-Hand-Grip-Rule. When students slide a magnet through the copper coil, they will observe that the LEDs will only light up one after another but not simultaneously. They will notice that the red LED lights up first followed by the green LED, or vice versa. Then, students need to invert the pole of the magnet and let it slide through the copper coil again. This time they will notice that the sequence of which LED lighted up first is also inverted. This activity is a good exercise for students to apply Lenz's Law hands-on.

Figure 6 shows the experimental setup for the second project. This project aims to showcase the effect of Faraday and Lenz's Laws physically through oscillation movement of coils when a magnet is approaching or moving away from it. It allows students to 'feel' the attractive or repulsive force in their hands while pushing in or pulling out the magnet from the coil due to electromagnetic induction. Three copper coils were made, namely (1) 200-turn open coil, (2) 200-turn closed coil, and (3) 500-turn closed coil. A long metre-rule was used as a level. Two activities had been designed for this project. The first activity requires the students to prove the existence of induced emf based on Faraday's Law. Students need to place both of 200-

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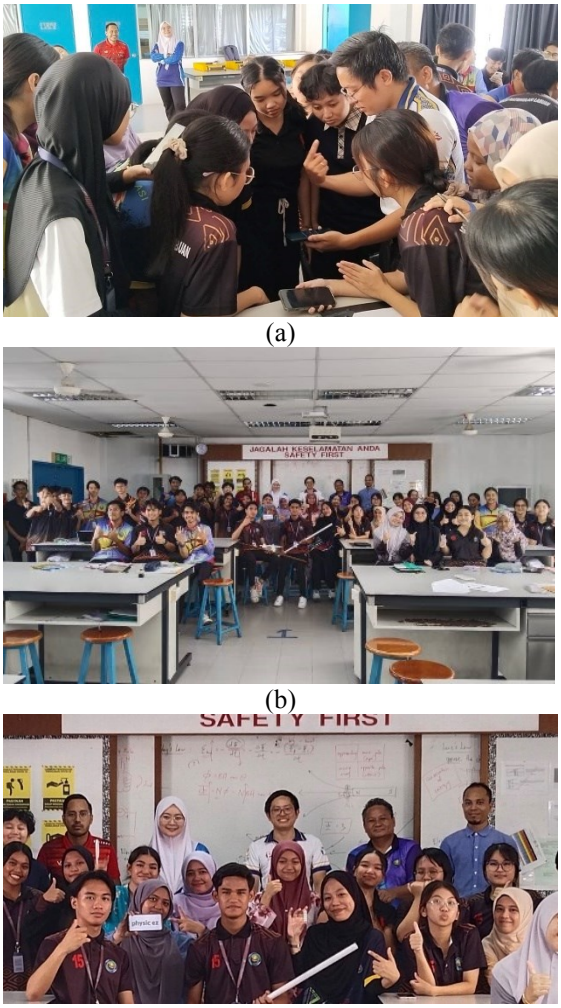
turn copper coils at both ends of the ruler to balance, closed coil at one end, and open coil at the other end. Then, students will use the magnet to test sliding in and out both coils and observe which coil reacts to the magnet.

Figure 6. Experimental setup for second project of EM-Kit.

The second activity is students need to test the difference between 200-turn and 500-turn copper coils against the amplitude of level oscillation. This activity will let students verify the relationship between number of coil turns and magnitude of induced emf in order to understand Faraday's Law. Besides, students will also pay attention to the direction of ruler movement when the magnet is approaching the coil or moving away from the coil, as this will also showcase the working principle of Lenz's Law. Both projects with LEDs and level balance were administered in a tutorial class by Mr Pek for the first cycle, under close observation by the team members who acted as the observers, as shown in Figure 7(a). Figure 7(b) shows the group photo with students involved in the project, whereas Figure 7(c) shows all five lecturers as the researchers of this project.



(a)

(b)

(c)

Figure 7. Classroom activities: (a) EM-Kit activities under closed observation by other lecturers, (b) group photo with students, (c) the researchers.

VI. RESULT AND DISCUSSION

A. First Cycle

Figure 8 shows a survey that was distributed among students using Google Form to collect their feedback regarding the things they learnt from the projects. Through hands-on physical experiment, students claimed that they could clearly see the relationship between the speed or size of a bar magnet with the magnitude of induced current, which is portrayed by the brightness of LEDs when lighted up. They could visualize the Faraday's and Lenz's Laws in a more physical way as well as relating it with daily life examples. A further interview with the students revealed that they could visualize that this EM-Kit mimics the power plant that generates electricity. Two primary components, such as magnet and copper coil, always can be found in an electric generator. Similar to this experiment, AC current is always generated for household consumption.

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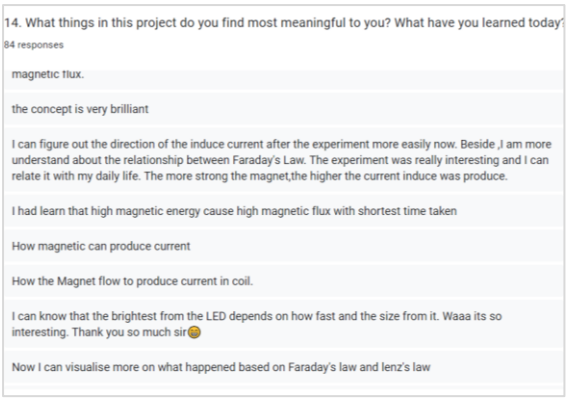
14. What things in this project do you find most meaningful to you? What have you learned today?

84 responses

magnetic flux.

the concept is very brilliant

I can figure out the direction of the induce current after the experiment more easily now. Beside ,I am more understand about the relationship between Faraday's Law. The experiment was really interesting and I can relate it with my daily life. The more strong the magnet,the higher the current induce was produce.

I had learn that high magnetic energy cause high magnetic flux with shortest time taken

How magnetic can produce current

How the Magnet flow to produce current in coil.

I can know that the brightest from the LED depends on how fast and the size from it. Waaa its so interesting. Thank you so much sir

Now I can visualise more on what happened based on Faraday's law and lenz's law

Figure 8. Students' feedback in questionnaire regarding the EM-Kit activities.

However, their description towards Faraday's and Lenz's Law still remained vague based on their responses. They did not provide accurate terms such as 'change of magnetic flux' that induced the current. Instead, students mentioned 'magnetic' or 'magnet flow' that produced the current, which were inaccurate definitions. The students could visualise physically how Faraday's Law works in the project but still unable to clearly explain its definition in correct terms. "Large induced emf caused by large change in magnetic flux" in Faraday's Law was wrongly described as "high magnetic energy caused by high magnetic flux". It is important to note that "large change in magnetic flux" has a totally different meaning compared to "large magnetic flux".

In order to fix their vague understanding towards the real concepts of Faraday's and Lenz's Law, the researchers proposed that a guided worksheet should be provided alongside the kit to help explain the working principles of these laws in accurate terms related to this project. Thus, the team collectively designed the worksheet which included students' observational data table and explanation according to the physical laws as well as equations. To lessen the cognitive load, the worksheet employs a fill-in-the-blank method to keep the students on track with the concepts easily. The whole project incorporating the revision was re-conducted again on another two tutorial classes for the second cycle. Figure 9 shows the usage of a worksheet during the second cycle to guide the Right-Hand-Grip-Rule lesson when determining the direction of induced current.

Figure 9. A guided worksheet alongside EM-Kit.

B. Second Cycle

Figure 10 shows sample data from the students' worksheet, where it is proven that students can explain qualitatively the working principle of Faraday's Law in both projects using Faraday's equation. In the first project as shown in Figure 10(a), the induced emf as represented by the brightness of LED is proportional to the rate of change of magnetic flux. Students noticed that the LED was dimly lit when the magnet slid through the coil slowly, whereas the LED was brightly lit when the magnet slid through the coil at a fast speed. They arrived at a conclusion that the higher the speed of magnet, the shorter the time taken (t) for change of magnetic flux, thus the higher the magnitude of induced emf. This shows that this project is able to assist students in visualizing the induced emf physically through the brightness of LED.

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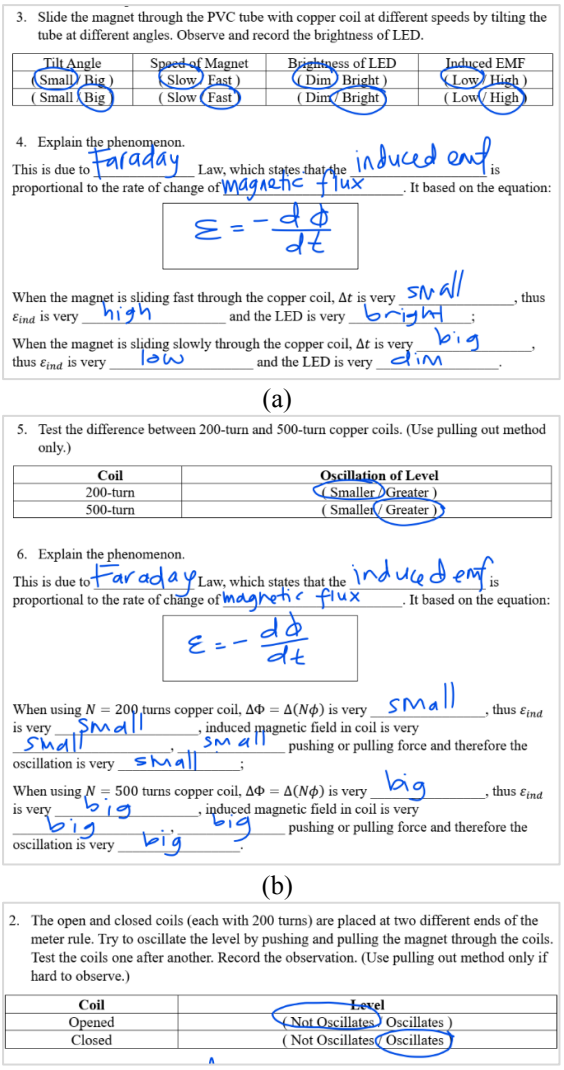

3. Slide the magnet through the PVC tube with copper coil at different speeds by tilting the tube at different angles. Observe and record the brightness of LED.

Tilt Angle	Speed of Magnet	Brightness of LED	Induced EMF
(Small / Big)	(Slow / Fast)	(Dim / Bright)	(Low / High)
(Small / Big)	(Slow / Fast)	(Dim / Bright)	(Low / High)

4. Explain the phenomenon.

This is due to Faraday Law, which states that the induced emf is proportional to the rate of change of magnetic flux. It based on the equation:

$$\mathcal{E} = -\frac{d\phi}{dt}$$

When the magnet is sliding fast through the copper coil, Δt is very small, thus ε_{ind} is very high and the LED is very bright;

When the magnet is sliding slowly through the copper coil, Δt is very big, thus ε_{ind} is very low and the LED is very dim.

(a)

5. Test the difference between 200-turn and 500-turn copper coils. (Use pulling out method only.)

Coil	Oscillation of Level
200-turn	(Smaller / Greater)
500-turn	(Smaller / Greater)

6. Explain the phenomenon.

This is due to Faraday Law, which states that the induced emf is proportional to the rate of change of magnetic flux. It based on the equation:

$$\mathcal{E} = -\frac{d\phi}{dt}$$

When using $N = 200$ turns copper coil, $\Delta\Phi = \Delta(N\phi)$ is very small, thus ε_{ind} is very small, induced magnetic field in coil is very small, small pushing or pulling force and therefore the oscillation is very small;

When using $N = 500$ turns copper coil, $\Delta\Phi = \Delta(N\phi)$ is very big, thus ε_{ind} is very big, induced magnetic field in coil is very big, big pushing or pulling force and therefore the oscillation is very big.

(b)

2. The open and closed coils (each with 200 turns) are placed at two different ends of the meter rule. Try to oscillate the level by pushing and pulling the magnet through the coils. Test the coils one after another. Record the observation. (Use pulling out method only if hard to observe.)

Coil	Level
Opened	(Not Oscillates / Oscillates)
Closed	(Not Oscillates / Oscillates)

(c)

Figure 10. Students' worksheet regarding Faraday's Law: (a) first project, (b) and (c) second project.

In the second project as shown in Figure 10(b), the induced emf is represented by the amplitude of oscillation of the ruler level. Students noticed a smaller amplitude of oscillation when using a coil with lesser turns (200), whereas the oscillation became larger when using a coil with more turns (500). They learnt that the higher the number of turns, the more the magnetic flux changes, thus the higher the magnitude of induced emf. Thus, the kit is able to help students visualize the induced emf too through amplitude of ruler oscillation.

In Figure 10(c), students could also notice that only the closed coil reacted to the moving magnet and oscillated. The opened coil did not oscillate at all. The usage between opened and closed coils here clearly proves the existence of induced current that only flows in a closed coil. A further interview with the students revealed that they understood there was a current induced in the closed coil, which caused it to react towards the magnet. No current can be induced in an opened coil. The induced current was due to Faraday's Law, which states that an emf will be induced whenever there is a change of magnetic flux through a closed coil.

In Figure 11, students have proven that they are able to explain qualitatively the working principle of Lenz's Law in the first project involving LEDs by determining the correct directions of the induced magnetic field in the solenoid when sliding a magnet across it to and fro. Based on the law, the copper coil tends to oppose the motion of a moving magnet by 'repelling' it when the magnet is approaching, or 'attracting' it when the magnet is moving away. The copper coil thus generates induced emf or current to produce the corresponding magnetic fields for the repel or attract effect. Students were also able to use Right-Hand-Grip-Rule (RHGR) in determining the direction of induced-current in the circuit. Since the LED only allows uni-direction of induced current flow, they could see that the red and green LEDs only get lighted up by induced current one after another but not simultaneously. In the reverse slide, they also observed that sequence of which LED gets lighted up first follows the sequence during initial slide. Finally, they arrived at a conclusion that when the magnet is oscillating through the solenoid, an alternating current (AC) is generated in the circuit. This is due to the repeating lighting sequence of either Red-Green-Red-Green or Green-Red-Green-Red LEDs during initial and reverse slide. This situation clearly explains why the electric generator in any electric station generates AC current but not DC current for our household utility. Based on the answer provided by students in Figure 5, it clearly shows that students can relate this concept to real-life situations such as the electric generator which generates AC current.

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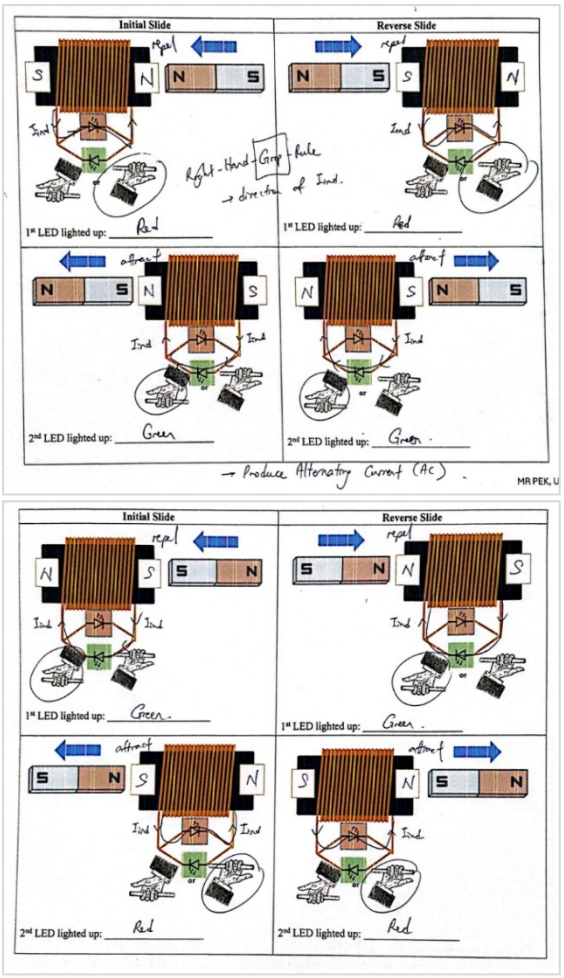
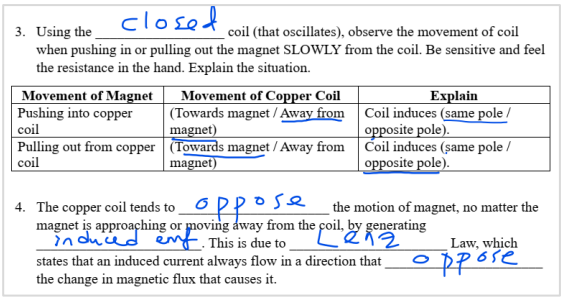


Figure 11. Students' worksheet regarding Lenz's Law in first project.

Figure 12 shows that students could explain qualitatively the working principle of Lenz's Law too in the second project. Here, instead of showing the direction of induced current flow by LEDs, the project actually allows a direct observation of the "repel or attract" effect as stated in Lenz's Law through the oscillation movement of copper coil on a level. They could "feel and watch" physically that the copper coil was being repelled when they pushed a magnet into it. They also noticed that the copper coil was attracted to the magnet when the magnet was pulled out from the copper coil. It was as though an invisible force pushing or pulling the copper coil although the magnet was not in contact with it. Students were able to provide an explanation of the situation using Lenz's Law that the copper coil tends to oppose the motion of a magnet by generating induced emf.



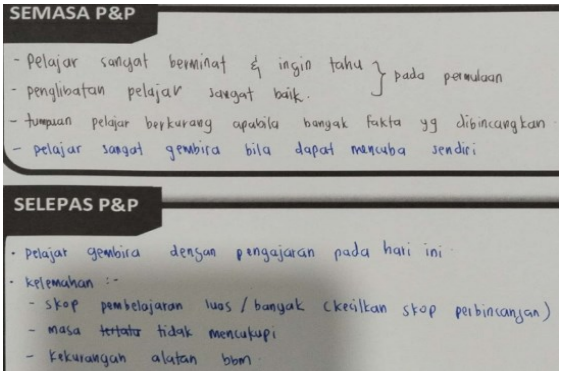
3. Using the closed coil (that oscillates), observe the movement of coil when pushing in or pulling out the magnet SLOWLY from the coil. Be sensitive and feel the resistance in the hand. Explain the situation.

Movement of Magnet	Movement of Copper Coil	Explain
Pushing into copper coil	(Towards magnet / Away from magnet)	Coil induces (same pole / opposite pole).
Pulling out from copper coil	(Towards magnet / Away from magnet)	Coil induces (same pole / opposite pole).

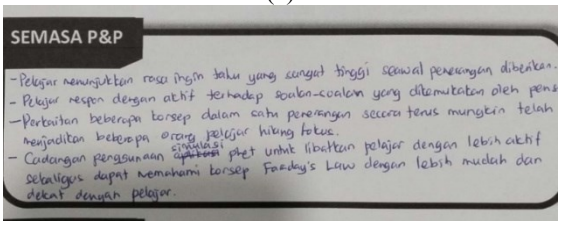
4. The copper coil tends to oppose the motion of magnet, no matter the magnet is approaching or moving away from the coil, by generating induced emf. This is due to Lenz Law, which states that an induced current always flow in a direction that oppose the change in magnetic flux that causes it.

Figure 12. Students' worksheet regarding Lenz's Law in second project.

Figure 13 shows lecturers' feedback towards the EM-Kit activities. The team members who acted as observers shares a similar view that students were very interested and had high curiosity as they could try the experiment hands-on. They gave active responses and engagement. However, some students seemed to be distracted when too many concepts were taught and linked at the same time. Students, in particular, were unable to visualize some abstract concepts such as the "change of magnetic flux", despite the fact that the effect can be observed in LED lights. Besides, there was also only a limited set of EM-Kit available, and most students had to wait for their turn to try it. Therefore, the team suggested that a supporting PhET simulation can be provided to help students visualize the concepts better. Perhaps a gallery walk should be implemented with a station conducting the physical experiment using EM-Kit, whereas the other station offers students the PhET simulation to be manipulated.



(a)



(b)

Figure 13. Lecturers' feedback in both projects: (a) Lecturer 1, (b) Lecturer 2.

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In Figure 14, the PhET simulation clearly shows the abstract concept such as the change of magnetic flux in the copper coil that induces the emf. It provides visual representations to show the invisible, such as the magnetic field lines [19]. Multiple audio-visual representations are provided to support deeper understanding and build real-world connections [19]. For instance, there is a voltmeter to show the change in induced current direction when the magnet bar moves in and out of the copper coil. A supporting background sound also accompanies the animation to help identify the change in induced current direction as the magnet bar slides through the copper coil. Learning physics is fun, real, and simple through PhET interactive simulation [20]. It also proved to significantly improve the academic performance of students in Science [21].

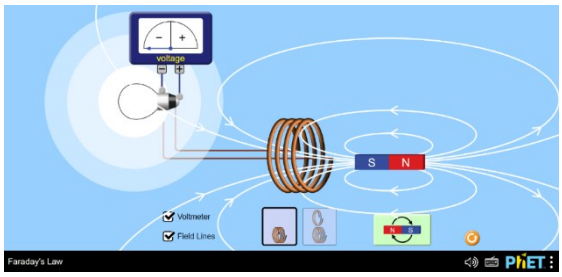

Figure 14. PhET simulation regarding Faraday's and Lenz's Laws [22].

In short, this simulation fully supplements the visualization process of Faraday's Law and Lenz's Law for the physical experiment conducted by students. It assists in explaining the abstract concept of magnetic flux that is otherwise invisible in a physical experiment. Following much debate, the team arrived at an integrated approach that includes the EM-Kit, guided worksheet, PhET simulation, and gallery walk, which can be applied during the future third cycle.

The electromagnetic induction kit was introduced to the Physics Unit KML among fellow lecturers during the Physics Sharing Session (PSS). Videos recorded during the classroom activity with students were showed and commented by lecturers. The Head of Physics Unit who acted as a critical friend had remarked that the activity was interesting and able to explain the concepts of Faraday's and Lenz's Laws to students. However, some lecturers responded that while these activities may aid in conceptual understanding, they are ineffective in problem solving involving formula calculations. The activities are more suitable to be conducted during lab sessions with longer hours. Instruction and explanation from lecturers are still much needed to guide students to understand the underlying principles behind the project as there are a lot of concepts involved. The sharing process has spurred interest in other physics teachers to develop comparable initiatives for their own classes. Lecturers also suggested that such activity be demonstrated during Physics Open Day (POD). Most importantly, the action research has undoubtedly boosted lecturers' collaborative efforts to benefit a larger pool of students. The author of this work also hopes to have it published in a journal to help other scholars.

VII. CONCLUSION

Generally, the objectives had been achieved where students are able to explain qualitatively the working principles of Faraday's and Lenz's Laws using EM-Kit, instead of just stating their definitions. In students' worksheet, they could draw a relationship between strength or speed of sliding magnet and magnitude of induced emf which correspond to the brightness of LEDs. Students can also explain how the amount of coil turns affects the amplitude of level oscillation. The necessity of using a closed coil instead of opened coil further convinced the students about the existence of induced current in the closed coil. The direction of induced current can also be determined correctly by students when they investigate the sequence of which LED gets lighted using Lenz's Law. Students also used Lenz's Law appropriately to explain the direction of sea-saw ruler oscillations. Finally, students can relate these two laws in real-life situations when they learnt that magnet and copper coil are primary components in any electric generators as well as the usage of household AC supply.

However, the problem of lacking several experimental sets and difficulty in visualizing abstract subjects such as magnetic flux still persist. Therefore, the suggestion for improvement in the third cycle will be conducting a gallery walk that comprises two stations: one with experimental set while the other with PhET Simulation that helps with the visualization process of the experiment. It is noteworthy that the activity encourages students to learn actively by having them apply their understanding of Faraday's and Lenz's Laws through practical experience rather than listening to lectures. The team found that, despite the study being in its second cycle, the project is on the right track towards a sustainable future education. In addition to imparting knowledge, educators must instill in their students a sense of purpose in their knowledge they learnt so as to be valued by them [1].

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who willingly participated and cooperated in this research.

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Enhancing Education through Business Intelligence: A Preliminary Assessment of Integrating Looker Studio into Management Information Systems Course at Politeknik Kuching Sarawak

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Abstract

This study explores the integration of business intelligence (BI) through Looker Studio as the primary instrument in the context of a Management Information Systems (MIS) course for second-semester Diploma in Business Studies students at Politeknik Kuching Sarawak. Looker Studio is an effective business intelligence and data visualisation tool that enables users to produce interactive dashboards and reports. It allows for data-driven decision-making processes which are essential for current enterprises. The primary goal is to assess students' level of familiarity, usage behaviours, satisfaction and recommendations with Looker Studio.

We collected data through a well-organised questionnaire, which resulted in a satisfactory response rate from all 121 students currently enrolled in the course. The sample comprised 82 females and 39 boys, ranging in age from 18 to 23 years. The results suggest that the frequency of consumption was not statistically significant. Furthermore, the findings indicated that over fifty percent of the participants self-identified as lacking competence in the field of information technology. The findings further revealed that, despite a lack of major technological proficiency, over half of the participants expressed a willingness to promote Looker Studio to their friends. The results of this study provide important information for improving usability and assistance, which can increase student happiness and the instrument's educational effectiveness.

Keywords : *Business intelligence; Dashboard; Looker studio; Management Information Systems; Politeknik Kuching Sarawak*

I. INTRODUCTION

In the dynamic landscape of business education, integrating advanced technological resources is vital for preparing students with the skills needed to meet the demands of the current job marketplace. Business intelligence (BI) alternatives, such as Looker Studio, are critical in such an environment because they allow users to visualize and analyse data, encouraging effective data-driven decision-making. Looker Studio is an effective business intelligence and data visualisation tool that allows users to produce interactive visualisations and reports, which are essential for understanding complex business data.

The use of BI tools in educational settings is not simply a passing trend, but instead a vital requirement. Previous research highlights the significance of business intelligence technologies in improving educational results and equipping students for practical business obstacles. BI systems enhance decision-making processes through their ability to perform thorough data analysis and visualisation[1]. Apart from that, BI tools enhance business process comprehension and strategic planning, which are crucial proficiencies for business students[2].

Furthermore, as stakeholders' expectations and demand for quality in higher education continue to rise and evolve, it becomes imperative for higher education institutions to recognize the significance of emerging management and learning methods offered by IT innovation. Politeknik Kuching Sarawak, specifically the Commerce Department, has acknowledged the significance of these abilities and has integrated Looker Studio into its Management Information Systems (MIS) course as part of the Diploma in Business Studies programme. The purpose of this integration is to close the divide between academic understanding and practical implementation, by providing students with the essential abilities to efficiently traverse and interpret corporate data. This significance arises from an increasing recognition of the need to use data to make informed decisions that improve corporate success. Therefore, the majority of organisations in the present era have made significant financial commitments to BI and analytics, acknowledging

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their ability to support well-informed decision-making and enhance overall results[3].

II. LITERATURE REVIEW

Over the past few years, there has been an increasing emphasis on integrating BI tools into institution courses. BI solutions, like Looker Studio, provide comprehensive features for visualising and analysing data, which are essential to promoting data-driven decision-making abilities in students. This literature review examines recent studies on the use and advantages of BI technology in educational environments, with a focus on the key factors that influence its success.

1) Benefits of BI in the education sector

People widely recognise BI technologies for their ability to transform unprocessed data into meaningful insights through sophisticated analysis and visualisation. A 2012 study demonstrated that BI technologies significantly enhance decision-making in educational settings by offering significant capabilities for data analysis[4]. Currently, higher education institutions utilise BI to facilitate decision-making processes and offer real-time information to assist top management in monitoring performance[5]. By incorporating BI tools into the curriculum, educators can offer students significant and advantageous opportunities to develop skills in data analysis and interpretation. This pedagogical approach promotes the development of critical thinking and analytical abilities.

Furthermore, BI facilitates personalised learning experiences. Previous research has indicated that data analytics in education enable the creation of customised learning paths that align with the individual performance of each student[6]. Utilising a tailored approach can lead to heightened academic performance and greater student involvement.

2) Effects on student engagement and academic achievement

A recent study has specifically investigated the impact of BI technologies on student engagement and academic performance. Implementing BI tools in educational settings can significantly enhance student engagement by fostering a more immersive and dynamic learning experience. BI tools use their visual and interactive capabilities to improve the accessibility and understanding of complex data, resulting in increased student engagement and participation.

Moreover, studies demonstrate that BI technologies enhance learning outcomes by equipping students with practical skills applicable to real-world business scenarios. Having a high level of skill in using BI technologies is becoming more and more important in today's data-focused corporate environment. Students with the ability to assess and understand data are better prepared for the requirements of the workforce. Integrating BI tools into the curriculum enhances the link between theoretical knowledge and practical implementation, leading to an enhanced educational experience[7].

Incorporating BI tools, like Looker Studio, into educational curricula offers significant benefits, including improved decision-making skills, personalised learning experiences, and better student engagement and academic performance. However, to fully realise these benefits, it is crucial to address the challenges related to data integration, technical complexity, and student proficiency. The challenges may stem from the adoption of technical innovation without well-defined objectives, inadequate management, limited financial resources, environmental constraints, and many cultural and organisational factors[8].

By providing comprehensive training and support, educators may assist students in surmounting these obstacles and acquiring proficiency in the use of BI technologies. This will empower individuals to obtain the fundamental competencies necessary to thrive in a data-centric business environment.

III. METHODOLOGY

The objective of this study is to assess the incorporation of Looker Studio into the MIS curriculum for second-semester Diploma in Business Studies students at Politeknik Kuching Sarawak. The methodology section provides a detailed description of the research design, participants, data collection methods, and data analysis procedures used in this study.

The structure and plan for conducting research are important considerations.

(1) Research design

We intentionally created the questionnaire in both English and Malay to ensure maximum clarity and comprehension for all participants. This multilingual technique was critical for addressing linguistic diversity among students and obtaining accurate and dependable responses. We recommend using appropriate parameters in the measurement instrument. An illustrative example[9] involves conducting research in Arabic and performing a double-translation process from English to Arabic, and then from Arabic back to English. We followed the methodology in reference[10] to ensure consistency with the original text.

The study employs a research methodology that incorporates quantitative methods to obtain a comprehensive understanding of the student's experiences using Looker Studio. The component

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entails employing structured surveys to collect quantitative data on students' familiarity, usage patterns, and satisfaction levels. We obtained the measurements using a five-level Likert scale, which ranged from "very dissatisfied" (1) to "very satisfied" (5) for satisfaction level questions.

(2) Participants

The study includes 121 second-semester students pursuing a Diploma in Business Studies who are currently enrolled in the MIS course at Politeknik Kuching Sarawak.

(3) Methods for Collecting Data

(a) Survey:

To collect data on various aspects of student's interactions with Looker Studio, we created a well-designed questionnaire. We segmented the questionnaire into multiple sections, each focusing on distinct variables. To gather demographic information, we are asking about gender and age. Ask about the user's Looker Studio experience, duration, and frequency. We evaluate students' self-perceived technical proficiency by asking questions that gauge their level of technological expertise. The survey also included questions to gauge students' overall satisfaction with Looker Studio and their likelihood of recommending it to others.

(4) Data Analysis

We examined the quantitative data obtained from the structured questionnaire using descriptive statistics. Using frequencies and percentages, we summarised the students' familiarity, usage patterns, tech-savvy, satisfaction levels, and recommendations about Looker Studio. The analysis was conducted using statistical applications such as Google Sheets.

(5) Methodology

We carried out the data-gathering process in the following manner:

(a) Questionnaire distribution: Using Google Forms, we distributed the structured questionnaire to all 121 students following their final MIS assessment. We clarified the study's objective and guaranteed the confidentiality and anonymity of students' comments.

(a) Data collection: After the final assessment, students had ample time to complete the questionnaire. This method guaranteed a high response rate and facilitated the prompt resolution of any uncertainties.

(c) Data analysis: To methodically analyse the gathered data, we used the aforementioned techniques. We then amalgamated the data to offer a comprehensive understanding of the integration of Looker Studio into the MIS course.

This methodology guarantees a strong and thorough evaluation of the integration of Looker Studio into the MIS course, gathering input to guide future enhancements and improve the educational experience.

IV. RESULT AND DISCUSSION

The study aimed to evaluate Looker Studio's integration into the MIS course for second-semester Diploma in Business Studies students at Politeknik Kuching Sarawak. The findings provide insights into the student's familiarity, usage patterns, tech-savvy, satisfaction levels, and overall perceptions of Looker Studio.

Table 1 Demographic profile, level of familiarity, and usage behaviours.

Item		F	%
Gender			
	Male	82	32.2
	Female	39	67.8
Age			
	18 – 19 years old	101	83.5
	20 – 21 years old	15	12.4
	22 – 23 years old	5	64.1
Have you heard about Looker Studio before you enrol on the Management Information Systems course?			
	Yes		24.0
	No		76.0
Duration of use			
	Less than a month		63.7
	1-3 months		14.0
	3-6 months		0.8
	6-12 months		0.0
	More than 1 year		0.0
	Not used at all		21.5
Frequency of use			
	Daily		0.0
	Weekly		5.8
	Monthly		1.7
	Rarely		63.6
	Never		28.9
Self-perceived tech-savviness			
	Yes		44.6
	No		55.4

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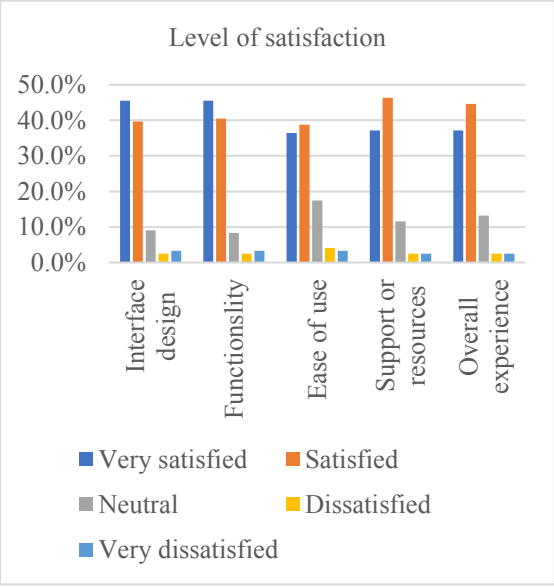
Table 1 displays 121 participants in the study, with 82 (67.8%) females and 39 (32.2%) males, all aged between 18 and 23 years. This demographic information provides a context for understanding the varied experiences and perspectives of the students.

According to the data presented in Table 1, 92 students, which accounts for 76% of the total, were not familiar with Looker Studio before taking the course. A total of 29 students, which accounts for 24% of the total, possessed prior knowledge of the tool. A total of 77 students, accounting for 63.6% of the sample, used Looker Studio for less than one month. A total of 26 students, accounting for 21.5% of the sample, reported not having used it at all. A total of 17 students, which accounts for 14% of the total, used it for 1–3 months. One student, accounting for 0.8% of the total, used it for 3–6 months.

A total of 77 students, accounting for 63.6% of the sample, reported using Looker Studio infrequently. Of the total number of students, 35 individuals, representing 28.9% of the sample, reported never using Looker Studio. Out of the total number of students, 7 individuals, representing 5.8% of the student population, have used it weekly. Only two students, or 1.7% of the total, used Looker Studio monthly. The results suggest that most students had limited familiarity with Looker Studio and only used it sporadically throughout the semester. A total of 67 students, accounting for 55.4% of the participants, reported that they did not perceive themselves as being proficient in technology.

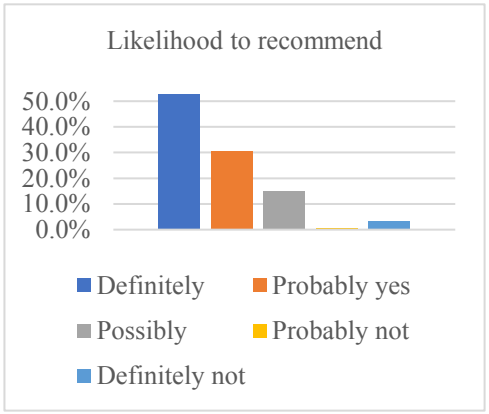
Figure 1 Level of satisfaction



Out of the total number of students, 54 individuals, comprising 44.6% of the group, identified themselves as tech-savvy. A study by [11] indicates that higher education institutions that view BI as significantly beneficial are more likely to adopt and implement BI systems. This is because BI can offer numerous advantages to higher education institutions, such as improved decision-making, increased operational efficiency, and a deeper understanding of student and institutional performance. The distribution illustrates an even combination of self-perceived technical expertise among the students.

According to Figure 1, a significant majority of students (85.2%) expressed satisfaction with the interface design of Looker Studio, suggesting that the platform's design is both user-friendly and visually appealing. A minority of respondents (5.8%) voiced displeasure, indicating the potential for slight enhancements. Looker Studio's functionality was highly regarded, with 86% of students reporting pleasure with positive reception of the interface design. The platform's extensive range of features and its capability to fulfil students' requirements for data analysis and visualisation are the reasons behind this significant degree of satisfaction.

Figure 2 Likelihood to recommend Looker Studio



Among the students, a considerable proportion (75.2%) reported finding Looker Studio user-friendly. However, a major percentage (17.4%) expressed a neutral opinion, while a smaller fraction (7.4%) reported being unsatisfied. This suggests that while the platform is generally user-friendly, certain aspects of the user experience could benefit from simplification or more effective support. The support and resources were well-received by students, with a satisfaction rate of 83.5%. Nevertheless, a significant proportion of students, specifically 11.6%, maintained a neutral stance, while 5% expressed dissatisfaction, indicating a clear requirement for more extensive or easily obtainable support materials.

Regarding the whole experience, a significant majority of students, specifically 81.8%, expressed satisfaction with Looker Studio. 13.2% of the respondents had a neutral opinion, while 5%

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voiced discontent. This suggests that although the overall reception is positive, making ongoing enhancements and updates could further enhance the user experience.

Figure 2 shows a significant majority of students strongly advocated for Looker Studio, with 52.9% (64 students) unequivocally indicating that they would "definitely" suggest the platform. The considerable level of enthusiasm indicates that more than half of the students had an exceedingly positive experience and derived substantial value from using Looker Studio for their coursework. Furthermore, an additional 30.6% (37 students) indicated that they would "probably" recommend Looker Studio. When added to the number of students who would "definitely" suggest it, the total percentage of students likely to recommend the platform is 83.5%. This suggests that many students had a favourable experience, although they may not have been extremely enthusiastic. Perhaps almost 14.9% (18 students) expressed neutrality, suggesting a degree of confusion or ambivalence towards the platform. While some students found Looker Studio to be beneficial, they faced significant obstacles that hindered them from giving it a full recommendation. Unlikely: Merely 0.8% (equivalent to 1 student) displayed a minor tendency to not recommend Looker Studio. Without a doubt, in the same vein, 0.8% (1 student) expressed their complete lack of recommendation for the platform.

V. CONCLUSION

The survey findings suggest that Looker Studio is highly regarded by students, especially for courses that include extensive data analysis, such as Management Information Systems. Looker Studio's user interface design garners widespread praise for its intuitive and visually captivating layout, aligning with research emphasising that underscores the significance of user-friendly interfaces in enhancing educational experiences [12][13].

Research on the effectiveness of comprehensive data visualisation tools[12][13] shows that Looker Studio's many features meet the different needs of students who need to analyse data. Although the platform is largely user-friendly, there is a recognised opportunity to improve its intuitiveness, which aligns with the broader literature emphasising the significance of user-friendly designs in educational technology [12][13].

While the current assistance resources are good, we could enhance them with more comprehensive materials to ensure their adequacy. This statement highlights the importance of providing robust assistance and training to enhance the efficacy of instructional tools, as emphasised by previous research [14][15].

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Cognitive Style and Achievement in The Cell Division Test

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Abstract

The basis of biology courses on genetics, production, growth, development and molecular biology is cell division. Research shows that despite efforts to improve their understanding and importance of cell division in biology, students often struggle with this concept. The aim of this study is to examine the relationship between cognitive styles and achievement in the cell division test. The study population consists of Form Four science students from rural secondary schools in the southwest coast of Sabah. 247 students were involved in this study. The Group Embedded Figures Test (GEFT) and the Cell Division Test (CDT) were the two instruments used for data collection in this study. SPSS version 29.0 was used for statistical analysis. The average score of the field-independent cognitive styles was higher than that of the field-dependent students. It was also found that the t-value is -2.016 and the significant level is p=0.045. Meanwhile, the correlation coefficient between cognitive styles and students' performance in the cell division test is 0.128 ($p<0.05$). Based on the results, it can be concluded that field-independent students perform better in cell division test than field-dependent students. The research results provided valuable insights for teachers and are incorporated into the development of integrative teaching approaches and individual learning plans that take different cognitive preferences into account and ultimately increase the academic success of all students in biology classes.

Keywords: *Cognitive Style, Field Dependence, Field Independence, Achievement, Cell division test*

I. INTRODUCTION

The difficulties that students encounter when taking biology classes have been thoroughly studied in earlier studies conducted all over the world. Many biology topics in the science curriculum are considered extremely difficult [1]. Form Four Biology covers a range of topics including cell division, according to the Kurikulum Standard Sekolah Menengah (KSSM). All living forms are constructed from cells, which are the fundamental building block of all living things' structure and function [2]. Despite the importance of cell division in biology and efforts to improve students' understanding, research has shown that students often struggle with this concept [3]. [4] revealed that students have difficulty learning the topics of nutrition, cell division and chemical composition in cells. Cell division is the basis for genetics, reproduction, growth, development, and molecular biology courses in the biology curriculum. Failure to master the concept of cell division will have negative consequences as cell division plays a direct role in the field of genetics.

Cognitive style, a fundamental aspect of an individual's psychological makeup, has long been recognized as a crucial factor influencing academic performance. Recent studies have examined the complex relationship between cognitive style and subject-specific performance, with particular emphasis on the area of biology education.

A previous study found that cognitive styles significantly influence the relationship between motivation and students' achievement in biology [5]. Other researchers also found that cognitive styles significantly influenced student performance [6]. In contrast, other researchers found that biology students' performance is not influenced by cognitive styles [7].

A multifaceted approach to understanding cognitive styles can shed additional light on how students understand and interact with complex biological processes, particularly when it comes to

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the topic of cell division. Biology is a challenging subject that requires specific teaching strategies [8,9]. Understanding the different ways individuals absorb information and solve problems can provide educators with indispensable perspectives for adapting their pedagogical approaches to different learning styles.

A. Research Questions of the Study

1. What is the level of cognitive style among rural secondary school students in the southwest coast of Sabah?
2. Is there a relationship between cognitive styles and students' achievement in cell division among rural secondary school students in the southwest coast of Sabah?

B. Hypotheses of the Study

H_{01}: There is no significance relationship between cognitive styles and students' achievement in cell division test among rural secondary school students in southwest coast of Sabah

H_{02}: There is no significant difference between the performances of field-independent and field-dependent students in the cell division test among rural secondary school students in the southwest coast of Sabah

In summary, the research results will make a significant contribution to existing knowledge on the role of cognitive styles in academic performance, particularly in the area of cell division. The study aims to highlight the importance of considering cognitive diversity in educational environments and provide actionable insights for educators to improve the learning experiences and academic success of all students. Ultimately, the goal is to bridge the gap between cognitive styles and pedagogical practices, paving the way for more inclusive and effective teaching and learning experiences.

II. LITERATURE REVIEW

The theoretical framework of this study is based on the concept of cognitive style, which provides a way to understand individual differences in information processing and learning approaches. Witkin's field dependence-independence continuum provides valuable insights into the way individuals perceive and process visual information [10]. When processing visual stimuli, people with a field-dependent cognitive style rely more on outside references and contextual cues, whereas people with a field-independent cognitive style rely more on their own internal frame of reference. Understanding the effects of these cognitive styles on visuospatial processing is crucial to discern their potential influence on performance in the cell division test.

Researchers have defined cognitive styles in a variety of ways. However, these definitions have many similarities. [11] stated that a person's particular technique for organizing their observation of external stimuli constitutes their cognitive style. In other words, cognitive style is regarded as a personality trait that affects social interaction, attitudes, and values. [12]. [13] said that cognitive style is related to the method of collecting and processing information presented to students. Furthermore, cognitive style influences how students deal with difficulties and decide how to interpret information that has a consistent pattern [14,15].

The present study considered learners' cognitive styles, both field -dependent and field-independent, because cognitive style is an essential factor in influencing students' academic decisions, career preferences, and knowledge processing methods [16]. The field dependence/field independence of the learner's cognitive style is related to his ability to find out the most important information, regardless of whether it is the most obvious or salient. [17] state that students with a field-dependent cognitive style typically approach learning and information processing from a broad perspective. [18] asserts that in addition to learning activities carried out in a social setting, field-dependent learning necessitates interactions with peers who serve as advisors and learning amplifiers According to [10, 15], those who are field dependent are to some extent dependent on others, enjoy socializing, and are aware of social cues. They are also interested in the language and actions of others.

III. RESEARCH METHODOLOGY

A. Participants

This study used the purposive sampling approach. The study group consists of Form Four science students from rural secondary schools on the southwest coast of Sabah. 247 students participated in this study.

B. Instrument

The Group Embedded Figures Test (GEFT) and the Cell Division Test (CDT) were the two instruments used to collect data for this study.

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The Cell Division Test (CDT) was developed to examine the relationship between cell division performance and their cognitive style. Three experts in biology education were involved in the preparation of the multiple-choice test instruments. Rasch analysis shows that the infit and outfit values of the MNSQ item range between 0.79 and 1.24 logit. It was also found that all ZSTD components of Infit and Outfit had logit values between -1 and 1.8. In addition, the point-measure correlation values (PTMEA-CORR) or item alignments for all items were positive (>0), indicating that the items can measure what they are intended to assess. The Rasch analysis accepted and validated each of the 22 multiple-choice test items in the biology assessment tool as they all met the requirements mentioned by [19]

Table 1: Expert Panel in the Preparation of the Instruments

Instrument	Expert Panel
Cell Division Test	• A teacher with 15 years of experience as a biology teacher at a secondary school in Sabah, Malaysia. • A lecturer who has taught biology for more than 15 years. from the Institute of Teacher Education Malaysia. • A lecturer who has been teaching biology for more than 14 years at the local universities in Malaysia

For the study, the Group Embedded Figure Test (GEFT) developed by Witkin *et al*. in 1971 was used. The instrument consists of 25 images. The Cronbach value was 0.91 and is considered high reliability. The ability of respondents to identify the marked simple shape within each pattern—which is thought to be the dominant visual field—determines whether they are classified as field-dependent or field-independent.

C. Procedure

The relationship between cognitive styles and academic performance is investigated in the particular context of cell division using a quantitative research approach. Statistical techniques are used to assess the survey data that was gathered. The statistical analysis was conducted using SPSS version 29.0. While inferential statistics can be used to determine relationships between variables, descriptive statistics are used to summarize the data that was collected. The mean, frequency, and percentage were the descriptive statistics employed in this data study. In the meantime, inferential statistics were performed using the Independent T-test and the Pearson correlation coefficient.

IV. FINDINGS

The percentage of respondents with each cognitive style was presented in Table 2 as a result of the study. The finding of the study revealed that 140 respondents are field independent and 107 are field dependent. 51.3% of male respondents are field dependent and 63.8% of female respondents are field independent.

Table 2: Descriptive Statistics Result

	Level	Frequency	%
Male	Field dependent	60	51.3
	Field Independent	57	48.7
Female	Field dependent	47	36.2
	Field Independent	83	63.8

Table 3: Pearson Correlation Coefficient

	Achievement in Cell Division Test	
Cognitive Style	**r**	.128
	p-value	.045
	N	249

The finding in Table 3 shows that the correlation between cognitive styles and students' achievement in the cell division test is 0.128 ($p < 0.05$). The two variables were found to be statistically significantly correlated. The hypothesis that "there is no significance relationship between cognitive styles and students' achievement in cell division test among rural secondary school students in southwest coast of Sabah" is rejected.

Table 4 shows that students with field-independent cognitive styles had a higher mean score than students with field-dependent cognitive styles. It was found that the t-value is -2.016 and the significant level is p=0.045. The significance level is below 0.05 ($p<0.05$). There is a statistically significant difference between field independent and field dependent students. The null hypothesis: "There is no significant difference between the performances of field-independent and field-

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dependent students in the cell division test among rural secondary school students in the southwest coast of Sabah" is therefore rejected.

Table 4: Independent T-Test Result

	Cognitive style	N	Mean	SD	Std. Error Mean
Cell Division Test	Field Dependent	107	2.03	.383	.037
	Field Independent	140	2.12	.324	.027

			Cognitive Styles	
			Equal variances assumed	**Equal variances not assumed**
Levene's Test for Equality of Variances	F		2.742	
	Sig		.099	
t-test for Equality of Means	t		-2.016	-1.971
	df		245	206.442
	Sig. (2-tailed)		.045	.050
	Mean Difference		-.091	-.091
	Std. Error Difference		.045	.046
	95% Confidence Interval of the Difference	Lower	-.179	-.181
		Upper	-.002	.000

V. DISCUSSION AND CONCLUSION

The results of the study were reviewed in light of the underlying research questions and hypotheses. A comprehensive analysis of all studies shows an increasing application of Witkin's theory of field-dependent-independent cognitive styles in research. This study measures participants' ability to separate or decompose a specific object from a broader context using the Group Embedded Figures Test (GEFT). According to [13], when gathering and analyzing student data for information transfer, cognitive style is linked to the process. [20] defines cognitive style as "the way people think, perceive, and remember information." [17] said that Individuals who hold a field-dependent cognitive style view typically participate in the comprehension and processing of information. Field independent, on the other hand, is more analytical and independent [21].

This study found that the majority of fourth grade science students in the southwest coast of Sabah had a field-independent cognitive style. This finding is consistent with [22] results. It was also found that the majority of male students had a field-dependent cognitive style that was in contrast to that of female students. This result is similar to [23] study: men were more likely to be field dependent than women. In contrast, students with field-independent cognitive style levels outperformed those with field-dependent cognitive style levels on both dependent variables when it came to the cell division test.

In the cognitive style, a more field-independent subject finds it easier to overcome the effects of the broader context, while a more field-dependent subject finds it more difficult to do so. From this study, it appears that the majority of Form Four science students in the southwest coast of Sabah are those who can accurately locate a simple figure within a much more complicated figure. This student may perform better on analytical tasks, as evidenced by their ability to effectively complete the GEFT. In general, they are capable of resolving intricate issues, remembering details, discerning reality from illusion, identifying vital information from unnecessary data, recognizing a specific item against its backdrop, storing information quickly and precisely, excelling in standardized assessments, and organizing when needed. As an independent student, this student is less dependent on the support of his teachers or classmates. They may benefit from tasks such as advanced reading and writing that they can complete independently. [24] suggested that teachers should be sensitive to the learning needs of their students and be creative in approaching different teaching methods in the classroom.

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Field-independent students can systematically analyze the steps of mitosis and meiosis in the context of cell division, while field-dependent students can develop new theories and imagine alternative scenarios. These findings about cognitive styles provide educators with the opportunity to adapt their teaching approaches to better support students' diverse cognitive strengths. Furthermore, it's critical to acknowledge that cognitive processes are dynamic and that students can change and evolve their cognitive styles over time. This requires an adaptive and personalized learning environment that not only accommodates cognitive diversity but also promotes its growth and development. By recognizing the unique perspectives and problem-solving approaches that arise from different cognitive styles, educators can create a collaborative learning environment that enriches the entire learning experience for all students.

In this study, students from rural secondary schools on Sabah's southwest coast were found to have a significant relationship between their cognitive styles and their performance on the cell division test. This finding supported by [25], who found that academic performance of both male and female students was positively correlated with their field dependence and independence; girls outperform boys in academic performance; cognitive styles are a significant predictor of academic performance. Recognizing these different cognitive strengths and tailoring instructional approaches to them can lead to improved learning outcomes. By providing a variety of instructional strategies that address different cognitive styles, educators can create an inclusive learning environment that supports all students to achieve academic success.

Furthermore, the effects of cognitive styles extend beyond individual academic performance and influence collaborative dynamics within a classroom. When students with different cognitive styles come together to discuss and solve problems, their unique perspectives and problem-solving approaches enrich the entire learning experience.

Field-independent students outperform field-dependent students on their cell division test, as evidenced by the results and the discussion above. In addition, students' performance on the cell division test also correlates significantly with their cognitive styles.

VI.IMPLICATION

By uncovering the relationships between specific dimensions of cognitive style and test performance, we contribute to improving the theoretical understanding of cognitive styles and their effects on academic performance. This deeper understanding can pave the way for the refinement and development of cognitive style models to accurately capture the different ways in which individuals process information and approach learning tasks.

Understanding the impact of cognitive styles in educational contexts has significant implications for teaching approaches. Educators can adapt their methods to suit the different cognitive strengths of their students, creating a more inclusive and effective learning environment. By recognizing the dynamic nature of cognitive processes and students' potential to adapt and evolve their cognitive styles over time, educators can adapt their teaching approaches to accommodate this variability. By integrating cognitive style considerations into assessment practices, educators can gain a more holistic understanding of students' learning outcomes and knowledge of cell division concepts, thereby providing targeted support and personalized feedback to improve academic growth. Implementing individualized learning plans requires accurate assessment and understanding of each student's specific cognitive styles. This comprehensive understanding allows educators to develop personalized learning strategies and goals tailored to each student's unique cognitive preferences and abilities.

In summary, the study contributed to understanding how cognitive styles affect academic performance in the specific topic of cell division. The research results also provided valuable insights for educators and inform the development of integrative teaching approaches and individual learning plans that address different cognitive preferences and ultimately increase the academic success of all students in biology classes.

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STUDENTS' PERCEPTIONS OF THE ENGINEERING MATHEMATICS 2 COURSE REINFORCEMENT WORKSHOP AT POLITEKNIK IBRAHIM SULTAN

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Abstract

Engineering Mathematics 2 is one of the courses offered to students taking Electrical Engineering Diploma (JKE) and Mechanical Engineering Diploma (JKM) at Politeknik Ibrahim Sultan. However, students fail the Engineering Mathematics 2 (DBM 20023) course every semester. The failure rate in this Mathematics 2 course is higher than in other courses. This study aimed to identify students' perceptions of the Mathematics Reinforcement Workshop as an initiative to improve student achievement in the Engineering Mathematics 2 (DBM 20023) course. A questionnaire (Google Form) was used as a research instrument. This study's sample size was 180 students who took the Engineering Mathematics 2 course in session 2 of 2023/2024. This study uses descriptive statistics (frequency, percentage, mean score, and standard deviation) to measure students' perceptions of the Mathematics Reinforcement Workshop as an initiative to improve the achievement of DBM 20023 course. Data was analyzed using SPSS software. The findings of this study show that the respondents agree and give a positive perception towards implementing the Reinforcement Workshop for Engineering Mathematics course 2 (DBM 20023). Positive feedback on the speakers, program implementation, and the program's impact on the overall high level of satisfaction among participants demonstrate that the program was well implemented and beneficial. The highest score which is "The speaker was able to deliver the course well" contributed to the highest mean score of 3.50, followed by item A1 " This program exposed students to techniques for answering the Final Examination." with a mean score of 3.45, and the third item with the highest mean score is item B3 " The allocated time was appropriate" with 3.44. The lowest mean score value is on item A3, which is " This program helped me feel more confident in answering Final Examination questions." With 3.35. The Mathematics Reinforcement Workshop for the DBM 20023 course for session 2 2023/2024 had a positive effect on the graduation achievement of students who took Engineering Mathematics 2 a total of 355 students (93.4%) passed and 25 students (6.6%) failed. The percentage of student failure decreased compared to semester 1 2023/2024. Therefore, this Mathematics Reinforcement Workshop can be used as an alternative by Mathematics lecturers as an effective teaching and learning reinforcement activity for students who have a weak level of mathematics proficiency

Keywords **:** *Mathematics Reinforcement Workshop; Engineering Mathematics 2 ;student*

I. INTRODUCTION

Mathematics is one of the courses that are deemed vital in the educational curriculum. It is crucial not only for academic knowledge but also for practical use in everyday life and numerous career domains. Mathematics is one of the disciplines that students deem difficult, which can cause low academic performance and a drop in interest in the subject [1]. However, many students face difficulties in understanding mathematical concepts, which can lead to low academic performance and decreased interest in the subject.

Mathematics Reinforcement Workshops have been introduced as one of the interventions to help students overcome challenges in mathematics learning. The use of Reinforcement Workshops in teaching mathematics has been proven to improve student performance significantly [2]. Interactive learning activities in Reinforcement Workshops can help students understand mathematical concepts more deeply [3]. The cooperative learning activities in mathematics Reinforcement Workshops can significantly improve students' mathematical skills [4]. Reinforcement Workshops that involve collaborative activities can increase student motivation in learning mathematics [5].

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Mathematics course is a basic core course that students must pass to complete their diploma. There are three (3) types of Mathematics courses offered to the Electrical Engineering Department (JKE) and Mechanical Engineering Department (JKM) students: Engineering Mathematics 1, Engineering Mathematics 2, and Engineering Mathematics 3 for JKM students, and Electrical Engineering Mathematics for JKE students. All the topics taught in these Mathematics courses are a continuation of the learning at the secondary school level through the core Mathematics subject and the Additional Mathematics elective subject.

However, student failure in the Engineering Mathematics 2 (DBM 20023) course occurs every semester. The failure rate in this Mathematics 2 course is higher compared to other courses. This significantly contributes to the overall performance of individuals and the polytechnic. Based on the examination results of semester 2, 2022/2023, there are still some students who fail and repeat the Engineering Mathematics 2 course every semester. Therefore, Mathematics Reinforcement Workshop has been introduced as one of the intervention to help students overcome challenges in learning mathematics. This study aims to examine students' perceptions of the effectiveness of the Mathematics Reinforcement Workshop in helping them master this course and improve their academic performance in the Engineering Mathematics 2 course.

A. Problem Statement

The achievement of a pass rate of not less than 95% for all courses each semester is the academic

excellence KPI for the Department of Mathematics, Science, and Computer (JMSK), Politeknik Ibrahim Sultan (PIS). Based on Table 1, shows the trend of the pass percentage for the Engineering Mathematics 2 (DBM 20023) course at JMSK PIS for two consecutive semesters, starting from Session 2 2022/2023 and Session 1 2023/2024. There are still a percentage of students who failed and repeat Engineering Mathematics 2 courses each semester and caused the KPI department's target not to be achieved.

Table 1 Trend of Passing Percentage for the Engineering Mathematics Course 2 (DBM 20023) For Two (2) Consecutive Semesters Beginning with Session 2 2022/2023 and Session 1 2023/2024.

Semester	% Pass	% Fail
2 2022/2023	75.3	24.7
1 2023/2024	74.5	25.5

Several factors were identified as causes of student failure in the Engineering Mathematics 2 course (DBM 20023) based on observations. Students who learn the theoretical ideas of mathematical formulas perfectly may nevertheless make errors in computations because they are less competent at using calculators. Students do not give the right responses because they are confused about how to employ mathematical formulas. Students do not review or practice outside of class hours to learn well. Self-training is required since the mathematical formula utilized remains constant, although the number and form of the question fluctuate.

Therefore, the Mathematics Reinforcement Workshop was proposed by the Engineering Mathematics 2 Course Coordinator to the Head of the JMSK Department. This seminar aims to help students effectively master the topics they have learned by providing space and opportunities for small-batch exercises and discussions with facilitators, emphasizing the use of formulas as answering guides, improving answering skills, and further improving the passing rate of grades B and above, thereby enhancing the knowledge and understanding of students participating in the DBM 20023 course. The Mathematics Reinforcement Workshop is an initiative to enhance Continuous Quality Improvement (CQI) for the Engineering Mathematics 2 (DBM 20023) course based on the examination achievement findings for the DBM 20023 course in Session 2 2022/2023 and Session 1 2023/2024.

II. LITERATURE REVIEW

To ensure that students achieve outstanding exam scores, a variety of tactics and approaches are used. Lecturers' roles are to help students grasp and master the material being taught. As a result, various strategies can be employed to ensure that students quickly learn and master the topics presented by the lecturer, as well as answer the evaluation questions correctly and achieve good results. A variety of techniques and methods in answering the exam help students improve their understanding and obtain high marks in the final exam. A study found that workshops focused on lectures and tutorials improved student achievement compared to conventional techniques [6].

A study found that educators must use effective approaches to engage and encourage pupils to learn [7]. While a study found that the question answering approach Workshop method can assist students

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perform well on the final examination [8]. This is supported by a study which found that Reinforcement Workshops increase student exam performance [9]. The students who attended Reinforcement Workshops achieved better results based on the assessments that had been made [10]. Several other research have indicated that teachers' learning approaches should be consistent so that students may understand the subjects taught and perform well in them [11], [12], [13].

According to previous studies, faults or neglect in Mathematics that are frequently detected include solving the work using the improper technique or formula[14], students forgetting the Mathematical formula connected to the question being addressed [15], Students do not fully understand the concept of mathematical formulas, which leads to errors in solving mathematical operations[16] students struggle to solve various calculation operation questions[17], and students are careless in solving mathematical problems as a result of rushing to answer questions [18].

Therefore, based on previous studies, implementing the Engineering Mathematics 2 Reinforcement Workshop is very important for students to improve their understanding of this course. This Workshop provides problem-solving methods and techniques for answering questions correctly according to the questions' requirements. Apart from that, students also need to master the concept of calculation and increase the number of exercises.

A. Objective

This study was conducted to identify students' perceptions of the Mathematics Reinforcement Workshop as an initiative to improve student achievement in the Engineering Mathematics 2 course (DBM 20023).

III. RESEARCH METHODOLOGY

The study method was designed involving study design, study population and sample, study instruments and data analysis methods. The study was conducted at Mathematics, Science and Computer Department, Politeknik Ibrahim Sultan.

A. Research Design

The research process includes the collection and analysis of quantitative data. The goal of this Workshop is to teach students how to answer exam questions face-to-face in order to improve their passing rate for the Engineering Mathematics 2 course (DBM 20023). This class focuses on past final exam questions to help students become more familiar with the format of the questions, techniques, and how to answer final exams. Following the session, students were given a 'Google form' to fill out the program feedback survey. The questionnaire analysis yielded the mean score of students' perceptions of the Mathematics Reinforcement Workshop as initiative to improve achievement in the Engineering Mathematics 2 course.

According to the memo on the Determination of Passing Marks of Continuous Assessment, Final Assessment, and Final Examination for Polytechnic and Community College Study Programs dated February 10, 2023, the passing grade for the Final Exam is 20%.

The workshop is held in the last week of the lecture before the final exam begins. Students taking the DBM20023 course are the identified target group (sample) who need to attend the Math Reinforcement Workshop to help obtain the Final Exam passing grade for the DBM20023 course at the end of the semester. The model for this study can be expressed as the following Figure 1:

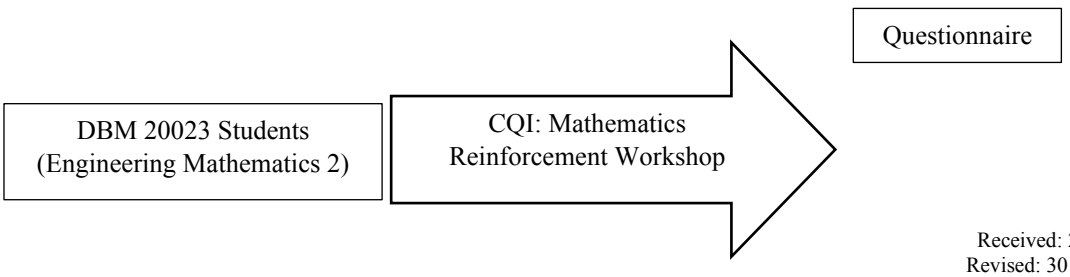

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Figure 1: Relationship Model DBM 20023 Student and Questionnaire

*CQI - Continuous Quality Improvement

B. Population and Study Sample

The study sample is made up of study participants chosen to represent a specific population. Determining the research population is critical in the study since it influences how and how many samples we will select for data sources. In this study, the researcher used a random sample selection since it ensures that all students have an equal chance of being chosen as part of the study. The population of this study consisted of 380 students who took the Engineering Mathematics 2 course (DBM 20023) for Session 2 2023/2024. The sample size is based on the total population [19]. Therefore, the total sample taken in this study is 180 people.

C. Research Instruments

The study items are as shown in Tables 1 2 and 3 which are adapted. The set of questionnaires provided consists of two parts, namely Part A, which contains respondent demographic items such as the name, gender and program of study while Part B contains 10 study items which consist of various scopes of items to get feedback from students about the reinforcement workshop attended. The Likert scale used is:

1 = Strongly Disagree

2 = Disagree

3 = Agree

4 = Strongly Agree

A four-point Likert scale was chosen for its ease of management and usage, as well as the items' ease of response. The Likert scale provides more reliable data than other scales such as Thurstone and Guttman [20]

Table 2 Item A (IMPACT OF THE PROGRAM)

Item code	Study Item
A1	This program exposed students to techniques for answering the Final Examination.
A2	This program guided students on how to answer Final Examination questions correctly and easily.
A3	This program helped me feel more confident in answering Final Examination questions.
A4	My level of knowledge and understanding increased.

Table 3 Item B (PROGRAM IMPLEMENTATION)

Item code	Study Item
B1	The program venue and atmosphere were appropriate.
B2	The planning and implementation of the program were smooth.
B3	The allocated time was appropriate.

Table 4 Item C (SPEAKER EVALUATION)

Item code	Study Item
C1	The speaker was able to deliver the course well.
C2	The speaker allowed participants to ask questions.
C3	The speaker helped solve the problems I faced (related to the course).

D. Data Analysis method

The entire data set is then evaluated using descriptive analysis with SPSS software version 20. The determination of levels in the analysis of research items will be measured based on the mean score value, as stated in Table 5 [21]. Only mean scores greater than 4.00 will be considered high. The demographic questions only contain numbers and percentages.

Table 5 Level determination based on the mean score

Mean Score	Interpretation
1.00 -2.00	Low/Negative

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2.01-3.00	Moderate
3.01-4.00	High/Positive

Further analysis is carried out, and the products' reliability must be tested. Table 6 shows the Cronbach's alpha reliability coefficient, which is used to determine the dependability of the instrument's items. The analysis results showed that all ten items may be tested for reliability with Cronbach's Alpha values better than 0.70, which is 0.987, as shown in Table 7. As a result, all items meet the criteria for further evaluation.

Table 6 Reliability values of items

Cronbach's Alpha	Strength of Reliability
$\alpha \geq 0.9$	The Best
$0.9 \geq \alpha \geq 0.8$	Very Good
$0.8 \geq \alpha \geq 0.7$	Good
$0.7 \geq \alpha \geq 0.6$	Moderate
$0.6 \geq \alpha$	Weak

Table 7 Results of item reliability analysis

Cronbach's Alpha value	Number of items
0.987	10

IV. RESULT AND DISCUSSION

A. Demographics of the Study Sample

A total of 180 students responded. The demographic information gathered from respondents was studied using descriptive statistical analysis, which included frequency and percentage distribution. This demographic data includes gender and program. Table 7 shows that 83 (46.1%) of the 180 responders were male students. While there are 97 female students (53.9%).

Table 8 Distribution of Respondents by gender

GENDER	FREQUENCY	PERCENTAGE (%)
Male	83	46.1
Female	97	53.9
Jumlah	180	100

Table 9 shows the number and percentage of respondents in each department based on the program. The Department of Electrical Engineering, specifically DEE, DJK, and DEP, with a total of 71 respondents (53.8%), and the Department of Mechanical Engineering, specifically DKM, DEM, DMB, and DTP, with 61 respondents (46.2%).

Table 9 Distribution of Respondents by Program

PROGRAM	NUMBER	PERCENTAGE (%)
DEE	48	26.7
DJK	18	10
DEP	21	11.7
DKM	30	16.7
DEM	25	13.9
DMB	19	10.5
DTP	19	10.5
TOTAL	**180**	**100**

B. Analysis of study items

Table 10 shows the findings of the mean score analysis for the ten (10) research items. Item C1 "The speaker was able to deliver the course well" contributed to the highest mean score of 3.50, followed by item A1 " This program exposed students to techniques for answering the Final Examination." with a mean score of 3.45, and the third item with the highest mean score is item B3 " The allocated time was appropriate" with 3.44. The lowest mean score value is on item A3, which is " This program helped me feel more confident in answering Final Examination questions.". Table 4 shows how the mean score value is used to establish the level of tendency.

Table 10 Analysis of Study Items.

ITEMS	MEAN	STANDARD DEVIATION	LEVEL
A1	**3.45**	**0.985[2]**	**High/Positive**

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A2	3.40	0.928	High/Positive
A3	**3.35**	**0.921[4]**	**High/Positive**
A4	3.40	0.941	High/Positive
B1	3.38	0.899	High/Positive
B2	3.41	0.972	High/Positive
B3	**3.44**	**0.978[3]**	**High/Positive**
C1	**3.50**	**0.972[1]**	**High/Positive**
C2	3.42	0.957	High/Positive
C3	3.41	0.899	High/Positive

Table 11 shows the results in the form of percentages obtained: 355 students (93.4%) passed, and 25 students (6.6%) failed for Semester 2 Session 2023/2024 that received technical assistance to answer current final exam questions Mathematics Reinforcement Workshop.

Table 11 Achievement Analysis of Students who took the DBM 20023 course for Session 2 2023/2024

PASS (%)	FAIL (%)	TOTAL
93.4	6.6	100

V. CONCLUSION

This study was conducted to identify students' perceptions of the Reinforcement Workshop for Engineering Mathematics 2 course (DBM 20023). Based on the study's findings, it can be concluded that the Reinforcement Workshop was successful in exposing students to techniques and how to answer final exam questions, providing clear and practical guidance, and increasing student confidence. Positive feedback on the speakers, program implementation, and the program's impact on the overall high level of satisfaction among participants demonstrate that the program was well implemented and beneficial. The Mathematics Reinforcement Workshop for the DBM 20023 course for session 2 2023/2024 improves the students' performance of Engineering Mathematics 2 students. The student failure rate fell compared to semester 1 2023/2024. If students have a low level of mathematics learning, this Reinforcement Workshop can be used as effective teaching and learning reinforcement activity instead of typical mathematics lectures. It is supported that the implementation of Math workshops is recommended and more effective to enable students to better understand the learning of Mathematics[22].

At the polytechnic level, the Reinforcement Workshop for the Engineering Mathematics 2 course (DBM 20023) specifically contributed to the achievement of the Politeknik Ibrahim Sultan Strategic Plan under Core 1: Producing Quality Graduates, which entails developing very effective graduate marketability programs. Recognizing the growing potential for strengthening mathematics in the workplace, the institution's academic management is responsible for improving teaching techniques, encouraging students, increasing training, and developing close relationships between lecturers and students. To achieve this purpose, programs/activities for students must incorporate student-centered concepts, interactive learning, formative implementation before actual assessment, and so on to have an impact on polytechnic students' performance.

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Visual Comfort in Learning Environments: A Student Feedback Analysis

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Abstract

Students' academic performance and general well-being are greatly impacted by visual comfort in educational facilities because good lighting improves concentration and lessens discomfort. This study evaluates students' perceptions of lighting in MPB1.1 workshop classroom at Sultan Abdul Halim Mu'adzam Shah Polytechnic (POLIMAS), focusing on light perception, comfort, and acceptability. A total of 36 students from the Diploma in Building Services Engineering program participated by completing a survey questionnaire based on a 5-point Likert scale. Descriptive statistics were used to analyse the data and the results showed that respondents had generally favourable feedback about the lighting conditions with high ratings for brightness, colour accuracy, even distribution and minimal glare. The results highlighted the effectiveness of the lighting setup in supporting student comfort and productivity while identifying minor areas for improvement, such as glare management and enhanced uniformity. It emphasises how crucial well-designed lighting is to creating a positive learning environment and maintain high levels of visual comfort and usability.

Keywords **:** *Comfort perception; Lighting perception; Students' perceptions; Visual comfort*

I. INTRODUCTION

Visual comfort refers to the ease and relaxation experienced by our eyes and mind within a particular lighting environment [1]. It's not just about how bright or dim a space is, it's about how lighting makes us feel, and that can be different for everyone. Assessing visual comfort can be challenging as it depends on individual perceptions of their surroundings, which often differ based on personal preferences and needs [2]. In educational buildings, visual comfort is a critical aspect of classroom design, as it is closely tied to students' well-being and learning outcomes. Proper lighting can significantly reduce discomfort and enhance students' focus and productivity, creating an environment conducive to effective learning. Inadequate lighting in educational buildings can lead to visual discomfort, particularly during task-intensive activities. Research indicates that poor lighting design, characterized by improper brightness levels, glare, and uneven light distribution can disrupt students' visual comfort, causing eye strain and reducing concentration [3]. A study by [4] analyzed the lighting performance in a university architecture studio and found that appropriate lighting plays a vital role in achieving a satisfactory indoor environmental quality for students. Furthermore, [5] stress that bright and well-lit spaces are linked to enhanced positivity, energy, and motivation, while dim or overly harsh lighting can contribute to feelings of fatigue and gloominess. This emphasizes the significance of proper lighting in environments such as workplaces, schools, and homes to promote well-being and productivity.

II. LITERATURE REVIEW

Studies indicate that lighting design in classrooms has a profound and immediate impact on students' visual comfort, which influences their emotional and cognitive responses. [6] conducted a preliminary study to assess the emotional responses to different lighting conditions in university classrooms, highlights that well-designed lighting can evoke positive emotional responses, fostering a more conducive learning environment. The study underscored that emotional comfort is linked to visual comfort, emphasizing the need for lighting that complements natural light and avoids extremes that might cause eye strain or discomfort. This aligns with the broader understanding that lighting influences not only physical visibility but also psychological comfort, affecting students' attitudes and engagement levels.

Different learning activities demand varying levels and types of lighting to create optimal conditions for engagement and performance. Activities involving detailed visual tasks are better supported by higher light levels. Brighter and more

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focused lighting can improve accuracy and efficiency by reducing eye strain and enhancing focus. On the other hand, softer and more diffused lighting is more suitable for collaborative activities, such as group discussions or creative brainstorming sessions. This type of lighting helps to establish a calm and inviting atmosphere, encouraging open communication and fostering creativity among participants. By tailoring lighting to the specific requirements of different learning activities, educators can significantly influence students' ability to concentrate and perform effectively. Adjusting light intensity, color temperature, and distribution can help create environments that are not only conducive to specific tasks but also supportive of students' overall well-being and productivity. Such an approach recognizes the interplay between environmental factors and learning outcomes, as highlighted by [7].

A well-designed and comfortable classroom environment plays a pivotal role in motivating students to perform at their best and enhancing the teaching-learning process. The physical environment of the classroom, including factors such as lighting, ventilation, seating arrangements, and overall layout, significantly influences students' engagement, focus, and academic outcomes. Given that students spend a substantial portion of their time indoors in classrooms, it is essential to consider how the built environment affects not only their concentration and learning performance but also their physical and mental health. Elements like proper lighting can reduce eye strain, while good ventilation improves air quality, supporting better cognitive function. Ergonomic seating and spatial arrangements can minimize discomfort and distractions, allowing students to stay attentive for longer periods. Furthermore, a thoughtfully designed classroom can foster a positive atmosphere that enhances collaboration and reduces stress, thereby contributing to a more effective and enjoyable learning experience. As highlighted by [8], understanding the relationship between the classroom's built environment and its impact on students' well-being and academic performance is critical for creating spaces that support both learning and overall health.

Effective lighting is a critical component of the learning environment, as it enhances the visibility of whiteboards and other educational materials. By providing sufficient illumination, good lighting reduces eye strain and fatigue, enabling students to focus better and engage more effectively with their studies [9]. Proper lighting levels not only support clarity and comfort but also play a pivotal role in academic performance. Research highlights that adequate lighting can significantly boost reading comprehension and speed, allowing students to process information more efficiently [10].

In contrast, inadequate or poor-quality lighting can negatively impact students' ability to concentrate and learn. Insufficient lighting often forces students to squint, which can cause discomfort, headaches, and even long-term vision issues. These physical challenges can lead to reduced focus, lower retention of information, and decreased academic productivity [11]. Optimizing classroom lighting is therefore essential for fostering an environment conducive to effective learning. Educators and school administrators must prioritize the installation and maintenance of appropriate lighting systems, considering factors such as brightness, color temperature, and even light distribution, to ensure students' comfort and academic success.

III. RESEARCH METHODOLOGY

A. Research Design

This research aims to evaluate students' perceptions of lighting in workshop classrooms, focusing on aspects such as light perception, comfort perception, and overall acceptability. The study specifically targets students in their third and fifth semesters from the Diploma in Building Services Engineering (DPB) program at Sultan Abdul Halim Mu'adzam Shah Polytechnic (POLIMAS), who have hands-on experience in workshop classrooms, specifically in MPB1.1. A total of 36 respondents participated, representing both the third and fifth semesters. This selection was made to ensure a diverse representation of perspectives, as students at different stages of their education may have varying experiences and expectations regarding their learning environments. By concentrating on these specific groups and settings, the study aims to capture detailed insights into lighting needs and preferences in specialized learning spaces.

B. Data Collection

Data were collected through a survey questionnaire that comprised six statements related to lighting perception, six statements related to comfort and one item on acceptability. The questionnaire used a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to gauge students' levels of agreement with each statement. The perception questions were adapted from [12], utilizing light descriptors to explore participants' perceptions. The second section focused on comfort, addressing aspects such as color, light levels, distribution, glare, and an overall evaluation of the visual environment. Additionally, a final question assessed the acceptability of the visual environment.

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C. Data Analysis

The collected data were analyzed using descriptive statistics to determine the mean and the standard deviation for each statement. This analysis provided insights into the overall trends in students' perceptions of lighting in workshop classrooms.

D. Limitations

The sample size of 36 respondents, while providing initial insights, may limit the generalizability of the findings. Future studies could benefit from a larger sample size to capture a broader range of experiences. This study focuses solely on students' perceptions and does not include objective measurements of lighting conditions, which could provide additional context to the findings. Additionally, the sample was restricted due to the absence of student intake for semesters two and four, and first-semester students have not yet used the workshop classroom, further narrowing the representation of perspectives. Expanding the sample to include a more diverse set of student experiences and integrating objective lighting measurements could enhance the depth and applicability of future research in this area.

IV. RESULT AND DISCUSSION

Table 1 presents the analysis of mean and standard deviation for each lighting perception item.

Table 1 Lighting Perception Analysis

No.	Item	Mean	Standard Deviation
1.	The color of the lighting in the room is warm.	3.167	1.342
2.	The color of the surfaces seems natural, without distortion.	4.000	1.014
3.	The room seems bright.	4.222	0.989
4.	The light is distributed evenly in the room.	4.278	0.882
5.	There is imperceptible glare in the room caused by the lamps.	2.694	1.390
6.	Overall, the visual appearance of the room is very pleasant.	4.139	0.931

The mean score of 3.167 suggests that students have a mixed perception regarding the warmth of the room's lighting, with some finding it acceptably warm and others possibly feeling it lacks warmth. The high standard deviation of 1.342 indicates considerable variability in students' opinions on this aspect, suggesting that while some students may find the lighting temperature suitable, others may feel it deviates from their preference, perhaps due to the intensity or hue of the light.

With a mean score of 4.000, students generally agree that the lighting allows for a natural appearance of surfaces without color distortion. This high rating reflects satisfaction with the light's quality in maintaining the true colors of surfaces, which is essential for a visually comfortable environment. The standard deviation of 1.014 shows moderate variability, suggesting that while most students perceive the colors accurately, a few might see slight inconsistencies, perhaps due to differences in light intensity or their seating position.

A high mean score of 4.222 shows that students perceive the room as sufficiently bright, which is ideal for visibility and focus in an educational setting. The low standard deviation of 0.989 indicates that most students consistently agree on the room's brightness, with little variability in perception. This consensus highlights that the lighting is suitably adjusted for brightness across the room, contributing positively to the students' learning environment.

This item received one of the highest ratings, with a mean of 4.278, indicating that students perceive the lighting distribution as uniform throughout the room. Even distribution reduces shadows and ensures all areas are equally illuminated, which is beneficial in maintaining visual comfort. The relatively low standard deviation of 0.882 shows strong agreement among students, suggesting that most find the lighting to be well-balanced and consistent, enhancing the overall quality of the environment.

This item has a lower mean score of 2.694, indicating that students may notice some glare from the lighting, which can be distracting and uncomfortable. The high standard deviation of 1.390 reflects a wide range of responses, showing that glare is a concern for some students more than others, possibly due to seating position or the type of light fixtures. This variability suggests that glare management may be an area for improvement to enhance the room's overall visual comfort.

The mean score of 4.139 demonstrates a positive perception of the room's visual appeal under

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the current lighting conditions, suggesting that most students find the room visually comfortable and pleasant. The low standard deviation of 0.931 indicates consensus among students, with only minor differences in opinion. This high satisfaction level with the overall ambiance suggests that the lighting setup contributes positively to a comfortable and aesthetically pleasing environment.

The analysis of student perceptions on lighting quality reveals a generally positive response, particularly in brightness, even distribution, and natural color rendering. Students have expressed satisfaction with the brightness levels, noting that the lighting is sufficient for tasks such as reading, writing, and using electronic devices without causing strain on the eyes. Additionally, the even distribution of light throughout the room ensures there are no dark spots or overly illuminated areas, which contributes to a comfortable and balanced environment. This uniform lighting helps to reduce distractions caused by glare or shadows, enhancing focus and productivity. Furthermore, the natural color rendering of the lighting has been well-regarded, as it accurately reflects colors within the space, creating a warm and inviting atmosphere. This aspect not only improves the aesthetic appeal of the room but also supports activities that require accurate color perception. Overall, the positive feedback underscores the effectiveness of the room's lighting design in meeting the students' needs.

Table 2 displays the analysis of mean and standard deviation for each comfort perception item.

Table 2 Comfort Perception Analysis

No.	Item	Mean	Standard Deviation
1.	The color of the lighting in the room is very comfortable.	4.278	0.882
2.	The appearance of the surfaces' colors is very comfortable.	4.222	0.866
3.	The amount of light in the room is very comfortable.	4.222	0.866
4.	The light distribution in the room is very comfortable.	4.250	0.967
5.	The lamp do not cause glare.	4.083	0.906
6.	Overall, the visual environment of the room is very comfortable.	4.194	0.856

The high mean score of 4.278 suggests that students find the color of the lighting to be very comfortable, indicating that the chosen color temperature aligns well with their preferences for a visually pleasant environment. The relatively low standard deviation of 0.882 shows that students generally agree on this comfort level, with little variability in responses, reflecting a successful choice in the color tone used.

A mean of 4.222 indicates that students perceive the color rendering of surfaces as comfortable, meaning that the lighting allows surfaces to appear naturally, without color distortion. This score suggests satisfaction with the accuracy of color representation under the room's lighting. The low standard deviation of 0.866 suggests strong consensus among students, indicating minimal variation in their comfort levels regarding this aspect.

Similar to color rendering, the amount of light in the room also scored highly, with a mean of 4.222. This score reflects that students generally feel comfortable with the brightness level, finding it neither too intense nor too dim. The low standard deviation of 0.866 suggests that most students are aligned in their comfort with the room's brightness, indicating that the lighting is well-adjusted for the activities in this space.

With a mean score of 4.250, students perceive the light distribution to be comfortable, indicating that it is spread evenly across the room. Proper light distribution prevents shadows and bright spots, which can cause discomfort and distraction. The slightly higher standard deviation of 0.967 indicates a little more variation in comfort levels, suggesting that while most students feel satisfied, some may perceive minor inconsistencies in distribution.

The mean score of 4.083 indicates that students generally find glare from the lamps to be minimal or non-existent, which is essential for visual comfort and focus. The standard deviation of 0.906 shows moderate agreement among students on this point, with some variability in experiences of glare, potentially influenced by seating positions relative to the light sources.

The high mean score of 4.194 reflects a positive overall perception of the visual environment, with students generally finding it comfortable and conducive to focus and engagement. The low standard deviation of 0.856

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suggests strong agreement across responses, indicating that the room's lighting conditions create a consistently comfortable experience for students.

The analysis of student comfort perceptions regarding the room's lighting reveals a strong positive response, with high comfort ratings across all assessed aspects: color, brightness, distribution, and glare. Students find the lighting environment comfortable overall, with minimal variability in responses, suggesting that the setup is well-aligned with their needs. However, there are slight indications for improvement in light distribution and glare, which can further enhance visual comfort and reduce potential strain. Such adjustments could make the lighting even more supportive for extended focus and general well-being.

To optimize the comfort of the room's lighting, several targeted adjustments are suggested. Enhancing the consistency of light distribution can address minor variations in comfort, as uniform lighting reduces shadows and creates a balanced visual field [13]. This could be achieved by repositioning fixtures or adding supplemental lighting in underlit areas. Minimizing glare further would be beneficial, as glare disrupts visual comfort and can cause eye strain.

The analysis of the mean and standard deviation for the acceptability item, as shown in Table 3, provides valuable insights into students' perceptions of the current visual environment. The mean score of 4.306, which is relatively high on a typical five-point Likert scale, indicates that students largely find the visual environment satisfactory. This high mean suggests that key aspects of the environment, such as lighting levels, color schemes, and spatial arrangement, align well with the students' needs and expectations, thereby promoting a positive and conducive setting for their activities. The standard deviation, measured at 0.889, is relatively low, signifying a tight clustering of responses around the mean. This implies a strong level of agreement among the students regarding the adequacy of the visual environment. In other words, the students' assessments are consistent, with few outliers or extreme differences in opinion.

Table 3 Acceptability Analysis

No.	Item	Mean	Standard Deviation
1.	At this moment, the visual environment is acceptable.	4.306	0.889

This overall positive perception suggests that the lighting configuration and general room setup have successfully achieved a balance between aesthetic appeal and functionality. Good lighting is critical for tasks such as reading, writing, and prolonged focus, while a well-organized room layout enhances comfort and ease of movement. These factors, when combined, likely contribute to the high acceptability rating and consensus among students. Moreover, the findings point to the effectiveness of the current design in meeting both practical and psychological needs. A visually acceptable environment not only supports physical activities but also fosters a sense of well-being, which can positively influence students' productivity and satisfaction. This data reinforces the importance of maintaining and potentially refining such environmental features to ensure sustained or improved user experience.

While the current visual environment is generally perceived as acceptable, there remains room for improvement to further optimize comfort and sustain high standards over time. Enhancements such as ensuring uniform light distribution and addressing potential issues with glare could significantly contribute to a more comfortable and functional environment. These adjustments are particularly important as they help to minimize eye strain and improve overall visibility throughout the room [13], ensuring a more balanced and conducive visual experience for all users. Moreover, by fostering a positive learning atmosphere through thoughtful lighting design, educators can play a pivotal role in supporting students' focus and engagement throughout the school day. Research by [14] highlights the importance of well-designed lighting in maintaining students' attention and productivity. Proper lighting not only reduces distractions caused by poor visibility or discomfort but also creates an inviting and motivating environment that encourages active participation and sustained concentration.

Integrating these strategies into the current visual environment can enhance not only the physical comfort of students but also their cognitive and emotional well-being. Over time, this comprehensive approach to lighting and room design can help maintain a high level of satisfaction and promote an environment that fully supports educational objectives.

V. CONCLUSION

The results indicate that the current lighting setup in the room is well-received by students, with high ratings across all aspects of comfort, including color, brightness, even light distribution, and minimal glare. The strong consensus and low variability in responses reflect that the lighting environment effectively supports student comfort, contributing to a positive and visually pleasant atmosphere. Students generally find the lighting

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color and brightness levels appropriate, the light distribution balanced, and the glare manageable, which are all crucial elements for maintaining focus and reducing eye strain. The positive rating of the overall visual environment as "acceptable" further confirms that the lighting conditions align well with students' needs.

These findings suggest that the room's lighting setup is successfully optimized for comfort, creating a conducive learning environment. Minor adjustments to ensure consistent uniformity and continued monitoring can maintain and enhance this positive experience, keeping the environment adaptive to any evolving student preferences.

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A Concept Paper: The Role Of Artificial Intelligence In Promoting International Baccalaureates Students' Essay Writing Skills Using Self-Regulated Learning Model (SRL)

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Abstract

Academic essay writing and artificial intelligence (AI) such as ChatGPT and Gemini converge to establish a revolutionary intersection in education, each refining and reforming one another. AI improves academic writing by providing dynamic, interactive learning environments and individualised educational experiences through cutting-edge technologies and adaptable learning methodologies. The purpose of this study is to explore the role of ChatGPT and Gemini in academic essay writing from the perception of the International Baccalaureate Diploma Programme (IBDP) students. To meet these aims, this research builds upon Zimmerman's Cyclical Model of Self-regulated Learning (SRL) and a quantitative approach involving 600 respondents from Kolej MARA Banting (KMB), Malaysia, to gain insight into students' attitudes towards AI tools in writing academic essays that reflects their essay writing skills. This study follows the Zimmerman's Cyclical model of self-regulated learning which serves as the foundation hypothesis by outlining three recursive stages planning, performance and reflection. PLS-SEM measurement is proposed as the method to be used for this research as it has several formative indicators that to be analyzed. Hypotheses testing using 5000 samples through replication bootstrapping approach to test the non-parametric PLS estimation. This includes tests to determine the f2 value, VIF and P value for the internal model. Findings predicted that the use of ChatGPT and Gemini will enhance students cognitive and metacognitive skills consists of planning, performance and reflection indicators. ChatGPT and Gemini will help to enhance student's essay writing process through idea generation, organization of points, develop sentence elaborations and making conclusions. Findings will also indicate the reception of how well AI-powered writing tools are received in the essay writing skills of IBDP students and demonstrates how AI helps students in metacognition to a considerable extent. Ultimately, the findings suggest that AI helps promote essay writing skills using the Self-Regulated Learning Model and it is beneficial to provide creative and interactive learning experiences. It is recommended for future research to design practical hypotheses, construct and analyze the possible indicators from qualitative or mixed method approach.

Keywords **:** *AI tools; Chatgpt; Essay writing; Gemini; Self-regulated learning; Self-assessment*

I. INTRODUCTION

Essays have been a component of academic evaluation since the early 1800s, when students at several European colleges were expected to compose intellectual articles for seminar discussions [44]. New students in writing English essays are often confused about how to begin writing because of difficulties in presenting ideas, word choices, organizing sentences effectively, and making errors in spelling [67]. Artificial Intelligence (AI) are portable and accessible on mobile devices hold promise for helping students develop and enhance writing abilities that are hard to learn from traditional training [46], [57], [30]. As AI is a field of computer science dedicated to solving cognitive issues related to human intellect, such as understanding, problem-solving, and pattern identification [4]. A revolutionary integration in education occurs when academic essay writing and AI converge, enhancing and modifying one another [7], [49].

Particularly, pre-university International Baccalaureate Diploma Program (IBDP) students ought to demonstrate an advanced level of writing proficiency as their assessments require producing a variety of intricate both official and informal

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writings [1], [69], [58], [62]. This curriculum is a well-known learning program that promotes international mindedness in learners that comprises international understanding, multilingualism, and global engagement [13], [5]. This formed skill, particularly cognition and metacognition, fall under the umbrella of a nexus that is Self-Regulated Learning (SRL) [36], [21]. Cognitive are skills that require the elaboration and organisation of information which plays an essential role in the processing and retention of new information, connecting it to prior knowledge so that it can be easily retrieve it for later [22]. While metacognitive skills are routines that students use to organise, track, and assess their cognitive processes, such as performing a task analysis of an issue or skimming a text before reading it assists students in preparing for an analytical approach to learning [60]. As a result, other innovative AI dialogue systems and Chat Generative Pre-Trained Transformer (ChatGPT) and Gemini have transformed the field of education owing to their vast knowledge base and exceptional conversational language interaction capabilities [69]. Along with offering significant support in the educational process, AI opens up new opportunities for creative approaches to evaluation [68]. This study aims to provide an integrated overview of AI adoption tools which are ChatGPT and Gemini on essay writing skills among students enrolled in the International Baccalaureate Diploma Program at Kolej MARA Banting (KMB). And complementing it with the Zimmerman's model of self-regulated learning theoretical framework as a lens in discussing the role of AI in essay writing skills.

AI tools such as ChatGPT and Gemini have been extensive research subjects in recent years and have been successfully used in various fields, including education, where they hold great promise for improving and enhancing the teaching and learning process. However, there hasn't been much research on how these prospects are achieved in the context of imparting academic writing [50]. Thus, this study tackles the issue and presents the findings of an analysis of AI's potential in essay writing among the IBDP students at KMB.

II. LITERATURE REVIEW

1) Artificial Intelligence in Education

The integration of AI and education has become increasingly emerged as a subject of interest [64]. The current use of AI and the potential advancement of AI applications can significantly transform the education industry and support international students [50], [43], [61], [70]. By decrypting students' clickstream data, AI analytics allows teachers to gain insight into students' performance, progress, and potential [37]. AI-powered tools have the potential to enhance a student's learning progress by automating a tracker of skills that need improvement and alerting a human teacher to assist them [42]. It has been demonstrated that using learner-centred AI tools, like ChatGPT and Gemini, increases the learning experience and may result in better learning outcomes for international students by creating unique and tailored content according to their skills and needs [64], [16].

2) Essay Writing Skills among IB Students

English academic writing is a complex, necessary, and integrative endeavour that native and international students find challenging [46]. Academic essay is an intensive endeavour involving comprehensive study, structured argumentation, and coherent writing to advance academic discussion. Students must immerse themselves in fundamental ideas that are essential to scholarly writing in order to establish the foundation for excellent writing [7]. The rigorous nature of IB assessments, including internal assessments, examinations, Theory of Knowledge (TOK) and the Extended Essay (EE), ensures that students engage in meaningful experiences that broaden their worldview and equip them with the skills to communicate and collaborate effectively across cultural boundaries [25]. A research study involving 58 IBDP alumni examined their satisfaction with their writing abilities after completing a two or four-year post-secondary program. The findings revealed that the IBDP significantly contributed to developing their writing skills, making it easier for them to succeed in college courses [65].

3) Use of Artificial Intelligence in Essay Writing

Writing for academic purposes may be challenging, emotional, and complicated [46]. The ability of advanced AI writing tools such as ChatGPT and Gemini to quickly generate content enables writers and content producers to compose lengthy documents with impressive efficiency [26]. Since these writing tools are helpful for students when it comes to providing instant feedback and improving writing abilities [29], have demonstrated how these tools boost students' writing skills and sense of self-efficacy.

However, it is pointed out that more developments in AI technologies are needed to enhance students' conceptual comprehension and efficiency in a variety of academic domains [18]. Concerning ethics, analysing the impact of ChatGPT and Gemini on plagiarism detection, highlighting the need for clear regulations, and teaching students about the limitations and proper use of AI [24]. Furthermore, ChatGPT and Gemini

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have proven to promote originality in essay writing [69], [58], [62], presenting fresh perspectives on the potential applications of AI beyond mere encouragement [7], [49].

Figure 1 below illustrate the process of how ChatGPT and Gemini assist student's essay writing process. The first step starts with students inserting an appropriate prompt text to generate the content based on the interest keywords and issues. Once the main content was developed, student will further regenerate the ideas to get further exploration of concept and discussion. All points and ideas will be compiled and organize to develop the essay writing. Final step is to do assessment on grammar and paraphrasing the sentences before the final essay writing. Throughout the process, student will learn on how to be creative to produce a good essay. These process also will benefit the students to be smart to use the technologies and time-savvy.

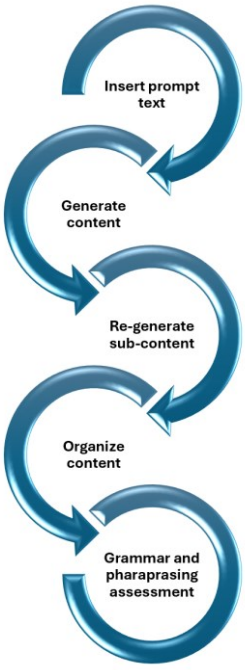

Figure 1 Essay writing process with the use of ChatGPT and Gemini

4) *Self-Regulated Learning (SRL)*

This study follows the Zimmerman's Cyclical model of self-regulated learning (2000). It serves as the foundation for this study's hypothesis by outlining three recursive stages that facilitate self-regulated learning: the forethought phase (planning), the performance phase (doing) and the self-reflection phases (reflecting), making it in accordance with the aim of this study, which is to investigate the way IB students engaged in promoting their essay writing skills, mainly cognition and metacognition, through the use of ChatGPT and Gemini [36], [48], [59].

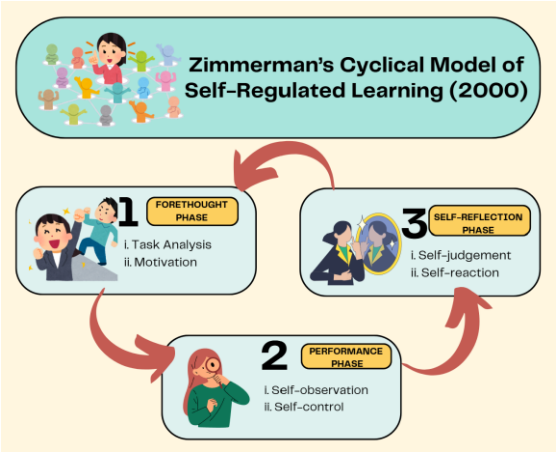

Figure 2 Self-developed graphical process adapted from Zimmerman's Cyclical model of self-regulated learning (2000)

A. *The Forethought Phase*

The initial phase involves the students approaching the work, analysing it, determining their ability to execute it successfully, and designing strategies and goals on how to do it. The students complete two primary tasks during this phase. First, they start by analysing the characteristics of the task and developing a preliminary model of how it ought to be completed. Second, they condition their motivation and effort by analysing the task's value to them [19].

i. Task Analysis

The self-regulatory cycle starts with the task analysis where this is fragmented into smaller pieces and the personal strategies [54], [43]. In this phase, goal-setting and strategic planning are established as crucial prerequisites for self-regulation. While establishing their goals, students consider two key factors: the performance level they aim to achieve and the assessment criteria [5], [46].

The standards that will be used to evaluate the performance are known as the assessment criteria (e.g., a criterion for a summary must include the primary idea from the material summarises). The second component that influences goal setting is the student's intended level of performance, which interacts with the assessment criteria [46], [55]. For instance, achieving an exceptional performance is not the aim, and the student shows little interest in the activity. This student will perform mediocrely since they don't value the task enough to put in the effort required for a high level. By selecting the

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tactics required to complete the job, strategic planning creates an action plan. Whereby planning is a crucial self-control mechanism and a reliable indicator of success [12]. According to research, the former spend more time planning, which is crucial for their higher achievement [34], [8], [19]

ii. Self-Motivation

Learners foster their motivation by addressing variables such as self- efficacy and outcomes expectations [11], [46]. The first refers to the individuals' convictions about their ability to succeed in completing tasks [2], [47].and the second entails expectations about the success of a learning activity [10], [19]. In a word, the higher these convictions and expectations, the more a learner becomes motivated to make the necessary efforts to deal with the task [36].

B. *The Performance Phase*

In this performance phase, students must maintain focus and employ suitable learning techniques mainly for two reasons. First, to ensure they remain motivated, and second to monitor their advancement towards their objectives. Both entail distinct behaviours and procedures that vary based on the self-regulation methodology employed. [9] state that self-observation and self-control are the two primary processes that occur during the performance [19].

i. *Self-Observation*

There are two kinds of actions that students may perform to be able to successfully self-observe: cognitive actions and acts which need external support. Self-monitoring, sometimes known as metacognitive monitoring or self-supervision, is the first type of exertion. Self-monitoring involves assessing the quality of the process, followed by comparing the quality that is produced originally with detailed criteria [53].

The second action type that encourages self-observation is self-recording, which involves encoding the activities performed throughout a performance. Following the completion of the activity, it is an external method to help monitor and enhance reflection. Students can use self-records to identify things that could have previously gone unnoticed [19].

ii. *Self-Control*

Self-control includes metacognitive and motivational strategies aimed at maintaining concentration and motivation such as self-instructions and help seeking [11]. In simpler terms, learners need to remain motivated and focused to accomplish their goals; thereby, they may give themselves instructions to raise their interest in the task and focus on their goals. Further, they may consult a more knowledgeable source for assistance (e.g., instructor, peer, parent...) [42], [15].

C. *The Self-Reflection Phase*

Throughout this phase, students evaluate their work and create arguments on their findings. The individual's feelings, good or bad, depend on their sense of style and how they defend their achievements or shortcomings. These emotions will impact their drive and self-control in the future [19].

i. *Self-Judgement*

Students assess their performance using a process known as self-judgment, which compromises Self-evaluation and causal attribution. Students utilise self-evaluation to assess their performance about the assessment criteria and their desired performance level [61]. For students to develop the ability to evaluate themselves using the assessment criteria, teachers must provide opportunities for reflection on their mistakes [9], [20], [6]. In contrast, students' self-explanations regarding the reasons for their success or failure in a task are referred to as causal attributions. Since the attributions are based on success or failure, as discussed in the next section, they trigger emotions that affect motivation and expectations for future task performance [19].

ii. *Self-Reflection*

According to Zimmerman and Moylan (2009), the principle of the process is to take into account two when talking about self-reaction: self-satisfaction/affect and adaptive/defensive decisions. Self-satisfaction is when students evaluate themselves according to their subjective and cognitive reactions [9], [15]. This process has been extensively researched: acts with favourable results enhance motivation for future performance, while actions with negative outcomes avert the task [3], [56]. Making defensive or adaptive judgements to achieve better results is the second phase. Students who make adaptive decisions are willing to repeat the activity, whether they employ the same strategies or attempt new ones [19].

5) Cognitive Skills

The integration of Artificial Intelligence (AI) tools into modern education presents a significant opportunity to enhance cognitive skills development, particularly in critical thinking [23]. ChatGPT and Gemini can analyze student performance and provide customized support, ensuring that each learner receives instruction that is aligned with their proficiency level and learning style [23], [17], [31]. Fundamental cognitive capabilities allow students to comprehend information, solve issues, and make decisions. For students to thrive academically and in their future

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employment, it is imperative that they develop these skills. ChatGPT and Gemini can create innovative approaches in improving the development of cognitive skills, especially in the areas of analytical reasoning, problem-solving, and critical thinking [17], [31]. AI tools play a major role in the development of cognitive skills through creating dynamic and interactive learning environments.

6) Metacognitive Skills

The metacognition is crucial for learning because students must understand the requirements of their assignments and objectives, as well as how to employ methods and what is needed to accomplish those requirements [33], [35]. Metacognitive abilities are believed to be crucial for identifying reliable information and for independent, lifelong learning [35], [52]. In education, metacognition is essential because it helps students become self-aware, introspective, and capable thinkers. Examples of exercises that teachers can use to promote critical thinking and metacognitive abilities are covered, including constrained choice tasks and metacognitive prompts. Furthermore, generative AI tools like ChatGPT and Gemini can be integrated to produce engaging and customised learning experiences that promote metacognitive reflection and standardise the growth of critical thinking abilities [33], [35], [52], [28]. By integrating these tools into the classroom, teachers can track student progress, create customised learning materials, encourage group discussions, give personalised feedback, and assess their own teaching methods.

III. PROBLEM STATEMENT

The use of AI in writing essays has become a necessity and is considered a facilitation tool that not only saves a lot of time but also facilitates the process of composing and forming interesting sentences [45], [23]. Among the frequently used applications are ChatGPT, Gemini, Jasper AI, Quillbot, Grammarly, Copy.ai and Notion AI [40]. However, to what extent can this AI application improve the quality of students in planning and producing quality essay writing? Can this AI application help improve students' performance and skills? In these proposed research, two most commonly used AI writing tools will be used for analysis which are ChatGPT and Gemini. In order to use these AI tools, student needs to be proficient in terms of understanding and should have knowledge in operating the application. In addition, appropriate skills are required for students to master the technology while complying with the technological and AI etiquette [38], [23], [17], [31], [28], [35].

Self-regulated learning is believed to help in evaluating and measuring the level of students' skills and competence in writing essays [39]. SRL is also expected to be used as a reference for self-reflection that helps students to assess their own strengths and weaknesses in the use of AI for essay production [41]. It can also provide references for improving the skills and competencies required by students. By adapting the Zimmerman's Cyclical model of self-regulated learning (2000), thus the research question was developed;

RQ: To what extent does ChatGPT and Gemini assist IB students engaged in essay writing in deploying their metacognitive abilities to perform academic tasks?

The following hypotheses are suggested as answers to the previously mentioned research question:

H_1: The use of ChatGPT and Gemini will engage students and influence the planning process of essay writing

H_2: The use of ChatGPT and Gemini will engage students and influence the performance of essay writing

H_3: The use of ChatGPT and Gemini will engage students and influence the students' self-reflection

IV. CONCPETUAL FRAMEWORK

Figure 3 illustrate a conceptual framework on how the AI were predicted to help student engagement and influence the student's essay writing based on three indicators which are the planning process, the performance process and the self-reflection process.

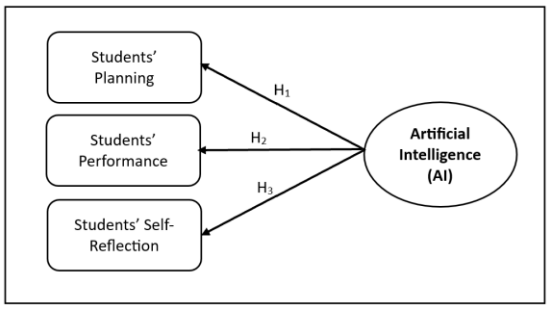

Figure 3 Conceptual Framework

V. PROPOSED METHODOLOGY

This research will investigate on how AI contributes to the enhancement of SRL among IB Diploma students in Kolej MARA Banting, Malaysia. A quantitative approach has been adopted to conduct this study by collecting and analyzing data involving 600 respondents. Questionnaire developed and employed to report on student's thought, assumptions, perceptions, and decisions with regards to the use of AI applications and software to

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promote their cognitive and metacognitive thinking. The data collected were then analysed using the SEM-PLS measurement software to test the hypothesis formed. The bootstrapping method was used to test the constructed hypothesis because it is a non-parametric method that can determine the accuracy of PLS estimation [4]. This PLS and bootstrapping method is recommended in the structuring model using an estimate of 5000 samples through replication to examine the research hypothesis. This includes tests to determine the f2 value, VIF and P value for the internal model [66], [27].

VI. DISCUSSION

This study sought to delve into the impact of AI tools which are ChatGPT and Gemini in assisting language learning on the essay writing skills of International Baccalaureate students. To provide a comprehensive analysis of this research, a quantitative method using SEM-PLS method will be used. Hypotheses will be tested to yield a significant insight, revealing substantial enhancements in the IB student's essay writing for both cognitive and metacognitive aspects in which later categorized into three dimensions: student's planning; student's performance; and student's reflection [14], [23], [17], [31], [28], [35]. Results will generate empirical report on how ChatGPT and Gemini will help to enhance student's essay writing process through idea generation, organization of points, develop sentence elaborations and making conclusions.

VII. CONCLUSION

Although generative AI such as ChatGPT and Gemini has the potential to offer students highly customised and interactive learning experiences, its incorporation into educational practices must be approached responsibly and ethically, with the assistance of the Self-Regulated Learning (SRL) theoretical framework [32]. The framework has tended to examine how AI tools plays a role in enhancing the International Baccalaureate (IB) students' essay writing skills. In this study, we have explored and expanded on how students of the IB Diploma at Kolej MARA Banting (KMB), Malaysia, adopted the facilitation tools of AI in their proficiency of understanding knowledge in applying essay writing and academic tasks.

Based on the SRL framework, the study has presented a generalised Zimmerman's Cyclical model of self-regulated learning (2000) that abstracts three recursive phases that support self-regulated learning: the forethought phase (planning), the performance phase (doing) and the self-reflection phase (reflecting), suggesting ways in which helps students evaluate and measure their skills and competence in essay writing with the presence of AI. It is predicted that the use of artificial intelligence will engage students and influence the planning process, the performance and the students' self-reflection in essay writing. This will provide an empirical evidence and have significance impact towards the teaching and learning methodology that can be practiced by the educators.

The given work is also intended to serve as a guide serve as a guide for future research and design, helping others to navigate this vast space design, constructing practical hypotheses, and distinguishing between essentially distinct types of combination methods.

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Factors Influencing Personal Financial Management Behaviour Among Polytechnics Student

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Abstract

Nowadays, students must have effective personal financial management. Managing resources and making informed decisions has become a pressing challenge in daily life. Historically, human consumption was focused solely on meeting basic necessities. In the current scenario, it is crucial for everyone to demonstrate sound financial management practices. This study surveyed 150 Diploma in Accountancy students at Polytechnic Sultan Abdul Halim Muadzam Shah, (POLIMAS), Jitra, Kedah and this research aims to identify whether the financial attitudes and parental financial behaviour influence the personal financial management behaviour among students in Commerce Department, POLIMAS. The data was obtained using google forms consists of 4 parts: demographic, financial management behaviour, financial attitudes and parental financial behaviour. Data were analysed using the program Statistical Package for Science (SPSS) version 26. From the data analysis, parental financial behaviour was found as the most significant factor (mean=3.25) compared than financial attitudes (mean=3.22) affecting students' financial management behaviour. Consequently, this research aims to raise awareness among students about the importance of financial management practices

Keywords **:** *financial attitudes; parental financial behaviour; personal financial management behaviour;*

I. INTRODUCTION

Everyone faces significant challenges in daily life that require careful resource management and decision-making. As a result, individuals often have to prioritize one interest over another. In the past, humans consumed primarily to meet their basic needs. Nowadays, it's essential for everyone to demonstrate effective financial management, particularly students in universities or any financial institutions. Strong financial management skills can help students avoid debt, plan for future investments, set clear financial goals, and develop practical money management abilities.

Many students rely on loans to finance their college education, but some may end up borrowing more than necessary. This excess borrowing can lead to debt that must be repaid after graduation, hindering the achievement of other financial goals. With the right educational support on independent living, students can minimize their risk of accumulating unnecessary debt from educational loans. Typically, young adults learn financial skills from their parents and teachers during childhood.

However, parents often neglect to teach essential financial skills like budgeting, spending and saving while their children are still at home. As a result, many students are left to navigate money management on their own once they enter college, leading to mistakes that could result in years of loan repayment.

Financial management is defined as "the art and science of managing money, utilizing economic theory and accounting principles to achieve both individual and organizational goals" (Abdul-Rahman & Zulkifly, 2016) [1]. It involves a complex series of decisions and actions, influenced by the specific demands of the task and the skills and abilities of those involved. Azmi and Othman (2017) emphasize the importance of understanding financial management, particularly for students, as Nordin et al. (2022) highlight that college often serves as the setting where students acquire financial management skills [2],[3]. This underscores the necessity of effective and innovative money management strategies for college students, which should not be overlooked.

II. PROBLEM STATEMENT

For many students, college represents their first experience of financial independence without parental supervision. They often struggle with managing their finances effectively and lack the

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skills to handle their own money. Additionally, they may not ensure that their funds are spent wisely and avoid misuse. These challenges are common among students trying to balance tight budgets with living expenses. In higher education, students face greater financial demands compared to primary and secondary school, with costs for books, food and beverages, tuition fees, accommodation, transportation, and telecommunications.

According to Barr and McClellan (2018), the pressures of living in higher education institutions and contemporary financial demands are quite significant [4]. As the economy has worsened, more students have sought financial aid for their education. Therefore, it is essential for students to manage their finances wisely. A study by Yong et al. (2018) reveals that the financial management rate in Malaysia is approximately 36%, compared to 59% in industrialized countries [5]. Lim (2019) notes that Malaysian students are among the contributors to the nation's substantial debt and severe financial challenges [6]. Higher education students, primarily young adults, are trying to prepare for the difficulties they will face beyond campus life.

Therefore, the main objective of this study is to gain a deeper understanding of how financial attitudes and family influences affect the financial management behaviour of Polytechnic students.

III. LITERATURE REVIEW

A. Personal financial management behaviour

Financial management is defined as "the art and science of managing money, utilizing economic theory and accounting principles to achieve both individual and organizational goals" (Abdul-Rahman & Zulkifly, 2016) [1] . Polytechnic students, in particular, face unique financial challenges due to the demands of their academic programs and the need to balance work, study, and personal expenses. (Heckman et al., 2014) [7]. Nordin et al. (2022) define financial management behavior as the allocation, distribution, and utilization of financial resources aimed at achieving personal goals (Chuah et al., 2020) [3], [8]. Barr and McClellan (2018) assert that the pressures of college life and financial responsibilities affect students' financial well-being [4].

Sina and Noya (2012) suggest that one way to develop a financial personality is by enhancing personal financial management behaviors through effective financial planning and self-control [9]. Experts indicate that individuals who practice good financial management are more likely to comprehend the dynamics of financial arrangements. They typically demonstrate self-organization, follow their initial plans even when situations shift, tackle financial challenges, and maintain awareness of their overall financial situation. This study examines how students manage funds received from scholarships, pocket money, or educational loans for further studies.

B. Financial attitudes

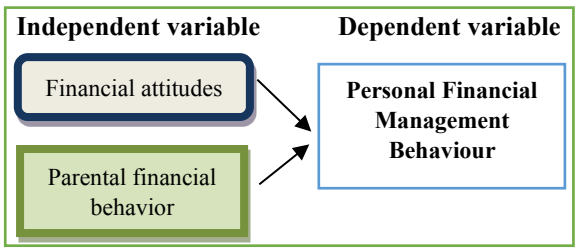
An individual level of education, particularly when it is relevant to daily life, influences their financial attitude. Listiani (2017) indicates that a positive financial attitude is closely linked to effective money management behaviors; thus, the more individuals can implement this mindset, the better their financial management will be [10]. Previous studies highlight two critical factors that encourage the adoption of sound financial management practices: gaining solid financial education within the family and consistently fulfilling financial obligations in everyday life. These elements can help prevent students from facing challenges in managing their finances effectively.

C. Parental financial behaviour

Parental financial behavior play a significant role in shaping students' financial management behavior. Financial education within the family has a positive and significant effect on students' financial management behavior, helping them resist peer influence and control their financial actions (Mufida & Sholikhah, 2022) [11]. The family environment also positively impacts financial management behavior among university students (Kamila et al., 2021) [12]. Parental income shows a significant positive influence on students' financial management behavior (Junita & Aslamiyah, 2024) [13]. Norvilitis and Maclean (2010) further argued that college students' financial issues, such as credit card debt, are closely linked to the influence of their parents. [14]. These studies highlight the importance of early financial education within families, as it benefits children in managing their finances effectively.

D. RESEARCH FRAMEWORK

Figure 1 Research Framework



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Based on the literature review, the above conceptual framework illustrates the independent variables of financial attitudes, and parental financial behaviour influences the students' financial management behaviour.

IV. OBJECTIVE OF THE STUDY

A. General Objective

To identify the factors that influence personal financial management behavior among Polytechnic Sultan Abdul Halim Mu'adzam Shah students.

B. Specific Objective

i. To identify whether financial attitudes influence personal financial management behavior of students.

ii. To identify whether parental financial behaviour influence personal financial management behavior of student.

METHODOLOGY

This study is conducted at the Commerce Department of Polytechnic Sultan Abdul Halim Mu'adzam Shah in Jitra, Kedah, with a primary focus on the various factors influencing personal financial management behaviour among Diploma in Accountancy students. Additionally, the research aims to investigate the significance of financial attitudes and parental financial behaviour on the personal financial management behaviour of these students.

This research was conducted on 150 students consisting of First semester until Final semester. Diploma in Accountancy students in Commerce Department. According to Krejcie and Morgan (1970), 150 individuals make up the sample from a population of 240 people, as a result 150 people, which represents a total of 240 Diploma in Acountancy students in semester 1 2023/2024[15].

The primary data were obtained from distributing questionnaires online to respondents using self-administered questionnaires to gather data on the influence of financial attitudes, and family influence on student's financial management behaviour.The data was obtained using google forms consists of 4 parts: demographic, financial management behaviour, financial attitudes and parental financial behaviour. Data were analysed using the program Statistical Package for Science (SPSS) version 26.

V. DATA ANALYSIS AND FINDINGS

A Data Analysis

The questionnaires were distributed to 150 POLIMAS students from Diploma in Accountancy to examine the influence of financial attitudes and family factors on their personal financial management behavior. Thirty questions using Likert-type scales (1 = strongly disagree; 4 = strongly agree) were administered among the students.

Based on Figure 2, the pie chart below shows that female's respondent is more than to the male respondents. The percentages of male are 30.7 % while female's respondent is 69.3 %. Therefore, the range between both genders is 38.6 %.

Based on Figure 3, the bar chart below shows that Malay's respondents are the highest compared to Chinese, Indian and others category of respondents. The percentages of Malay are 73.3 % while Chinese respondents are 11.3 %, Indian are 10.7 % and others are 4.7 %.

Based on Figure 4, the bar chart below shows that group age of respondent from 21-25 years are high compared to the others group age of respondents. The percentage of 20 and below is 48 %, from 21-25 is 48.7 %, from 26-30 is 3.3% and 30 and above is 0 % respectively.

Based on Figure 5, the bar chart below, it shows that single respondents are higher compared to married respondents. The percentage's of single is 95.3 % and married respondent is 4.7 %.

Based on Figure 6, the bar chart below, shows that the respondents with none working experience is higher compared to the student who have less than 2 years, two to less than 4 years, four to less than 6 years and six years or more working experience. The percentage of none is 46.0%, less than 2 years is 43.3%, two to less than 4 years is 8.7%, four to less than 6 years is 2.0% and six years or more is 0% respectively.

Based on the Figure 7, bar chart below, it shows that the high school or equivalent category is the most popular father's level education of the respondent and the percentage is 44.0% compared to others.

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Based on Figure 8, the bar chart below, it shows that the high school or equivalent category is the most popular mother's level education of the respondent and the percentage is 41.3% compared to others.

Based on Figure 9, the bar chart below, it shows that respondents mostly get student loan from their parents compared to others category. It can see from the higher percentages of mostly parents which is 21.3%.

Figure 2 Pie Chart of Respondent by Gender

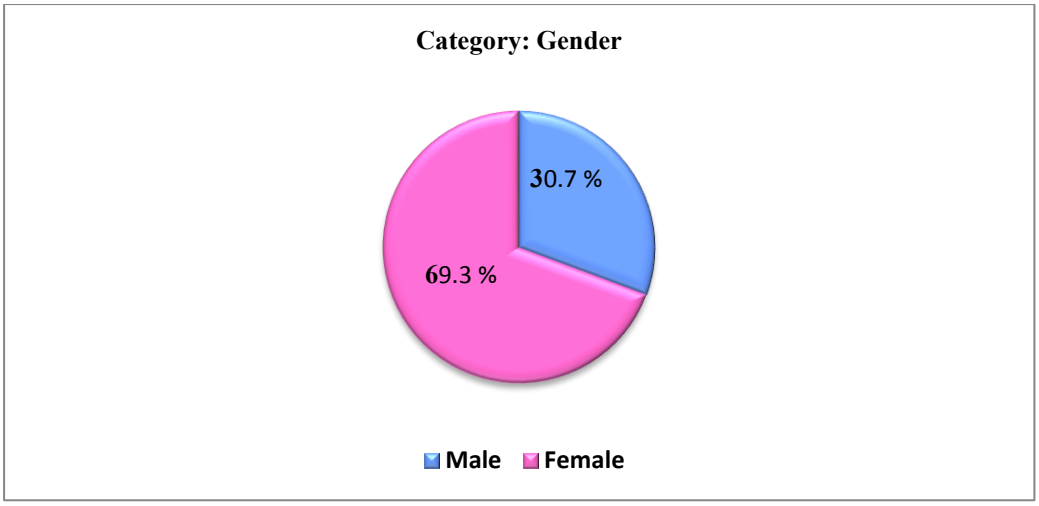

Figure 3 Bar Chart of Respondent by Race

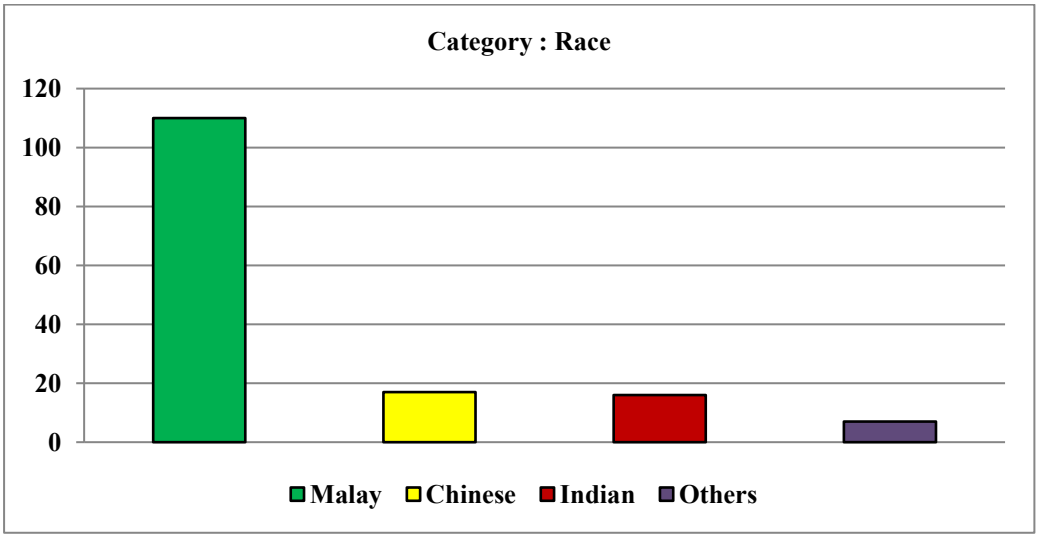

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Figure 4 Bar Chart of Respondent by Age

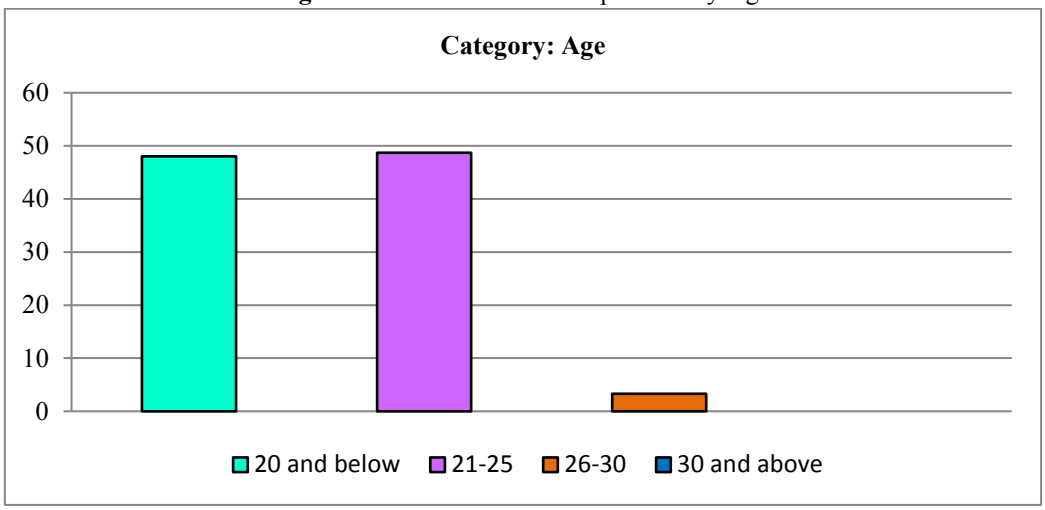

Figure 5 Bar Chart of Respodent by Marital Status

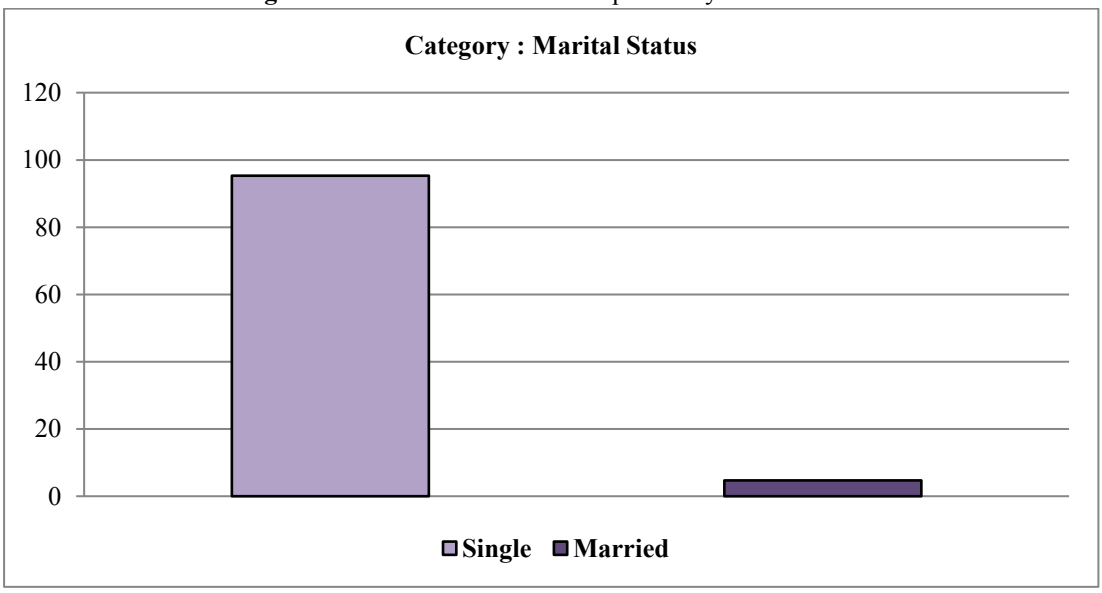

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Figure 6 Bar Chart of Respondent by Work Experience

Figure 7 Bar Chart of Respondent by Father's Level of Education

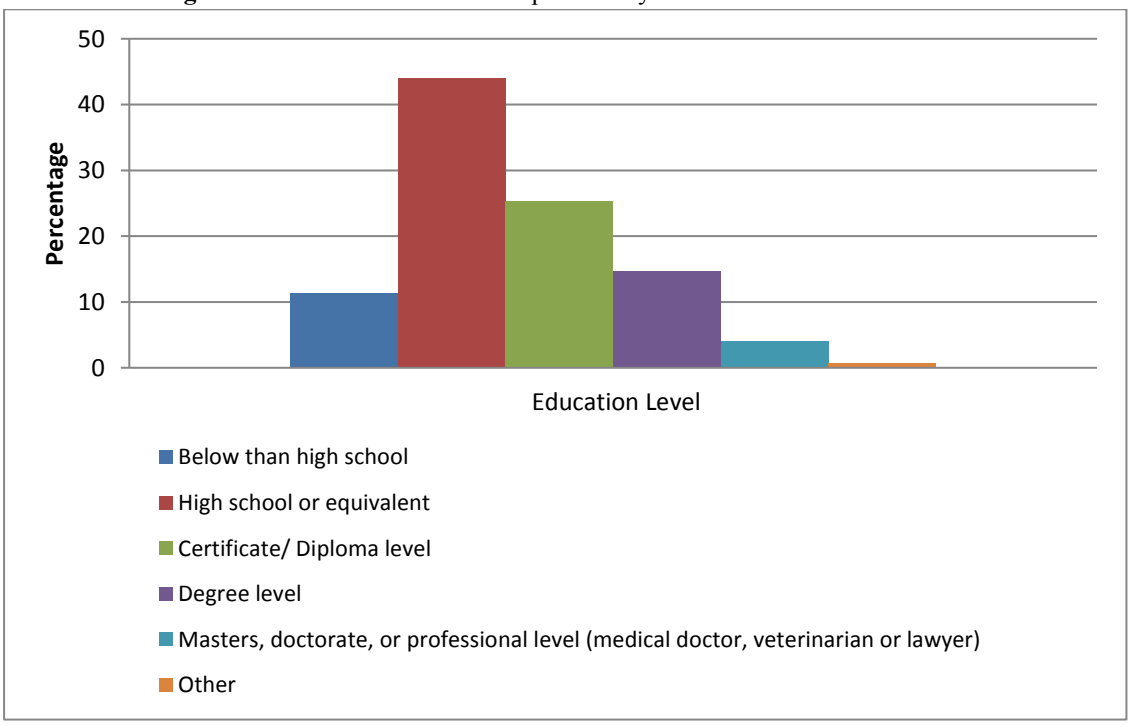

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Figure 8 Bar Chart of Respondent by Mother's Level of Education

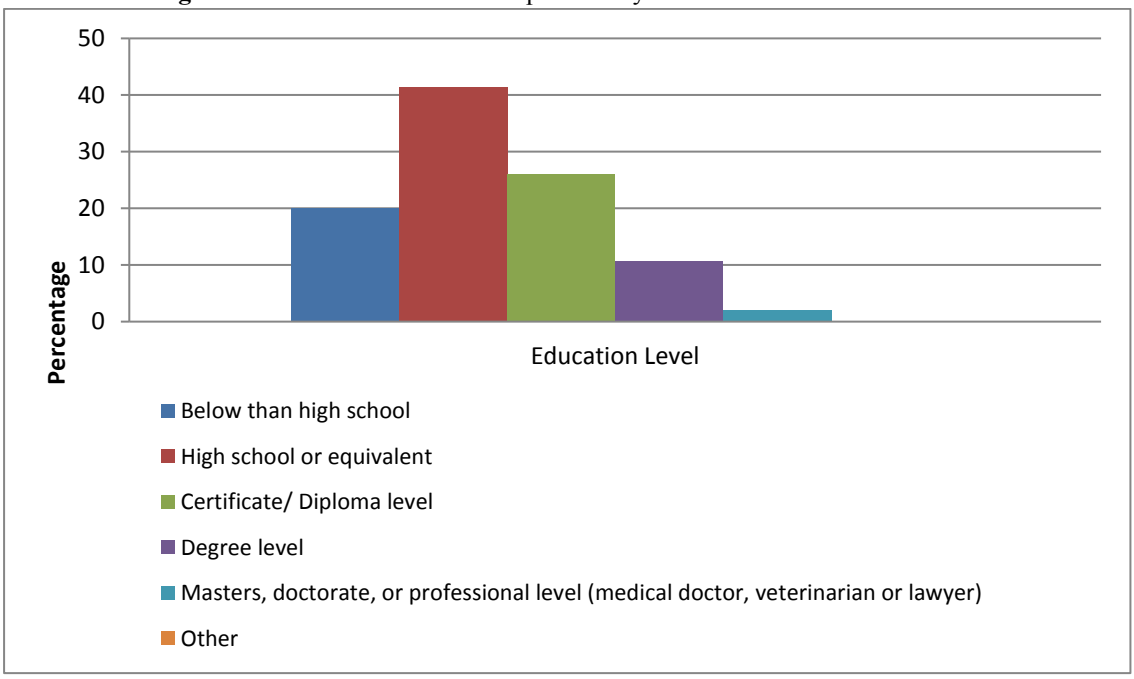

Figure 9 Bar Chart of Respondent By Financial Sources

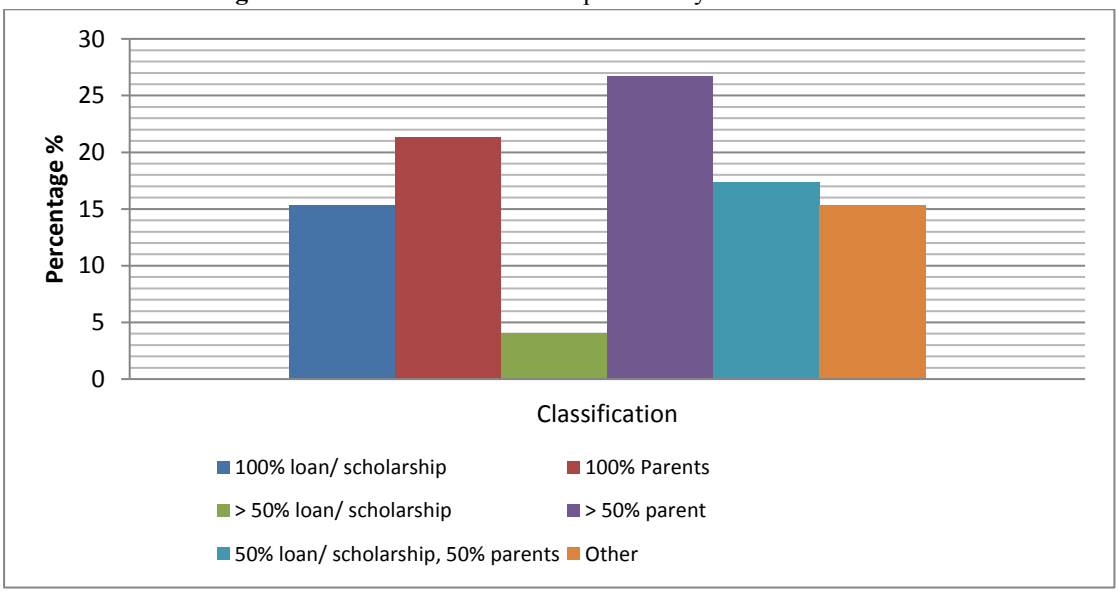

Table 1 Financial management behaviour

No	Items	Mean	Std. Deviation	Cronbach- Alpha Coefficient
1	I compare price when shopping for purchases.	3.46	0..631	0.728
2	I budget and track spending	3.37	0.738	
3	I contribute to savings account regularly.	3.26	0.823	

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4	I read to increase my financial knowledge	3.17	0.847	
5	I have a life insurance policy.	2.87	1.032	

Table 2 Financial attitudes

No	Items	Mean	Std. Deviation	Cronbach- Alpha Coefficient
1	I am certain about where my money is spent.	3.35	0.725	
2	I plan and implement regular savings.	3.31	0.770	0.797
3	I am able to manage my own finance	3.27	0.682	
4	I am interested in increasing my financial knowledge.	3.27	0.644	
5	I always maintain adequate financial records	3.24	0.792	
6	I always spend less than my budget.	3.07	0.946	
7	I would take a personal finance course as an elective if offered.	3.02	0.831	
8	I am accountable for my own financial well being	3.26	0.823	
9	I read to increase my financial knowledge	3.17	0.847	

Table 3 Parental financial behaviour

No	Items	Mean	Std. Deviation	Cronbach- Alpha Coefficient
1	Comparing myself to my parents, I am more likely to save.	3.34	0.834	0.785
2	I learn most from the following individuals or sources about managing my money: Media	3.31	0.811	
3	I learn most from the following individuals or sources about managing my money: Life experience	3.30	0.663	
4	I learn most from the following individuals or sources about managing my money: Parent	3.29	0.550	
5	My parents included me in various financial decisions	3.28	0.828	
6	I learn most from the following individuals or sources about managing my money: Books	3.20	0.714	
7	I learn most from the following individuals or sources about managing my money: Internet	3.19	0.862	
8	Within the family we openly discussed our finances	3.19	0.862	

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9	My parents explicitly taught me about finance (e.g., credit cards, debt, budgeting, saving)	3.16	0.905	

Table 4 Descriptive Analysis for each variable

No	Variables	Mean Score
1	Financial management behavior	3.2267
2	Parental financial behaviour	3.2504
3	Financial attitudes	3.2190

The finding for students' financial management behaviour showed that the highest mean score is 3.46 while the lowest is 2.87, meaning students have good financial behaviour in relation financial management.

In terms of financial attitude, the highest mean score is 3.35, and the lowest is 3.02, indicating that students generally exhibit positive attitudes toward personal financial management behavior. Table 3 reveals that the highest mean score is 3.34, while the lowest is 3.16, suggesting that parental financial behaviour significantly influences students' personal financial management behaviour.

Overall, the mean score exceeds 3, indicating that participants generally agreed on the factors influencing their personal financial management behaviors among POLIMAS students. The highest mean score, 3.2504, was associated with parental financial behavior, suggesting that parental financial behavior has a stronger influence on students' financial management behavior compared to financial attitudes.

Reliability of coefficient

From Table 1 until 4 above, the Alpha value for financial behaviour is 0.728, financial attitude is 0.797, and parental financial behaviour is 0.785 are "Good". Thus, we can conclude that all items can be combined to measure the influence of personal financial management behaviour in a consistent manner.

Table 5 Reliability of Coefficient

Dimension	No of item	Cronbach' Alpha Conflict
Financial behaviour	5	0.728
Financial attitude	9	0.797
Parental financial behaviour	9	0.785

VI. CONCLUSION

As a conclusion, based on this research, the researcher hopes that this research will help students to manage well the financial to get a better life without thinking any problems that related to financial management problems among students. This study also will give benefits to student because we already find out why students always fail to handle this problem.

The advantages if student can manage their finance well, it will reduce financial management problems and can manage their future finance much better than before. It also can help students to differ the differences between needs and wants and make they more concerned about their needs which is more important than their wants.

At the end, through this business research we can get a final conclusion that is financial management is very important to student to further. If eliminated the financial management, not only effect student cannot get chance for further study, also a big loss of our country.

1.0 ACTION TAKEN

i. Polytechnic Malaysia should implement more effective personal financial campaigns targeting specific groups, with a focus on enhancing understanding of investment planning and learning how to manage finances wisely.

ii. Additionally, the study should investigate how a student's knowledge impacts their views and decisions regarding personal finance management. Often, students prioritize their wants over their needs, so this research will help them distinguish between the two and encourage more frugal habits.

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iii. Most importantly, it is essential to teach students how to control their spending and prioritize necessary expenses. This approach will enable them to save for emergencies and make sound investments in the future. By improving their understanding of personal finance, students can alleviate their financial burdens as consumers down the line.

2.0 RECOMMENDATION FOR FUTURE RESEARCH

i. Future research could be expanded to include students from various programs to examine whether significant differences exist in their planning and spending patterns.

ii. Additionally, a comparative study between commerce students and those from other departments could yield more accurate and comprehensive results regarding students' financial planning abilities and spending habits.

iii. Since the current research primarily focused on family factors, the results may not provide a conclusive prediction of students' personal financial management behavior. Future research should explore other influences, such as peers, relatives, and social media platforms like Tiktok, Instagram and Facebook.

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Transition from Hands-On Learning To A Simulated Learning: An Investigation On Readiness, Challenges And Performance Among Polytechnic Students

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Abstract

The COVID-19 pandemic forced an abrupt shift in learning modalities, requiring students to transition from hands-on practical learning to simulation-based methods. This study investigates the readiness and challenges faced by diploma students at Politeknik Kuching Sarawak (PKS) in adapting to this change, focusing on electronic courses such as Measurement Devices and Electrical Technology. Using a quantitative research design, data were collected from 116 semester 2 and 3 students via a structured questionnaire. Statistical analyses, including t-tests, ANOVA and multiple regression were applied to assess differences based on gender and school learning streams and explore the relationships between readiness, challenges and academic performance. Key findings indicate that while gender does not significantly influence readiness or challenges, variations in school learning streams impact the challenges faced. Readiness was found to be a stronger predictor of academic performance than the challenges encountered. The study underscores the importance of preparatory measures to enhance readiness, such as tailored training programs, to ensure effective adaptation to simulation-based learning. Future research should explore additional factors, such as technology access and institutional support, to provide a comprehensive understanding of this transition.

Keywords **:** *Challenges; Computer Simulation; Hands On Experience; Readiness; Student Achievement*

I. INTRODUCTION

E-Learning is one way of learning methods, where students can learn individually at their preferred time, unlike the traditional classroom learning method. It is home-based and the courses designed can be altered to suit learners' needs and preferences [1].

For engineering course, to achieve an optimum student learning and to develop valuable skills for future employment, engineering courses often complement lectures and tutorials with laboratory classes [2]. A hands-on approach to learning means that the students must interact and involve with their environment to adapt and learn. This can be closely related to psychomotor domain which promotes deeper learning which is becoming increasingly popular as a means of assisting students in developing strong, transferrable knowledge and skills for the twenty-first century.

Politeknik Kuching Sarawak (PKS) students must be involve with cognitive domain (knowledge), psychomotor domain (skills) and affective domain (attitudes). This three domain is in Bloom's Taxonomy which act as guidance for PKS to maintain the accreditation from Engineering Technology Accreditation Council (ETAC).

The COVID-19 pandemic forced an abrupt shift in learning modalities which requires students to do hands-on activities such as practical and lab work in using a simulation software

II. LITERATURE REVIEW

Bloom's taxonomy is a set of three hierarchical models used to classify learning objectives according to levels of complexity and specificity. Cognitive, Affective and Psychomotor.

Psychomotor is used to measure practical and technical skills which includes physical movement, coordination and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. [3]

Practical in electronic are done using simulation software that can be shown in **Figure 1**

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A, B and **C**. **Figure 1A** is the circuit that the students have to connect during the practical and **Figure 1B** and **1C** shows the comparison between simulated circuit and the real-world connection circuit. Software used is ThinkerCAD.

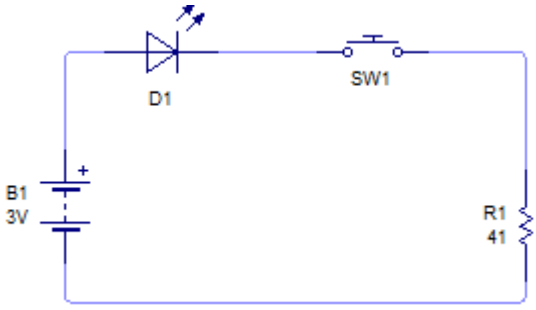

Figure 1A Circuit Schematic that is needed to be created

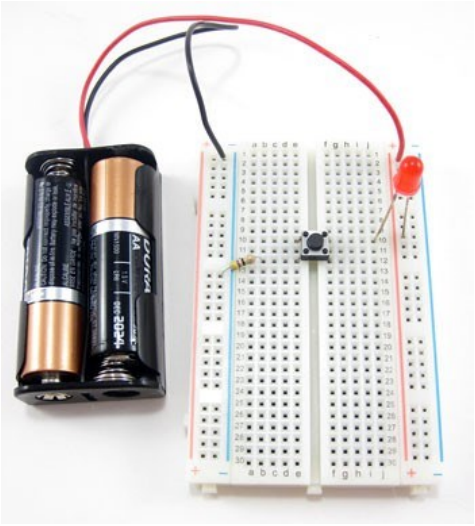

Figure 1B Real world connection

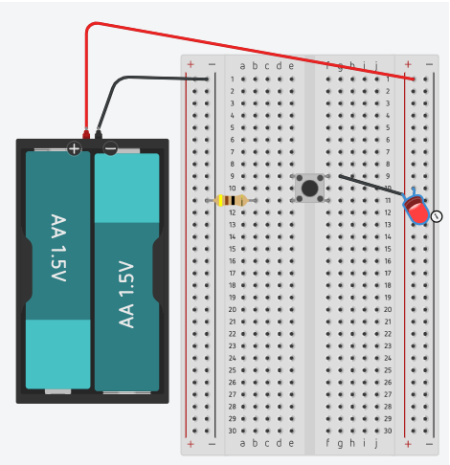

Figure 1C Simulated Circuit

This study will be focusing on the psychomotor domain in which psychomotor has five levels. The imitation level, which starts at the bottom and progresses to the top, is the lowest level, which began as an impulse and can develop through repeated acts. Choosing one action over another, following instructions, and acting correctly are all examples of manipulation. Precision relates to how quickly and precisely learners can control their activities in response to a particular goal. Learners who have mastered articulation may do a wide range of tasks, including multitasking. Naturalization is the last step of the process, in which learners demonstrate proficiency in their performance on any given job [3].

Simulation Learning and E-learning

Science and engineering educators believe that the hands-on experience of the science laboratory is a necessary supplement to the relatively passive experiences of reading textbooks and listening to lectures that comprise a large part of the student experience in universities. [4]

The use of simulation in formal education has been in existence for more than 200 years and the approach has been applied widely in medical, aviation and maritime courses.

Despite differences in understanding the construct and its applications, simulation has shown success in creating engaged and meaningful learning environments in various academic fields [5]. Hence the inquire of what simulation software is used and the effectiveness in collaborative learning is needed to facilitate and help both students and instructor.

III. RESEARCH METHODOLOGY

Research Design

This study aims to evaluate the readiness and challenges associated with the transition from practical to simulation-based learning, and to compare these factors with students' end-of-semester performance.

A quantitative research design is used to meet the stated objectives. The study participants consist of diploma students from Politeknik Kuching Sarawak (PKS), specifically those who experienced practical electronic courses during the COVID-19 pandemic, when face-to-face learning was replaced by online instruction. A non-random sampling

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method was selected to ensure that all participants had experienced this unique learning environment.

The sample size for this research includes at least 100 students from semester two and three who have completed courses in Measurement Devices and Electrical Technology, both of which involve a significant transition from hands-on to simulation-based learning. The sample size was determined using G*Power software to confirm that it is sufficient for achieving adequate statistical power in the analysis.

Population and Sample

The population for this research comprises semester 2 and 3 students pursuing a diploma in Electrical Engineering at PKS. All participants have taken at least two courses that require transitioning from practical hands-on activities to simulation, ensuring the sample's relevance to the research objectives.

Instruments

The primary data collection tool is a questionnaire consisting of four sections:

1. Demographics: This section gathers background information about the participants, such as gender, course of study, and previous educational background.

2. Readiness for Simulation-Based Learning: This section measures students' readiness for the transition from hands-on to simulation learning.

3. Challenges in Simulation Learning: This section identifies constraints and challenges experienced by students during simulation-based learning.

4. Student Performance: This section collects data on students' end-of-semester results in electronic courses.

The questionnaire employs a Likert scale with detailed labels ranging from "Strongly Agree" to "Strongly Disagree" for greater accuracy in capturing participants' responses.

Data Collection Tool

The questionnaire was adapted from previous studies and refined through a pilot study to establish its reliability and validity [6][7]. Cronbach's alpha was calculated to confirm the internal consistency of the instrument. Once finalized, the questionnaire was converted into a Google Form for ease of distribution. The form was then distributed to a minimum of 116 participants in semesters 2 and 3 at PKS.

IV. RESULT AND DISCUSSION

Descriptive Statistics

Demographics and background information were summarized using descriptive statistics, providing insights into participants' characteristics and their distributions across different groups.

The hypothesis testing revealed the following:

1. Gender Differences (Ho1 and Ho2): The hypotheses concerning gender differences in readiness and challenges were accepted, suggesting that gender does not significantly influence students' preparedness, or the level of challenges faced during the transition to simulation-based learning.

2. School Learning Stream Impact (Ho3 and Ho4): Hypothesis 3 was accepted, indicating no significant differences in readiness based on school learning streams. However, Hypothesis 4 was rejected, demonstrating that students from different school learning streams experience varying levels of challenges when shifting to simulation-based learning. This result may be due to differences in prior knowledge or curriculum emphasis across school streams.

3. Relationship Between Readiness, Challenges, and Performance (Ho5 and Ho6): Readiness showed a stronger positive correlation with student performance in electronic courses than challenges, as indicated by the acceptance of Hypothesis 5 and the rejection of Hypothesis 6. This finding suggests that better preparation significantly contributes to improved academic outcomes.

4. Combined Effects on Student Performance (Ho7): Hypothesis 7 was rejected, indicating that readiness plays a more dominant role in influencing student performance compared to challenges. The multiple regression analysis revealed that while both factors contribute to student outcomes, readiness had a more substantial impact.

Implications for Educators: These findings suggest that increasing students' readiness for simulation-based learning could enhance their academic performance more effectively than simply

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addressing the challenges faced. Educators could implement preparatory training sessions or orientation programs tailored to bridge knowledge gaps and better equip students for the transition.

Comparison with Previous Research: The results align with Watkins, Leigh, and Triner's (2008) study, which found that readiness significantly influences e-learning outcomes [6]. However, this study adds new insights by indicating that readiness is more crucial than challenges in simulation-based settings.

Sample Size and Generalizability: The study's limited sample size may affect the generalizability of the findings. Future research with larger and more diverse samples could yield more robust conclusions.

Self-Reported Data: The reliance on self-reported measures may introduce bias, affecting the accuracy of the findings. Using objective assessments or triangulating data sources could improve future studies.

Practical Recommendations

Training Programs: Introduce specific training for students and educators to improve readiness levels before transitioning to simulation-based learning.

Curriculum Adjustments: Customize programs to account for variations in school learning streams, potentially reducing the challenges experienced by students from different educational backgrounds.

V. CONCLUSION

This study investigated the readiness, challenges, and performance of polytechnic students transitioning from hands-on to simulated learning.

The findings indicate that prior knowledge and previous school streams significantly influence students' readiness and the level of challenges they face. The analysis revealed that readiness is a more dominant factor affecting students' academic performance compared to challenges. This suggests that students who are better prepared for the transition tend to perform better in their electronic courses.

The study also highlighted that the shift from practical to simulation-based learning presents varying levels of difficulty for students depending on their background. Consequently, to improve academic outcomes, it is essential to focus on enhancing students' readiness for simulated learning, possibly through targeted training and preparatory programs.

Future research could explore additional factors influencing readiness and challenges, such as access to technology and the effectiveness of support measures provided to students. Overall, the findings underscore the need for tailored approaches to support students in adapting to changes in learning modalities, ensuring a smoother transition from traditional hands-on methods to digital simulation tools. [9][10]

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Mobile Application for Practical Structural Engineering Learning: A USE Questionnaire-Based Student Evaluation on Usefulness, Satisfaction and Ease of Use

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Abstract

Mobile learning (m-learning) is a modern approach to education that uses mobile devices, such as smartphones and tablets, to improve how students and educators interact with learning materials and activities. This study investigates the effectiveness of a mobile application designed for structural engineering practical courses, focusing on usability, satisfaction, and ease of learning. Using a quantitative methodology, data were collected from 58 students at Sultan Abdul Halim Mu'adzam Shah Polytechnic through the USE Questionnaire, a validated tool for assessing user experience. The USE Questionnaire evaluates four key dimensions: usefulness, which measures how well the system fulfills its intended purpose; ease of use, assessing the simplicity and effortlessness of using the system; ease of learning, which gauges how quickly and intuitively users can become proficient with the system; and satisfaction, capturing users' overall contentment and enjoyment. Each dimension comprises multiple items rated on a 7-point Likert scale, ranging from "strongly disagree" to "strongly agree." Analysis revealed consistently high mean scores across all dimensions, with usefulness scoring between 6.138 and 6.397, ease of use ranging from 6.155 to 6.397, ease of learning between 6.207 and 6.310, and satisfaction scoring from 6.207 to 6.379. These results highlight the application's ability to enhance productivity, simplify tasks, and foster engaging learning experiences. While minor variability in responses indicated areas for improvement, the overall findings demonstrated the tool's reliability, accessibility, and adaptability in meeting educational needs. These results reinforce the significant role of m-learning in creating dynamic, interactive, and self-directed educational environments, making it an essential component of modern education.

Keywords **:** *Mobile Applications; Mobile Learning; Satisfaction; Usability, Usefulness*

I. INTRODUCTION

Mobile learning (m-learning), a subset of e-learning, represents a specialized area within the broader field of digital education. In order to share information and improve learning, instructors and students around the world are depending more on mobile phones for educational reasons, according to [1]. This trend has been further fuelled by the introduction of sophisticated mobile technology, such as wearables, tablets, and smartphones, which have made mobile learning a flexible and essential component of contemporary education.

Advanced technology in mobile devices inspires educators and researchers to promote teaching and learning in innovative ways. According to [2], mobile learning has gained popularity in the last ten years and offered fresh chances to improve teaching methods. M-learning is defined as an education that takes place in various contexts, driven by social involvement and engagement with content, using personal electronic devices.

As highlighted by [3], mobile learning offers a significant opportunity to bridge educational gaps, particularly in underserved areas. The organization emphasized the importance of leveraging mobile technologies to expand access to education, support teacher training, and facilitate lifelong learning. Similarly, [4] described m-learning as an evolution toward learner-centered education, showcasing how mobile technologies allow students to engage with content in flexible and innovative ways.

A key advantage of m-learning lies in its flexibility, as it facilitates learning that can occur anytime and anywhere. This is enabled through mobile applications and content delivery platforms designed to provide seamless access to educational resources. Advocates of m-learning emphasize its

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potential to broaden educational opportunities by reaching diverse learners, including those in remote or underserved areas. Furthermore, m-learning promotes engagement through interactive and multimedia content, encouraging a more interactive and engaging educational atmosphere. It also supports personalized and self-directed learning pathways, enabling learners to customize their learning experiences to align with their unique needs and preferences [5].

Despite these promising benefits, the successful implementation of m-learning requires more than merely incorporating mobile tools and activities into educational settings. The effectiveness of m-learning is heavily dependent on thoughtful instructional design and strategic integration into the broader curriculum. Educators play a crucial role in ensuring that mobile apps and technologies align with specific learning objectives and teaching practices. Effective use of m-learning tools involves careful planning to harmonize these technologies with traditional classroom methods, ultimately creating a cohesive and impactful educational experience [6].

II. LITERATURE REVIEW

Constructivism emphasizes the importance of training students to be independent and self-directed learners, advocating for active participation in their learning processes [7]. Within this framework, mobile devices have been recognized as invaluable tools that significantly enhance teaching and learning. These devices empower both learners and educators to retrieve information, access resources, communicate efficiently, and collaborate effortlessly [8,9,10,11].

M-learning facilitates the development of social knowledge by promoting critical thinking, innovation, teamwork, and effective communication. It supports the creation of learning networks and strengthens interactions among learners, making the experience more interactive and vibrant. M-learning fosters deeper and more meaningful interaction with the content by motivating students to take an active role in various activities [12].

Educational content delivered through m-learning platforms is augmented with multimedia components like visuals, animations, written text, sound, and video elements. These features are crafted to grab students' attention and promote interaction, creating a more engaging and impactful learning experience [13]. Furthermore, mobile technologies enable group discussions and professional guidance through online platforms, enhancing the collaboration between students and lecturers. This integration of digital tools fosters class discussions and reshapes the interaction dynamics between educators and learners [14,15]. The flexibility, adaptability, and accessibility of mobile technologies provide a convenient and efficient learning environment that supports both students and educators [16].

Digital technologies have become indispensable in education, offering interactive ways to engage with information and serving as vital tools for academic activities. Mobile applications are increasingly being utilized in education due to their practicality and ability to motivate students. These applications enhance the learning process by ensuring it is more engaging, easily accessible, and efficient [16,17].

In summary, m-learning offers significant advantages in education by combining the benefits of mobile technology with innovative teaching strategies. It enhances student engagement, promotes active participation, and enables flexible learning environments, making it an essential component of modern education.

III. RESEARCH METHODOLOGY

A. Research Design

This study utilizes a quantitative research approach to evaluate the effectiveness of a mobile application aimed at enhancing practical learning in structural engineering. The research specifically aims to evaluate the application's usefulness, satisfaction, and ease of use using the USE Questionnaire framework. The questionnaire collects feedback on how the application enhances students' learning experience, focusing on three core metrics: usability, satisfaction, and perceived usefulness. The study uses a survey approach, gathering data once from students who have actively utilized the application. The feedback is then quantitatively analyzed to gain insights into the application's impact on student learning.

B. Data Collection

Data collection was conducted through the USE Questionnaire were adapted from [18], which measures four key aspects of usability across 30 items using a 7-point Likert scale, where respondents indicate their level of agreement, ranging from "strongly disagree" to "strongly agree.". Each item reflects a distinct usability attribute (usefulness, ease of use, ease of learning, satisfaction), allowing for a comprehensive understanding of the system's usability.

The Usefulness dimension, comprising 8 items, evaluate how effectively the system fulfills its intended purpose for users, assessing practical benefits and productivity gains. Ease of Use, with 11 items, examines the system's accessibility and overall user-friendliness, measuring the effort

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required by users to operate the system efficiently. The Ease of Learning dimension, covered by 4 items, measures how quickly users can learn to use the system, reflecting the learning curve associated with the interface. Lastly, the Satisfaction dimension, with 7 items, captures users' overall enjoyment and contentment with the system, assessing their emotional responses and comfort during use.

The 58 respondents in Semester 4 of the Structural Engineering Practical course at Sultan Abdul Halim Mu'adzam Shah Polytechnic provided feedback anonymously to encourage honesty and reduce social desirability bias, ensuring data reliability. The format of the questionnaire enables straightforward analysis of patterns across participants' responses.

C. Data Analysis

The collected data were analyzed quantitatively to assess central tendencies and variability within the usability scores. Descriptive statistics, such as mean and standard deviation, were calculated for each item in the USE Questionnaire.

IV. RESULT AND DISCUSSION

Table 1, summarizing the mean and standard deviation values for each statement in the "Student Evaluation on Usefulness".

Table 1 Student Evaluation on Usefulness

No.	Statement	Mean	Standard Deviation
1.	It helps me be more effective.	6.362	0.912
2.	It helps me be more productive.	6.345	0.928
3.	It is useful.	6.328	0.980
4.	It gives me more control over the activities in my life.	6.241	0.924
5.	It makes the things I want to accomplish easier to get done.	6.397	0.897
6.	It saves me time when I use it.	6.397	0.877
7.	It meets my needs.	6.172	1.045
8.	It does everything I would expect it to do.	6.138	1.067

This statement “It helps me be more effective” reflects how the tool or resource contributes to enhancing effectiveness. With a high mean of 6.362, this shows users generally find the tool significantly effective in helping them reach their goals. The relatively low standard deviation of 0.912 suggests that most users agree on this point, with minimal variation in responses, indicating a consistently positive impact on effectiveness.

A mean of 6.345 implies that users perceive the tool as highly beneficial for boosting productivity, enables users to perform tasks faster or more efficiently, possibly by automating certain processes or providing helpful shortcuts. The standard deviation of 0.928 indicates low variation, meaning most users experience a similar productivity benefit from using the tool, confirming its reliability in enhancing productivity.

This general usefulness score, with a mean of 6.328 reflects students’ overall perception of the tool’s relevance to their needs. The standard deviation of 0.980 shows slightly more varied opinions, suggesting that while most users find it useful, a few may have different experiences or expectations of usefulness.

A mean of 6.241 shows that users feel the tool moderately enhances control over their activities, allowing for better task management. With a standard deviation of 0.924, user opinions are relatively consistent, pointing to a shared sense of improved control.

Statement five has the highest mean of 6.397, which highlights that users strongly agree the tool simplifies task completion, it indicates that the tool reduces the complexity or difficulty of tasks. A standard deviation of 0.897, the lowest of all items, shows very little variation in responses, meaning users almost universally find the tool makes tasks easier.

With the same high mean of 6.397, users agree that time-saving is a major benefit, marking it as one of the tool’s strongest features. The very low standard deviation of 0.877 underscores that this time-saving aspect is a common and reliable benefit for nearly all users.

A mean of 6.172 suggests the tool generally fulfills user requirements, though this is slightly lower than other items. The standard deviation of 1.045 is among the highest, indicating more variation in responses. This might mean the tool

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meets needs well for some but could have room for improvement in certain cases.

With the lowest mean of 6.138, users find it meets expectations, though perhaps not as strongly as other areas. The standard deviation of 1.067, the highest among all items, suggests greater variability in responses, indicating some users may have unmet expectations while others feel it performs well within expected parameters.

Overall, the student evaluation on usefulness reveals a highly positive perception of the tool, with strong ratings across all statements. Students consistently find it effective, productive, and time-saving, indicating that it supports them well in managing their tasks and achieving goals more efficiently. The high mean scores show the tool's reliability in enhancing productivity and ease of task completion, while the generally low standard deviations suggest that most students have a similar, favourable experience with it. Although there is slightly more variation in responses regarding how well the tool meets all individual needs and expectations, the overall impression is one of substantial usefulness and value in a student setting.

Table 2 displays the analysis of mean and standard deviation for each of the statements on ease of use.

Table 2 Student Evaluation on Ease of Use

No.	Item	Mean	Standard Deviation
1.	It is easy to use.	6.397	0.897
2.	It is simple to use.	6.345	0.928
3.	It is user friendly.	6.310	0.940
4.	It requires the fewest steps possible to accomplish what I want to do with it.	6.241	1.048
5.	It is flexible.	6.259	0.928
6.	Using it is effortless.	6.241	0.961
7.	I can use it without written instructions.	6.293	0.955
8.	I don't notice any inconsistencies as I use it.	6.155	1.056
9.	Both occasional and regular users would like it.	6.259	0.965
10.	I can recover from mistakes quickly and easily.	6.259	1.001
11.	I can use it successfully every time.	6.172	0.994

With a high mean of 6.397, this statement indicates that students generally find the tool straightforward and accessible. The relatively low standard deviation of 0.897 shows that most users have a consistent, positive experience regarding ease of use.

Mean score of 6.345 for the second statement reflects a strong agreement that the tool's design or functions are uncomplicated, making it intuitive. A standard deviation of 0.928 suggests that most students have a similar experience, reinforcing its simplicity.

Scoring a mean of 6.310 for "It is user friendly", this statement suggests a positive perception of the tool's user-centered design. The standard deviation of 0.940 indicates relatively consistent feedback, affirming its accessibility for users of various skill levels.

With a mean of 6.241, users feel the tool minimizes unnecessary steps, enhancing efficiency. The standard deviation of 1.048, among the highest here, shows that while many users appreciate this simplicity, others may feel there's room for improvement.

A mean score of 6.259 suggests that the tool allows users to adapt it to different tasks or needs. The standard deviation of 0.928 indicates a stable consensus, pointing to reliable flexibility for various user goals.

"Using it is effortless", the mean of 6.241 indicates that students generally feel the tool requires minimal effort to operate. The standard deviation of 0.961 suggests consistent ease, though a few users may find some aspects could be further simplified.

A mean of 6.293 reflects confidence in intuitive usability without needing external guidance or written instructions. The standard deviation of 0.955 is fairly low, suggesting that most users quickly learn to navigate the tool independently.

With a mean of 6.155, this score implies that the tool's functionality feels coherent and predictable to most users. However, the standard deviation of 1.056, the highest in this set, suggests

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that some users occasionally experience inconsistencies.

A mean of 6.259 indicates that students feel the tool would be beneficial for both novice and frequent users, highlighting broad appeal. The standard deviation of 0.965 reflects general agreement, showing the tool's versatility.

With a mean of 6.259, students feel the tool allows for easy error correction. The standard deviation of 1.001 shows some variation, indicating that while recovery is generally smooth, a few users may encounter challenges.

Statement "I can use it successfully every time", this mean of 6.172 reflects a high level of reliability in usage, with students confident in its consistent functionality. The standard deviation of 0.994 suggests a steady, though not universal, positive experience.

In summary, the high mean scores across these statements demonstrate that students find the tool highly usable, intuitive, and flexible. The relatively low standard deviations indicate consistency in their positive perceptions, though aspects like handling inconsistencies and error recovery show slightly more variability in user experience.

Table 3 shows the analysis of mean and standard deviation for each of the statements on ease of learning.

Table 3 Student Evaluation on Ease of Learning

No.	Item	Mean	Standard Deviation
1.	I learned to use it quickly.	6.310	0.959
2.	I easily remember how to use it.	6.241	1.048
3.	It is easy to learn to use it.	6.276	0.988
4.	I quickly became skillful with it.	6.207	1.005

With a mean score of 6.310, this statement reflects that students generally find the tool easy to pick up and understand right from the start. The relatively low standard deviation of 0.959 indicates consistency in student experiences, showing that most users were able to learn how to use it quickly, with minimal need for extensive guidance or trial-and-error.

A mean of 6.241 suggests that students feel confident in recalling how to use the tool after their initial learning experience, which is crucial for tools that students might use intermittently. However, the slightly higher standard deviation of 1.048 indicates that a few users may occasionally find it challenging to remember certain aspects, suggesting potential areas for improvement in user interface design or instruction.

This mean score of 6.276 points to a general consensus that the tool has an intuitive, user-friendly design, making it easy for students to learn without a steep learning curve. The standard deviation of 0.988 suggests moderate consistency in responses, indicating that most students find it easy to learn, with a few reporting slightly more effort in understanding its features.

A mean of 6.207 indicates that students feel they could quickly become adept at using the tool after a short period of practice. The standard deviation of 1.005, though slightly higher, shows that while many students found the skill acquisition to be straightforward, others required a bit more time or practice to become fully comfortable.

Overall, the high mean values in Table 3 reflect positive student perceptions of the tool's ease of learning, suggesting that its design minimizes the time needed to become proficient. The relatively low standard deviations, although slightly variable, indicate a generally consistent experience across students, with a few experiencing minor difficulties in memorability and skill acquisition.

Table 4 shows the analysis of mean and standard deviation for each of the statements on satisfaction.

Table 4 Student Evaluation on Satisfaction

No.	Item	Mean	Standard Deviation
1.	I am satisfied with it.	6.345	0.965
2.	I would recommend it to a friend.	6.379	0.933
3.	It is fun to use.	6.345	0.983
4.	It works the way I want it to work.	6.328	0.962
5.	It is wonderful.	6.328	0.906
6.	I feel I need to have it.	6.207	1.039
7.	It is pleasant to use.	6.362	1.021

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A mean of 6.345 reflects that students are generally satisfied with the tool, feeling it meets their expectations and provides a positive experience. The standard deviation of 0.965 indicates a fairly consistent level of satisfaction across users, though there is some variation, suggesting a few students may have specific preferences or areas for improvement.

This high mean score of 6.379 suggests that students have a strong positive opinion of the tool and are likely to recommend it to others, a good indicator of overall satisfaction and perceived usefulness. The standard deviation of 0.933, one of the lowest in this set, shows that most students share a similar enthusiasm, reinforcing the tool's high satisfaction level.

With a mean of 6.345, students generally find the tool enjoyable to use, adding an element of engagement to their experience. The slightly higher standard deviation of 0.983 reflects that while most students agree, some may find it less entertaining, potentially depending on their individual preferences or learning styles.

A mean of 6.328 indicates that students feel the tool aligns well with their expectations and requirements, meeting functional needs effectively. The standard deviation of 0.962 shows that this experience is consistent for most students, with minimal deviations, which is a good sign of reliability.

The mean score of 6.328 shows that students hold the tool in high regard, viewing it as a high-quality resource. The low standard deviation of 0.906 suggests a steady consensus, with many students agreeing on its overall excellence.

This mean of 6.207 indicates that students find the tool beneficial and feel it adds value to their experience, though it is slightly lower than other statements. The higher standard deviation of 1.039 suggests a bit more variability in responses, with some students seeing it as essential while others might view it as supplementary.

With a mean score of 6.362, students generally find the tool enjoyable and comfortable to use. The standard deviation of 1.021, while slightly higher, indicates that the experience of pleasantness is generally shared, though some students might have mixed reactions based on personal preferences or interaction with the tool.

In summary, these high mean values demonstrate a strong level of student satisfaction, with consistency across responses in most areas. The slightly higher standard deviations in a few statements, such as "I feel I need to have it" and "It is pleasant to use," suggest some variability, but overall, students perceive the tool as satisfying, recommendable, and enjoyable to use.

V. CONCLUSION

The findings strongly emphasize the pivotal role mobile devices play in transforming the teaching and learning experience for both educators and students. Mobile devices were consistently rated highly for enhancing effectiveness and productivity, with respondents acknowledging that these tools make tasks easier to accomplish and provide greater control over their activities. This highlights the devices' ability to streamline educational tasks and align with the needs of modern learners and teachers. Furthermore, the high ratings for user-friendliness, flexibility, and minimal effort required for usage underline their accessibility and adaptability. The ability to use these devices without extensive instructions and their suitability for both occasional and regular users ensure inclusivity across diverse user groups.

In terms of learning, the devices were perceived as easy to adopt and use, with respondents agreeing that they quickly became skilled in their operation. This underscores their value in educational environments where quick adaptability is essential. The interactive and intuitive nature of mobile devices makes them ideal for engaging learners, fostering active participation, and supporting self-directed learning.

Additionally, the satisfaction levels reported indicate a deep sense of enjoyment and fulfilment associated with using mobile devices. Respondents found them to be not only effective but also fun and pleasant to use, enhancing the overall learning experience. The devices' ability to meet and often exceed user expectations reinforces their reliability and value in academic contexts. Their capability to integrate seamlessly into teaching strategies and support diverse educational needs makes them indispensable tools for modern education.

In conclusion, mobile devices are far more than just tools for information access—they serve as enablers of efficient, engaging, and enjoyable educational experiences. By fostering productivity, enhancing interaction, and promoting satisfaction, they address critical aspects of teaching and learning, making them essential for fostering meaningful educational outcomes in today's digital age.

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Potential of Coconut Coir as an Environmentally Friendly Wet Floral Sponge

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Abstract

Wet floral foam commonly used in flower arrangements, has a negative environmental impact as it is made of non-biodegradable plastic material that can break down into microplastics. This study explores the development of an environmentally friendly floral sponge formulated from a blend of coconut coir and polyurethane. Coconut coir a natural resource, was selected for its biodegradability and water retention properties, while polyurethane was used as a binding agent to enhance structural integrity. The research employed three different ratios of coconut coir to polyols to diisocynates which were 0.5:1:1 (Sample A), 1:1:1 (Sample B) and 2:1:1 (Sample C). Each sample was subjected to ASTM D570 water absorption test and ASTM E96/E96M water evaporation tests to determine its effectiveness as a floral sponge. Results revealed, as the coconut coir ratio increases, the absorption rate increases but the absorption percentage drops. Coconut coir contributes its natural hydrophilic and capillary structure, allowing effective moisture wicking and retention. While polyurethane adds porosity and increases the material's surface area for trapping water. In term of evaporation, increasing the ratio of coconut coir enhances evaporation rates due to its fibrous texture and larger porous structure, which increases the surface area for water exposure and promotes faster evaporation. In conclusion, the findings suggest that a balanced formulation of coconut coir to polyurethane 1:1:1 (Sample B) can yield an effective and environmentally friendly floral sponge. This biodegradable alternative hold promises for reducing plastic waste in floral arrangements, offering a viable substitute to traditional floral foam without compromising on performance.

Keywords **:** *Wet floral sponge; Coconut Coir; Polyurethane; Environmentally friendly; Absorption; Evaporation*

I. INTRODUCTION

A wet floral sponge, often referred to as floral foam, is a specialized material widely used in floral arrangements to provide structural support and water to cut flowers. This sponge is made from a dense, lightweight foam that has been specifically designed to absorb and retain water. The wet floral sponge is essential in creating fresh flower arrangements that need to stay hydrated and maintain their appearance for an extended period.

The equivalence of each block of commercial floral sponge to the weight of around 10 single-use plastic bags highlights its significant environmental impact, as widespread use contributes to the accumulation of non-biodegradable waste, exacerbating microplastic pollution in ecosystems and posing long-term threats to wildlife and soil health.

The accumulation of coconut coir waste in Malaysia has become an environmental and resource management challenge due to the country's significant coconut production. This waste, primarily comprising husks and fibers, often ends up in landfills or is burned, contributing to air and land pollution.

Addressing by these two issues, this research is focusing on studying the potential of coconut coir as an environmentally friendly wet floral sponge. Coconut coir was selected for its biodegradability and water retention properties, while polyurethane was used as a binding agent to enhance structural integrity.

Three different ratios of coconut coir to polyurethane were used in this research to determine its potential based on water absorption and water evaporation rate. Those two tests will be using the American Society for Testing and Materials, now known as ASTM International. It is a globally recognized organization that develops and publishes voluntary consensus technical standards.

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II. LITERATURE REVIEW

This chapter focus on a few studies are that being focused in developing the research which are on wet floral sponge, coconut coir and ASTM for water absorption and water evaporation.

A. Environmental Effect of Floral Sponge

Commercial floral sponges are manufactured with formaldehyde-based chemicals, which can cause skin irritation upon contact. Moreover, the environmental impact of these synthetic sponges is estimated to be approximately 100,000 tons of floral foam are produced globally each year, much of which is not biodegradable, contributing to long-term environmental pollution. [1]

The production process itself also generates significant greenhouse gas emissions. For example, studies suggest that the carbon footprint of producing a kilogram of floral sponge is around 2.5 kg of CO_2 equivalents. [2]

B. Environmental Effect of Coconut Coir

According to research issued in 2023, coconut trash accounts for around 6.7% of total agricultural waste generated in Malaysia. This equates to a significant volume of 80,000 tonnes of coconut coir produced yearly. [3] The inappropriate disposal or underutilization of coconut coir can have serious environmental consequences. The accumulation of organic waste, such as coconut coir, can lead to pollution, soil deterioration, and habitat damage.

C. ASTM Water Absorption and Water Evaporation

Water absorption tests measure the amount of water a material absorbs under specified conditions. In this research, ASTM D570 - Standard Test Method for Water Absorption of Plastics was used. [4] The percentage of water absorption is calculated as follows:

$$Water\ Absorption(\%) = \frac{Wet\ weight - Dry\ weight}{\text{Dry Weight}}\ x\ 100$$

ASTM standards related to water evaporation typically focus on measuring the rate of evaporation, vapor transmission, or drying properties of materials in controlled environments. In this research, ASTM E96/E96M – Standard Test Methods for Water Vapor Transmission of Materials was used. [5]

III. RESEARCH METHODOLOGY

A. Sample Preparation

Three different ratios of coconut coir to polyurethane were used in this research as shown in Table 1 below:

Table 1: Different Formulation Ratio

Sample	Coconut Coir	Polyols	Diisocyanates
A	0.5	1	1
B	1	1	1
C	2	1	1

All the material was mixed in a proper mold to ensure a good shape of the sponge according to the ratio. The samples were lest to dry for a certain period to let it fully polymerize and then was cut into 3x3x3 inch sample size.

Figure 1: Different ratios of coconut coir samples

B. Water Absorption Testing Procedure

The dried sample was weighed and recorded. It is then immersed in water for 24 hours at room temperature. After 24 hours the sample was removed, surface water was wiped off, and the sample is re-weighed. The final weight was recorded and the water absorption was calculated with the given formula. [4]

C. Water Evaporation Testing Procedure

ASTM E96/E96M specifies test methods to measure the water vapor transmission rate (WVTR) of materials. Continuously after weighing the sample from the absorption test, the sample was placed in a controlled environment with room temperature and humidity. The sample was avoided from being exposed to direct sunlight. The sample was left to dry for 12 hours. After that the sample is re-weighed. The weight change of the sample was recorded over time to calculate water vapor transmission. [5]

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Figure 2: Close-up sample C structure

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Table 2: Water Absorption Result

Sample	Percentage (%)				Absorption Rate (g/h)			
	1st	2nd	3rd	Average	1st	2nd	3rd	Average
A	530.66	537.95	406.84	491.82	2.02	2.18	3.05	2.42
B	982.76	1051.27	842.31	958.78	3.40	3.33	4.23	3.66
C	302.67	195.95	188.24	228.95	4.44	3.69	4.01	4.05

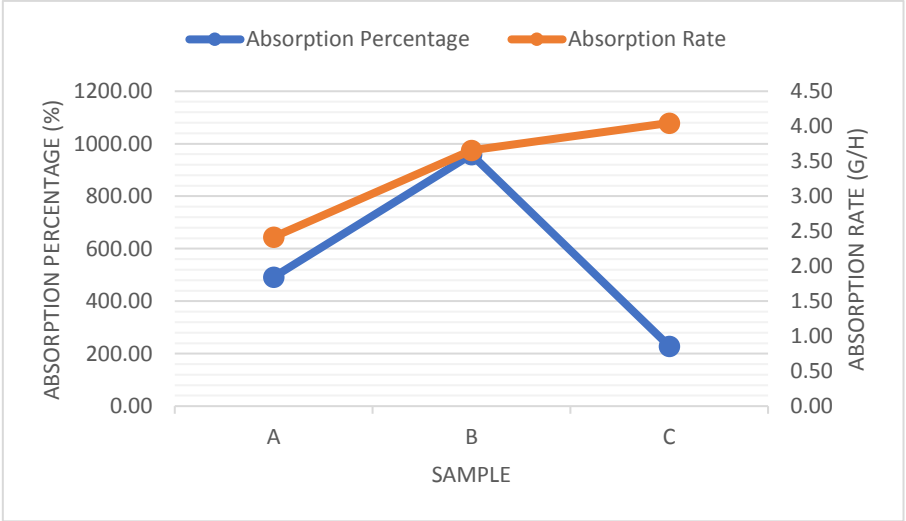

Figure 3: Graph of Absorption Percentage and Rate

Table 3: Water Evaporation Result

Sample	Percentage (%)				Evaporation Rate (g/h)			
	1st	2nd	3rd	Average	1st	2nd	3rd	Average
A	13.29	17.84	7.87	13.00	0.64	0.92	0.60	0.72
B	12.24	10.98	17.20	13.47	0.92	0.80	1.63	1.12
C	23.10	22.32	23.94	23.12	2.73	2.49	2.94	2.72

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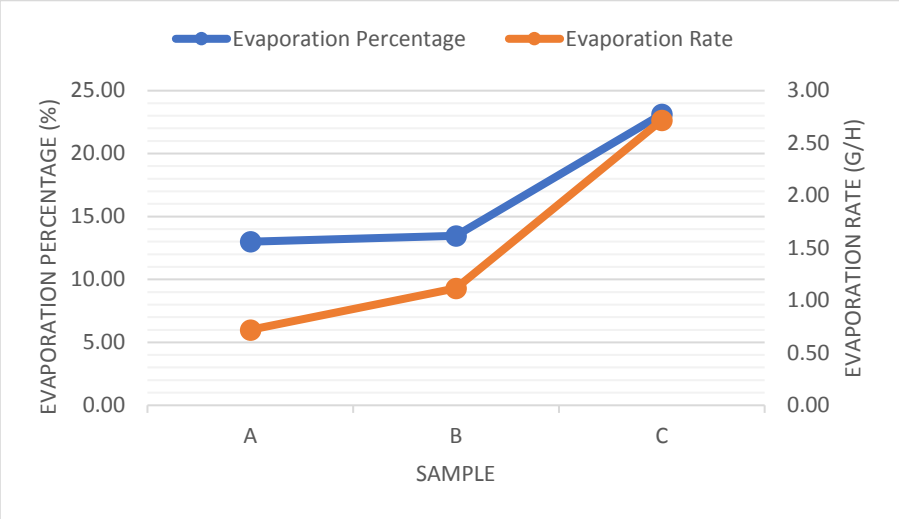

Figure 4: Graph of Evaporation Percentage and Rate

A. Water Absorption

The mechanism of absorption involves the transfer of molecules or particles from a bulk phase into the surface or interior of another substance. In the case of sponges, the material absorbs water into its porous structure, which traps and retains the liquid. [6]

According to the experimental data, Sample B demonstrated the highest absorption performance at the balance ratio of coconut coir to polyols to diisocynates at 1:1:1. While for absorption rate, the higher the coconut coir ratio, the higher the absorption rate was observed.

Based on the experiment, it can be stated that blending natural fibers like coconut coir with synthetic polymers can enhance water absorption as coconut coir is generally hydrophilic, meaning it absorbs and retains water well. Coconut coir, made from the fibers of coconut husks, has excellent water retention properties due to its natural capillary structure, which allows it to wick moisture effectively. [7] In addition, the presence of polyurethane creates a highly porous structure like sponges that increases the surface area and the ability to trap water within the material. The interconnected pores allow water to penetrate and be retained within the matrix. [8]

Apart from that, as the coconut coir ratio increases, the absorption rate increases but the absorption percentage drops. This is the drawback of coconut coir as it appears to allow for a larger porous structure, contributing to its limitation to absorb more water despite its hydrophilic properties. Sample B, with a balanced ratio of 1:1:1, demonstrates an optimal combination of structure and the hydrophilic properties of coconut coir, resulting in a high absorption percentage and rate.

B. Water Evaporation

Evaporation is a process in which liquid turns into a vapor at temperatures below its boiling point. During evaporation, molecules at the surface of a liquid gain sufficient energy to break free from the intermolecular forces holding them in the liquid state and enter the gaseous phase. [9]

Based on the data obtained, it shows that as the ratio of coconut coir increases, the evaporation percentage and evaporation rate increase. The water evaporation among each sample can be explained by examining their material composition, structural properties, and the interaction between coconut coir and polyurethane in each formulation.

As the ratio of coconut coir increases in the sample, it has a higher evaporation rate because the fibrous texture of coconut coir increases the surface area exposed to air, promoting faster evaporation as more water molecules have the opportunity to escape into the atmosphere. [10] This statement can be proved by observing the structure of the sample as Sample C with ratio 2:1:1 has a larger porous structure compare to other sample structures.

In contrast, Samples A (0.5:1:1) and B (1:1:1) likely contain a more balanced ratio of polyurethane to coconut coir, creating a denser, less porous structure that retains moisture longer. The polyurethane in these samples forms a network that reduces evaporation pathways, slowing down water loss.

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The differences in evaporation rates also reflect the distinct roles that polyurethane and coconut coir play in these compositions. Coconut coir offers excellent absorption due to its hydrophilic properties but provides limited structural support, resulting in larger porous structures that increase the rate of evaporation. In contrast, polyurethane functions as a semi-barrier to water movement, effectively reducing evaporation.

This property is especially advantageous in applications where extended moisture retention is needed, as it reduces the need for frequent water replacement in floral arrangements. Therefore, a balance ratio 1:1:1 as demonstrated by Sample B show promising formulation for an environmentally friendly wet floral sponge.

V. CONCLUSION

The study demonstrates that blending natural fibers like coconut coir with synthetic polymers such as polyurethane enhances water absorption properties. Coconut coir contributes its natural hydrophilic and capillary structure, allowing effective moisture wicking and retention, while polyurethane adds porosity and increases the material's surface area for trapping water. The optimal balance between these components is crucial, as higher coconut coir ratios increase the absorption rate but reduce the overall absorption percentage due to structural limitations. The experiment also demonstrates that the evaporation rate and percentage are influenced by the ratio of coconut coir to polyurethane, reflecting the distinct roles of these materials in the composite. Increasing the ratio of coconut coir enhances evaporation rates due to its fibrous texture and larger porous structure, which increases the surface area for water exposure and promotes faster evaporation. Thus, a balance ratio between coconut coir and polyurethane which is exhibited by Sample B is critical to achieving desired absorption and evaporation characteristics, making these composites versatile for applications requiring controlled moisture retention and release such as in wet floral sponge.

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Exploring Student Perceptions And Interactions With Chatgpt In Java Programming Learning

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Abstract

The integration of Artificial Intelligence (AI) tools like ChatGPT is transforming programming education by offering immediate assistance, debugging support, and simplifying complex concepts. This study explores students' experiences and perceptions of using ChatGPT for Java programming assignments in the Integrative Programming and Technologies course. It also examines how students formulate and adjust prompts to optimize ChatGPT's responses and assesses its impact on their understanding of key programming concepts. A qualitative approach using semi-structured interviews with nine participants was adopted, with data analysed through Interpretive Phenomenological Analysis (IPA). The findings show that ChatGPT significantly reduces task completion time, helping students' complete assignments more quickly. Students frequently relied on ChatGPT for coding tasks such as debugging and database integration, improving productivity and minimizing time spent on troubleshooting. However, some challenges arose when ChatGPT provided advanced responses beyond the students' current knowledge. ChatGPT also supported students in understanding complex and advance concepts in Java Programming. The study highlights the importance of clear and specific prompts to optimize ChatGPT's effectiveness. While students appreciated the tool's efficiency, concerns about over-reliance and its potential to hinder independent problem-solving were noted. The study concludes that, while ChatGPT is valuable for enhancing learning efficiency, educators must establish structured guidelines to ensure a balance between AI use and the development of critical thinking skills. This research contributes to the responsible use of AI tools in education, recommending their integration within traditional teaching frameworks to enhance student learning.

Keywords: *Artificial Intelligence(AI); ChatGPT; Java programming; Programming Education; Qualitative Research.*

I. INTRODUCTION

Artificial Intelligence (AI) has significantly transformed various industries, including education, by introducing advanced tools that enhance both learning and teaching practices. In Malaysia, AI is increasingly being integrated into the educational framework, particularly within Technical and Vocational Education and Training (TVET) and polytechnic institutions. This integration supports personalized and adaptive learning experiences, essential for preparing students for the modern workforce [1]. This shift reflects the government's commitment to embedding AI across educational sectors, as seen in recent initiatives to establish the nation's first AI-focused polytechnic and the development of guidelines for responsible ChatGPT usage in higher education [2][3]. However, challenges such as equitable access, digital literacy gaps, educator training, and ethical considerations remain prominent, as Malaysia seeks to make AI-driven education inclusive and culturally sensitive [4],[5].

One of the most influential AI technologies in education today is ChatGPT, a large language model developed by OpenAI. ChatGPT has demonstrated versatility across different educational domains, showing potential as both a teaching assistant for instructors and a virtual tutor for students [6]. It is designed to generate human-like responses, provide real-time answers to complex queries, and support a range of learning activities, making it particularly valuable in programming education [7]. In the context of Java programming, tools like ChatGPT offer personalized assistance by simplifying complex concepts, providing debugging guidance, and delivering immediate feedback [8]. These features could be transformative in Malaysia's polytechnic settings, where students often face

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challenges with core programming concepts. By integrating ChatGPT into Malaysia's educational landscape, institutions have the opportunity to improve learning accessibility and interactivity, though ongoing research and policy considerations are essential for addressing associated challenges [9].

Despite its benefits, there are growing concerns about students' over-reliance on AI tools like ChatGPT in programming courses. In classrooms, students have been observed depending heavily on ChatGPT to complete their coding assignments, with many tasks directly sourced from the platform. This raises concerns regarding the authenticity of their work and the depth of their understanding. Although ChatGPT is encouraged as a learning tool, its use is not sufficiently emphasized in the classroom, limiting its proper integration. Additionally, students sometimes lack knowledge about the appropriate prompts to use in order to generate correct code and fully understand the code they are learning. Research indicates that unclear or inadequate prompting can hinder the effectiveness of AI tools like ChatGPT, leading to incomplete or unsatisfactory outcomes in educational settings. For instance, studies suggest that when students use poorly structured prompts, the AI-generated responses may lack the necessary accuracy and context, impacting their ability to fully grasp the concepts being taught. This is particularly evident in programming education, where detailed and specific prompts are essential for generating relevant code and ensuring students develop a deeper understanding of programming principle [5], [6]. Furthermore, the absence of clear guidelines for using ChatGPT effectively in programming exacerbates the issue. This is especially true for Polytechnic students, as there are no specific findings or comprehensive guidelines available to assist educators in properly integrating the tool into their teaching.

The Malaysian Qualifications Agency (MQA) has recommended that higher education institutions develop clear guidelines for the use of generative AI in teaching, learning, research, and scholarly writing to help align AI usage with program learning outcomes [5]. Without structured guidance, students may misuse the tool, bypass foundational concepts, and develop gaps in their learning. Over-reliance on AI-generated answers, especially for students struggling with programming, could hinder the development of critical thinking and problem-solving skills [10],[11]. The long-term impact of such dependency on students' overall understanding and performance in programming remains a concern. Furthermore, Java programming courses, such as those in Integrative Programming and Technologies, present unique challenges in understanding complex concepts, particularly object-oriented languages like Java [12],[13]. Given these challenges, the role of AI tools like ChatGPT in helping students overcome learning barriers is becoming increasingly important.

This study aims to investigate students' perceptions of using ChatGPT for Java programming assignments within the Integrative Programming and Technologies course. It explores how students interact with ChatGPT, focusing on the effectiveness of prompt strategies in enhancing the tool's responses. Additionally, the study seeks to provide valuable insights for educational institutions on integrating AI tools like ChatGPT effectively, emphasizing balanced use to enhance learning outcomes, foster critical thinking, and support the development of independent problem-solving skills among students.

II. LITERATURE REVIEW

ChatGPT in Programming Education

ChatGPT, developed by OpenAI, has emerged as a transformative tool in programming education, particularly for tackling complex coding challenges. With its ability to generate human-like responses, ChatGPT assists students in debugging, coding, and understanding intricate programming concepts. This is particularly beneficial in subjects like Java programming, which is often challenging due to its syntax, object-oriented principles, and debugging intricacies [7],[8]. ChatGPT simplifies these challenges by breaking them into manageable steps, enabling students to learn independently and at their own pace, fostering a more inclusive learning environment [14],[15].

In Malaysia, the integration of ChatGPT is gaining traction, particularly in Technical and Vocational Education and Training (TVET) settings. Studies show that ChatGPT is particularly effective in providing real-time assistance, allowing students to focus on understanding foundational programming concepts rather than spending excessive time troubleshooting errors [16]. Additionally, ChatGPT has proven its competency in solving programming problems by offering structured and optimized solutions to complex challenges [17]. These features position ChatGPT as a promising tool for addressing programming difficulties in Malaysia's education system.

However, while ChatGPT has been praised for enhancing accessibility and personalizing the

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learning process, its adoption comes with challenges. Over-reliance on AI can hinder the development of critical thinking and problem-solving skills [18]. Furthermore, ethical concerns such as plagiarism and the passive use of AI-generated solutions must be addressed to ensure meaningful learning experiences [19]. Educators in Malaysia are encouraged to implement clear guidelines for using ChatGPT, integrating it as a supplementary resource rather than a replacement for foundational learning activities. This balanced approach can maximize ChatGPT's potential while fostering independent learning and preparing students for a tech-driven future [4].

Challenges in Java Programming

Java programming, as one of the most widely taught programming languages, is often perceived as challenging by students due to its complex syntax, object-oriented principles, and intricate debugging processes [13],[20]. These difficulties highlight the need for innovative tools and strategies to assist students in navigating these complexities. In this context, AI tools like ChatGPT have emerged as valuable resources, offering step-by-step assistance and simplifying the understanding of Java concepts [8],[21].

One major concern is the potential over-reliance on AI tools, which may inhibit the development of critical thinking and problem-solving skills essential for programming [18]. The tendency of students to rely on ChatGPT-generated solutions without fully understanding the underlying concepts also raises ethical concerns, such as plagiarism and academic dishonesty [22]. These issues underscore the importance of integrating AI as a supplementary resource rather than a replacement for foundational learning. Research highlights the need for educators to actively monitor AI usage to ensure students remain engaged in the problem-solving process, which is vital for building long-term programming skills [21].

Despite these challenges, studies have shown that AI tools like ChatGPT can help overcome learning barriers in programming education. By breaking down complex concepts into simpler, manageable components, ChatGPT makes programming more accessible and interactive for learners [7],[14]. Furthermore, the ability of ChatGPT to offer immediate feedback and personalized assistance has been shown to increase engagement and confidence among students [8],[21]. This is particularly valuable for students struggling with Java's intricacies, as it fosters a deeper understanding of the material and supports students in independently navigating programming tasks. However, to maximize these benefits, educators must guide students in using AI responsibly, ensuring that it complements rather than replaces traditional teaching and learning methods [4],[23].

Advantages and Disadvantages of ChatGPT

AI tools like ChatGPT have brought significant benefits to programming education by offering instant feedback and personalized guidance. This helps students resolve errors quickly, navigate coding challenges, and understand complex concepts better. These features are particularly useful in programming subjects, fostering independent learning and boosting student confidence [10],[23]. Additionally, ChatGPT adapts to the diverse needs of learners, making programming education more accessible and efficient [12],[24].

However, over-reliance on AI tools poses challenges. It can limit students' critical thinking and problem-solving skills, essential for programming success [18]. Ethical concerns like plagiarism and misuse of AI-generated content also arise when students fail to fully understand the solutions provided [22],[25]. These risks emphasize the need for educators to guide students in using ChatGPT responsibly as a supportive tool, rather than a substitute for active learning.

While many students appreciate ChatGPT's ability to enhance their learning experience, some remain cautious about its outputs. Misalignment with course objectives or reliance on AI can undermine student confidence in their abilities [26],[27]. Educators must promote a balanced approach to integrating AI tools, encouraging students to critically engage with AI-generated solutions while developing independent problem-solving skills [28],[29].

Prompt Design in Programming

Prompt design plays a crucial role in enhancing ChatGPT's effectiveness for programming tasks. Studies show that carefully crafted prompts significantly improve ChatGPT's performance, especially in coding education. Sun et al. [30] emphasize that prompt-based learning can boost critical thinking skills and improve programming outcomes, calling for further research on the long-term impact of prompts. Liu et al. [31] and Liu et al. [32] found that specific, context-rich prompts improve code generation accuracy, highlighting the importance of optimizing prompt structure for better

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AI results. Additionally, Mnguni et al. [33] advocate for the use of code-to-code prompts, which outperform text-to-code prompts by offering clearer guidance, leading to more accurate and efficient code generation. These findings collectively stress the need for teaching students "prompt literacy" to maximize ChatGPT's potential in programming education.

III. RESEARCH METHODOLOGY

Study Design

This study employs a qualitative approach, specifically using Interpretive Phenomenological Analysis (IPA) to analyze the data collected. IPA is particularly suited for capturing participants' lived experiences and gaining insights into their perceptions and interpretations of phenomena [29]. By using IPA, this research aims to uncover rich, nuanced responses from participants regarding their experiences and interactions with ChatGPT in their Java programming studies. The qualitative approach was selected as it allows for an in-depth understanding of student experiences and perspectives, offering a comprehensive view of the role ChatGPT plays in their educational journey.

Participant Selection and Consent

Participants were selected using purposive sampling, focusing on students who had used ChatGPT in class to complete Java programming assignments. This approach ensured the data collected was relevant to the research question, which sought to understand students' experiences and perceptions of using ChatGPT in learning Java. Among the 14 students who participated in the task session, only 9 were selected for the interviews. This selection was based on the quality of their ChatGPT-generated responses to ensure the interviews provided data that aligned with the study's objectives.

Before the interviews, each participant signed a consent form, confirming their understanding of the study's purpose and agreeing to participate. Confidentiality was prioritized, with appropriate measures in place to protect the participants' personal information and ensure their privacy throughout the research process.

Data Collection Procedure

The data collection process was conducted in several phases to gather comprehensive insights into students' experiences with ChatGPT in their Java programming assignments. First, participants were given a designated period during class time to complete a set of practice questions based on Chapters 1 to 4 of the course material. These questions were the same set that had been previously assigned to the students for completion without using ChatGPT. During this session, students were instructed to complete the tasks exclusively using ChatGPT. Upon completing the tasks, students submitted their responses via a Google Drive link, and the submission times were recorded based on the timestamp provided by Google Drive.

After the task completion, the researcher conducted semi-structured, face-to-face interviews with each participant. The interviews, which lasted between 20 and 40 minutes, allowed participants ample time to reflect on and discuss their experiences using ChatGPT. The interview guide included five main topics: Experience and Activity-Based Questions, Understanding and Learning Questions, Prompt Strategy Questions, Advantages and Disadvantages Questions, and Overall Perspective and Suggestions Questions. These structured areas of inquiry allowed the researcher to capture a wide range of insights while also giving participants the flexibility to elaborate on their thoughts.

IV. RESULT AND DISCUSSION

The analysis of student experiences with ChatGPT in Java programming assignments, conducted through interviews after completing tasks with and without ChatGPT, provides valuable insights into its influence on learning outcomes and students' perceptions. Key themes emerged based on interview topics: Experience and Activity-Based Responses, Understanding and Learning, Prompt Strategies, Advantages and Disadvantages, and Overall Perspectives and Suggestions.

Comparing Task Completion Time

The analysis of the time taken by students to complete assignments with and without using ChatGPT reveals a significant difference in efficiency. As shown in the chart in Figure 1, the average time spent on assignments was notably shorter when students used ChatGPT. On average, students completed their tasks in approximately 52 minutes when using ChatGPT, compared to approximately 121 minutes when completing the same tasks without ChatGPT. The time measured includes both the time spent on inputting answers into the answer sheet and completing the tasks themselves.

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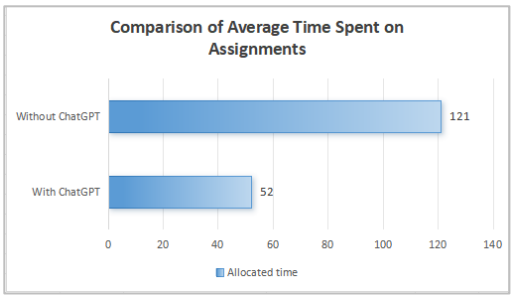

Figure 1: Comparison of Average Time Spent on Assignments

The results demonstrate that ChatGPT has a significant impact on task completion time, helping students' complete assignments more quickly. However, the variation in time taken by different students indicates that ChatGPT's effectiveness may depend on individual usage. This highlights the importance of providing proper guidance to ensure that students use AI tools in a way that complements their learning. Factors such as students' prior experience with programming, their familiarity with AI tools, and their ability to formulate effective prompts all play a role in determining how ChatGPT can be leveraged for maximum benefit [1][20]. While ChatGPT has demonstrated potential in increasing productivity and saving time, educators must ensure that it is used as a tool to enhance learning without fostering over-reliance on the technology [10].

Experience and Activity-Based Responses

The analysis of students experiences shows that ChatGPT is frequently relied upon for coding-related tasks such as debugging, database integration, and interface design. Many students noted that ChatGPT significantly reduced the time required to complete assignments. One student explained, "*Instead of wasting hours fixing syntax errors, ChatGPT identified them immediately*". Another shared, "*It saved a lot of time I would have spent searching online or looking through forums*." This aligns with findings by Castro et al. [27], who reported that ChatGPT enhances productivity by providing quick and accessible solutions for coding challenges. A third participant added, "*I could focus more on understanding the logic behind the code because ChatGPT helped resolve minor issues quickly*." These responses highlight how ChatGPT streamlines the coding process, allowing students to allocate more time to higher-order learning tasks. Similarly, Kadir et al. [7] emphasize that ChatGPT's debugging capabilities enable students to focus on understanding coding logic rather than being hindered by minor syntax errors.

However, students faced challenges when ChatGPT produced outputs that were too advanced or beyond the scope of what they had learned in class. One participant shared, "*The code it generated sometimes included concepts we hadn't learned, making it hard to apply*." Another noted, "*Sometimes the answers were beyond what we covered in class, so I wasn't sure how to apply them.*" This highlights a concern raised by Silva et al. [18], who caution that AI-generated solutions may sometimes be overly complex, necessitating iterative refinement and educator guidance to ensure alignment with the students' academic levels.

Understanding and Learning

The analysis reveals that ChatGPT provided significant support to students in understanding Java programming concepts such as AWT, Swing, Event Handling, and Database integration. Many students expressed that ChatGPT offered clear explanations, enabling them to grasp challenging topics more effectively. For instance, one student remarked, "*It breaks down complex concepts into simpler terms, which helps me get a quick grasp of topics I struggle with*." These observations are consistent with findings by Deriba et al. [8], who highlighted ChatGPT's ability to simplify complex programming topics, making them more accessible to learners. However, some students noted that ChatGPT's responses could be overly technical or advanced, leading to confusion. As one participant explained, "*Sometimes the answers were beyond what we covered in class, so I wasn't sure how to apply them.*" These instances necessitated iterative queries and adjustments to ensure the generated code aligned with their assignments. For example, one student shared that they had to "*…ask ChatGPT to simplify the coding to match what we learned in class.*"

Students generally found ChatGPT accurate in generating basic code solutions, such as creating user interfaces or debugging syntax errors. It was particularly helpful for database connectivity tasks, where several participants highlighted its ability to save time by providing precise step-by-step instructions. As one participant explained, "*ChatGPT really helped with database connection problems by providing clear steps to fix the issue.*" This aligns with Hartley et al. [23], who emphasized the value of AI tools in providing structured and timely guidance for technical tasks. Nevertheless, the need to verify and refine ChatGPT's outputs encouraged students to critically engage with the tool. One participant mentioned, "*Even when I use ChatGPT, I still have to fix parts of the code, and that helps me understand it better.*"

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Overall, ChatGPT positively impacted students' conceptual understanding, particularly for practical applications like database integration and event handling. However, its effectiveness was limited when the tool introduced advanced techniques beyond students' current knowledge. This highlights the importance of guided use, where educators could provide structured support to ensure students leverage ChatGPT effectively while developing their coding and problem-solving skills independently.

Advantages and Disadvantages

The analysis reveals that students find ChatGPT highly useful for completing assignments quickly. Many describe it as a "*...lifesaver during tight deadlines*" due to its ability to provide instant and accessible solutions. One student mentioned, "*ChatGPT helps us learn new things, such as coding in different languages*." Another student noted, "*It helps us with basic coding and makes it easier to understand complex topics because it explains step by step how the code works.*" Students also appreciated how ChatGPT reduced frustration by identifying and resolving errors more efficiently than traditional trial-and-error methods. As one student put it, "*ChatGPT is useful for repetitive tasks and for troubleshooting errors. It saves time and ensures fewer mistakes in our work.*" Additionally, some students found that ChatGPT provided quick solutions, making it easier to complete assignments faster. One student shared, "*ChatGPT provides quick solutions and suggestions, making it easier to complete assignments faster.*" These advantages align with Hartley et al. [23], who highlighted the time-saving benefits of ChatGPT and its positive impact on reducing students' stress during assignments.

However, students also raised concerns about over-reliance on ChatGPT, which they felt could limit their ability to develop independent problem-solving skills. One student admitted, "*I sometimes rely too much on it and feel like I'm not truly learning to solve problems on my own.*" This reflects insights from Chukwuere [26], who warned that excessive dependence on AI tools like ChatGPT might hinder the development of critical thinking and self-reliance in learning processes. Students pointed out that ChatGPT sometimes provides advanced solutions which are not suitable for beginners, with one student mentioning, "*ChatGPT sometimes provides advanced solutions which are not suitable for beginners.*" Another concern was that some of the code generated by ChatGPT required adjustments, especially for more complex tasks. As one student noted, "*Some code generated by ChatGPT requires adjustments, especially for complex tasks like database integration.*" There were also concerns about the specificity of prompts, with a student commenting, "*If the prompt is not specific enough, ChatGPT may give incorrect or irrelevant answers.*"

Students emphasized the importance of critically evaluating ChatGPT's outputs to ensure alignment with course requirements and avoid potential misunderstandings. As one student mentioned, "*ChatGPT cannot replace understanding the core concepts. Over-reliance on it may hinder independent learning*." They also noted that for specific tasks, ChatGPT's solutions might not always meet their needs, and sometimes they would have to refine the results themselves. A student shared, "*For specific tasks, ChatGPT's solutions may not always be what we need, and sometimes we have to refine the results ourselves*." These concerns align with the findings of Silva et al. [18] and Selvanathan and Narayanan [10], who recommended the integration of AI tools into educational frameworks to ensure they complement rather than replace foundational learning. Structured guidance from educators is essential to help students use ChatGPT effectively while fostering independent learning.

Prompt Strategies

The analysis of student prompts highlights the critical role of clear and specific instructions when using ChatGPT for Java programming assignments. Students consistently reported that detailed prompts resulted in more accurate and useful outputs. As one student noted, "*If I just type 'help with database error,' the response is too generic. But when I specify the exact problem, like a 'connection issue in SQL, I get more useful advice*." Furthermore, students emphasized the need for step-by-step guidance in their queries, with one stating, "*I asked for step-by-step guidance, giving simple and basic coding requests to ChatGPT*". When asking for specific tasks, such as centering a button, students had to be precise, with one participant explaining, "*When I needed specific tasks like centering a button, I told ChatGPT to give me the code for that specifically*". Additionally, students adjusted their prompts to ensure clarity, as one remarked, "*I had to ask for simple, basic coding and request explanations with each prompt for clarity*". For more tailored answers, students refined their queries to meet their learning level, with another participant saying, "*When I needed to adjust something, I had to refine my prompts for more specific answers*". These insights underscore the necessity of precise, clear

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prompts to optimize the effectiveness of ChatGPT in programming tasks.

From the prompts analyzed, students used two main strategies. Firstly, students often copied full assignment questions, including detailed descriptions of components such as labels, text fields, and database requirements, into ChatGPT. They iteratively refined the generated outputs, requesting adjustments to align with their desired outcomes. **Figure 2** illustrates an example of a prompt where a complete question is provided to ChatGPT, detailing specific requirements for creating a Java Swing-based registration form and integrating database functionalities. Based on the analysis, students employing this strategy were generally used by students with learning difficulties and less focused during class sessions. This method appeared to be a shortcut for completing tasks without fully understanding the underlying concepts.

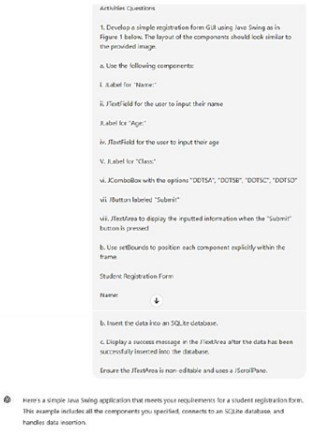

Figure 2 Prompt example - Copying full assignment questions

Students employed a visual-based approach by capturing screenshots or photos of the assignment interface and uploading them to ChatGPT or other generative AI tools to generate the required code. This approach enabled students to first replicate the visual layout of the interface before progressively incorporating functionalities or database integration. By dividing the tasks into smaller, manageable components, students ensured the generated code aligned with their specific requirements. **Figures 3** and **4** illustrate this method, beginning with interface design in **Figure 3** and progressing to database integration in **Figure 4**. This strategy was particularly effective for students who remained focused during class and had a clear understanding of all the topics they had learned.

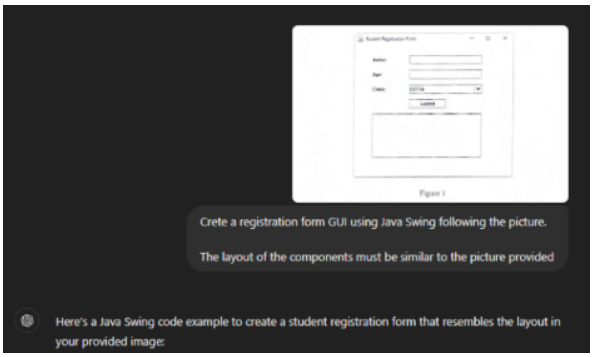

Figure 3 Prompt example - Visual-based prompts

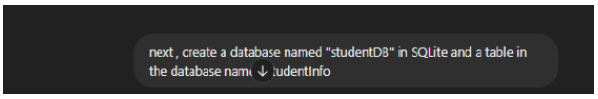

Figure 4 Database creation prompt

Java programming is widely used and integral to computer science education, enabling ChatGPT to generate code, including GUI-focused courses. However, students often rely on overly simplistic or vague prompts, which can hinder ChatGPT's ability to provide accurate solutions. Sun et al. [30] emphasize that unclear prompts may lead to incomplete or inaccurate responses. Liu et al. [31] highlight the need for specific, context-rich prompts to improve the quality of code generation, particularly for complex tasks like GUI programming. Mnguni et al. [33] also stress the importance of detailed prompts to ensure ChatGPT's output aligns with students' expectations and reduces the need for repeated corrections. Furthermore, Liu et al. [32] note that precise prompting significantly enhances ChatGPT's ability to generate relevant code, especially for advanced programming concepts.

Overall Perspectives and Suggestions

Most of the students responded positively to the effectiveness of ChatGPT, particularly in enhancing productivity and comprehension, especially for tasks like debugging and learning new coding concepts. One student remarked, "*ChatGPT makes it easier to understand complex topics because it explains step by step how the code works*." However, they emphasized the importance of balanced usage, highlighting that while ChatGPT is helpful, it should complement traditional learning rather than replace it. Another participant suggested, "L*ecturers should create guidelines to help us understand when and how to use ChatGPT appropriately.*" Many participants highlighted that ChatGPT is particularly beneficial for repetitive or foundational tasks, such as writing code templates or troubleshooting errors.

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However, they stressed the need for assignments that require critical thinking and independent problem-solving to balance AI assistance. One student shared, "*ChatGPT is useful to start assignments, but lecturers should focus on tasks that make us think critically, especially in exams*." This reflects a consensus that AI tools should aid skill development without fostering dependency. Several students also emphasized that ChatGPT should not be used as a replacement for engagement with core learning concepts. As one student mentioned, "*I think it's useful, but it should be used for support, not as a shortcut to doing the work*."

The findings suggest that educators need to integrate ChatGPT into their teaching strategies responsibly. Structured guidelines and activities that blend AI usage with traditional teaching can enhance learning efficiency while preserving academic integrity. For instance, ChatGPT can be incorporated into collaborative coding exercises where students critically evaluate AI-generated outputs [1][4]. These measures can ensure students leverage ChatGPT as a complementary tool while maintaining focus on core programming skills and ethical considerations, aligning its use with broader pedagogical goals [11].

V. CONCLUSION

This study highlights the transformative role of ChatGPT in Java programming education, particularly within courses like Integrative Programming and Technologies. ChatGPT is frequently relied upon for debugging, database integration, and interface design tasks, enabling students to save time and reduce frustration. Students reported that ChatGPT helped streamline their coding processes, allowing them to focus on understanding programming logic and higher-order learning tasks [7],[27]. By providing immediate feedback and personalized guidance, ChatGPT simplifies complex concepts, making programming more accessible and interactive [10],[14].

However, over-reliance on ChatGPT remains a significant concern. Some students admitted to relying too heavily on the tool, potentially limiting their critical thinking and independent problem-solving skills [23],[26]. Additionally, ChatGPT sometimes produces outputs that are overly advanced or misaligned with the students' academic level, requiring iterative refinement to align with coursework requirements [8],[22]. These findings underscore the need for structured guidelines to ensure that ChatGPT is used as a supplementary tool, fostering balanced engagement and deeper conceptual understanding [24],[25].

To address these challenges, educational institutions should implement clear frameworks for integrating ChatGPT into programming curricula. These frameworks must emphasize responsible use, focusing on AI literacy and prompt-crafting skills to help students critically evaluate and refine the tool's outputs [18]. Furthermore, incorporating independent problem-solving tasks can complement ChatGPT's benefits, ensuring students actively engage with programming concepts rather than passively relying on AI-generated solutions [4],[28].

The study also highlights students' positive perceptions of ChatGPT, particularly its ability to provide immediate feedback and improve productivity. However, educators must strike a balance to prevent dependency and ensure ChatGPT enhances, rather than replaces, traditional learning methods. By fostering responsible integration and encouraging active learning, ChatGPT can be a powerful tool for improving programming education outcomes while maintaining academic integrity and skill development [10],[21].

Future research should explore how long-term use of ChatGPT affects students' programming skills, including problem-solving, conceptual understanding, and knowledge retention. Experimental studies should be conducted to evaluate the impact of structured ChatGPT usage guidelines on improving learning outcomes, fostering academic integrity, and encouraging independent coding skills [18]. For instance, controlled experiments could compare student performance in environments with and without specific guidelines for ChatGPT integration.

Additionally, research should focus on integrating ChatGPT with other educational technologies to create personalized and adaptive learning environments. Experimental frameworks can assess how combining ChatGPT with traditional teaching tools influences engagement, comprehension, and performance. Special attention should be given to addressing digital literacy gaps in Technical and Vocational Education and Training (TVET) and polytechnic institutions, ensuring equitable access and effective use of AI tools in education [1],[14]. Such experiments could involve pilot programs to measure the effectiveness of AI-enhanced teaching methods in diverse educational settings.

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The Effect of Tax Complexity on Tax Compliance Behavior Among Self-employed Taxpayers in Malaysia

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Abstrak

Tax complexity is a critical factor influencing tax compliance behavior among self-employed individuals in Malaysia. This study examines how aspects of tax complexity impact tax compliance intention and behaviour among self-employed taxpayers.. Through a quantitative approach involving surveys, this research aims to provide empirical evidence on the challenges faced by self-employed taxpayers due to tax complexity. The findings contribute to the literature by highlighting specific areas where simplification of tax rules and improved taxpayer education can potentially enhance compliance rates and overall tax administration effectiveness in Malaysia.

Kata Kunci **:** *Tax Complexity, Tax Compliance rates, Self-employed taxpayers, Quantitative approach, SmartPLS*

I. INTRODUCTION

Taxation involves governments imposing taxes on corporate profits and individual incomes to finance public services and achieve various governmental objectives [13]. Tax revenue plays a crucial role in bolstering a nation's economy, education, societal welfare, and security. Given the pivotal role of taxes as a primary income source for governments worldwide, both in developed and developing nations, ensuring tax compliance has emerged as a paramount concern. Adequate funding is essential for governments to execute developmental and infrastructural projects effectively, thereby supporting continuous national growth and the welfare of citizens [10]

Despite taxes playing a crucial role in fostering national development, there are individuals who fail to acknowledge its importance. They continue to evade taxes while expecting to enjoy the benefits financed by others who dutifully fulfill their tax obligations. This situation is perceived as unfair by compliant taxpayers. If not addressed seriously, it could lead to significant revenue losses for the country and undermine the fair distribution of fiscal responsibilities [19]. Several researchers in the field of tax compliance highlight that self-employed individuals often face unique challenges in tax compliance [15]. This group is often identified as having a higher propensity to evade income taxes compared to other taxpayer categories. Additionally, they are acknowledged as the primary contributors to the income tax deficit [19].

Tax compliance among self-employed taxpayers is influenced by numerous factors, among which tax complexity plays a crucial role. Tax complexity refers to the difficulty and intricacy involved in understanding and fulfilling tax obligations, including the complexity of tax laws, regulations, forms, and procedures [5]. For self-employed individuals in Malaysia, navigating these complexities can be particularly challenging due to limited access to professional advice and varying levels of tax literacy [6].

Ghani [8] demonstrated that tax complexity has a substantial impact on the level of tax compliance among self-employed taxpayers. Particularly, Tax regulations play a pivotal role in shaping tax compliance behavior, primarily because these regulations are often challenging for taxpayers to comprehend [7]. It is strengthened by Yayha [21] tax complexity is the root of tax non-compliance behaviour among corporate taxpayers in Malaysia. Young workers in Malaysia are more careful in their tax assessment due to tax complexity which leads to positive behaviour on tax compliance [12].

In Malaysia, the tax law is based on the ITA 1967, Public Rulings and its associated Schedules which are important for tax obligation by taxpayers. A study has been done by Isa [11] and Saad [18] regarding the Readability Assessment of

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Complexity of Malaysian Income Tax Act 1967 whereby using the Flesch Reading Ease Score (FRES) and Flesch-Kincaid Grade Level (FKGL) analysis, they have found that the ITA 1967 and its Schedules are complex to understand. Subsequently, one of the determinants of tax compliance within the tax system or structure is the complexity of the tax system that has been identified for a long-time being [18]. In addition, Isa [11] further highlighted that tax complexity can influence tax compliance.

As of the latest available evidence from [14], studies conducted by the Malaysian Tax Department and economic research agencies such as the Malaysian Institute of Economic Research (MIER) consistently show that self-employed individuals in Malaysia exhibit a higher tendency to evade income taxes. These studies analyze tax compliance data and patterns of tax reporting among different taxpayer groups, highlighting the prevalence of underreporting income and overstating deductions among self-employed taxpayers. Such practices contribute significantly to the income tax gap in Malaysia, emphasizing the ongoing challenge of enforcing tax compliance effectively within this sector [14].

The impact of tax complexity on compliance behavior has been extensively studied in various contexts, highlighting its potential to affect both unintentional errors and deliberate non-compliance [4]. However, specific research focusing on self-employed taxpayers in Malaysia is limited. This study seeks to fill this gap by investigating how tax complexity influences compliance behavior among self-employed individuals in Malaysia

Given the issues discussed earlier, this data provides compelling evidence of how noncompliance among self employed significantly contributes to the overall tax gap. It highlights the urgent necessity of addressing compliance challenges within this group to ensure effective tax administration.

The main research objective of this study is to determine the factors that influence the tax compliance intention among self-employed workers in Ipoh by using Theory of Planned Behavior proposed by Ajzen [2] with three variables in the field of tax compliance intention. The first objective of this study is to examine the relationship between tax complexity and tax compliance intention of self-employed. The second objective is to examine the relationship between the Tax complexity and tax compliance behaviour. The third objective is to examine the relationship between tax compliance intention and tax compliance behaviour. The fourth objective is to analyze the mediating role of tax compliance intention between tax complexity and tax compliance behaviour.

In conclusion ,this study seeks to answer several research questions. The first research question is, what is the relationship between tax complexity and tax compliance intention of self-employed. The second research question is, what is the relationship between the Tax complexity and tax compliance behaviour. The third research question is, what is the relationship between tax compliance intention and tax compliance behaviour. The fourth research question is, does the tax compliance intention mediates the role between tax compliance intention between tax complexity and tax compliance behaviour.

II. LITERATURE REVIEW

A. Theory of Planned Behaviour

The Theory of Planned Behavior (TPB), formulated by Ajzen in 1991, is a prominent framework in social psychology widely utilized for integrating various factors influencing tax compliance behavior and other domains. Since its inception, this model has garnered significant attention in behavioral research. It has been effectively applied to elucidate and forecast individual behaviors across a spectrum of contexts such as healthy eating habits, drug use, recycling practices, travel planning, consumer choices and the adoption of technology [1]. According to TPB, an individual's behavior is primarily driven by their intentions regarding whether to perform or refrain from a specific action.

These behavioral intentions, in turn, are shaped by three fundamental determinants: the individual's attitude toward the specific behavior, subjective norms, and perceived behavioral control. Perceived behavioural control determines the ease or difficulty for individuals in carrying out certain behaviour, depending on the availability of resources necessary to execute certain behaviour, as

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well as the time and opportunity to implement them [2].

Relating to tax complexity, A complex tax system may restrict taxpayer likelihood to comply with tax obligations by generating higher compliance costs and barriers for the taxpayer, which decrease compliance preference. Saad [17] reviews the tax complexity literature and categorizes the complexity of tax systems into the types "computational, tax forms, compliance cost, rule and procedural". Therefore, this study intends to examine the complexity of tax and could impact the intentions and behaviour of tax compliance among self-employed taxpayers.

This variable is usually determined by an individual's experience or others' experience.For instance, Trivedi, Shehata and Mestelman [23] proved this theory in explaining the relationship between the intention towards tax compliance in Canada while Bobek and Hatfield [24] demonstrated the same thing in the United States. There are few past studies in Malaysia built upon the framework of TPB which state that attitudes, subjective norms, and perceived behavioural control exert influences on the intention to behave and act, which then drives compliance behavioural [28].

A. B. Tax complexity

In the tax compliance literature, the phrase complexity refers to the taxpayer being burdened with an excessive amount of record keeping, tax form filling, or other compliance work [29]. Tax complexity can be classified into legal simplicity (i.e. readability and comprehensibility of the tax law) and effective simplicity (i.e. ability to determine tax liability correctly) [30]. Tax complexity is identified as an important variable that influences compliance behavior and it may be at the root of non-compliance among corporate taxpayers in Malaysia. The idea is that taxpayers will comply if the system is straightforward to understand and easy to follow. A complicated tax system, on the other hand, may mislead or dissuade people from complying, whether purposefully or inadvertently [11].

Countries with complex tax codes tend to have larger populations, higher GDPs, and higher tax rates, while countries with complex tax frameworks tend to have lower GDPs, poorer infrastructure, lower levels of development, and lower quality governance [31]. In Malaysia, Mustafa (1996) investigated taxpayers' perceptions of the implemented self-assessment system and found that the tax system in Malaysia had tax complexity, notably regarding record-keeping, too much information in the tax legislation, and ambiguity.

The complexity of tax regulations, the difficulty of keeping correct records, taxpayer carelessness, and the failure in collecting the information required to comply can all lead to unintended non-compliance [34]. This study is supported by Saad [35] and Gambo, Masud, Mustapha and Oginni [32], whereby they found that the tax rule is the major contributor to tax compliance due to the fact that the rule is difficult to understand. The above statement strengthens with some empirical studies that have been carried out within the scope of the TPB and tax compliance behaviour in many countries. Taing and Chang [33] confirmed tax complexity has a statistically significant influence on the tax compliance intention of the Phnom Penh citizens. Ghani [28] found that tax complexity significantly affects tax compliance level among the self-employed taxpayers.

A simple tax system and legal procedure enhance compliance by allowing taxpayers to more easily understand their tax obligations and calculate the amount of tax they need to pay. Richardson [36] investigates tax evasion in 45 countries, accounting for both economic and non-economic factors, finding that complexity was the most significant determinant to influence tax compliance behavior. Many taxpayers believed that the tax system was excessively complicated, difficult to comprehend, and that the terminology employed was unfamiliar to them. This could lead to noncompliant behavior and consequently increase tax evasion. Therefore, the following hypothesis is constructed.

H1: The Tax complexity has a negative influence on tax compliance intention increases in Malaysia among self-employed taxpayers.

H2: The Tax complexity has a negative influence on tax compliance behaviour in Malaysia among self-employed taxpayers.

H3: tax compliance intention positively affects the tax compliance behavior by self-employed taxpayers in Malaysia

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H4: Tax compliance intention mediates the relationship between tax complexity and tax compliance behavior.

III. RESEARCH METHODOLOGY

This research investigated the tax compliance behavior of Malaysian citizens in Ipoh . However, we were unable to conduct a complete survey because the total population of the study was hard to define, and many potential subjects refused to participate in the study because tax compliance is a sensitive issue [39]. Thus, snowball sampling was used, whereby the initial subjects were due to their occupation, such as self-employed, a total of 400 questionnaires were distributed to self-employed, employees of a private organization, employee of a public organization, and university student. The survey was carried out between June 2023 and February 2024. A total of 300 responses were obtained and out of this figure, 59 were excluded from the sample due to incomplete data giving the final response rate of 61 per cent. Tax Compliance Intention and Tax Compliance Behaviour were adopted from Roth [40]. The measurement of Tax complexity of Perceived behavioral control component, items adapted from Saad [18] was adapted. Three items for tax compliance, six items for tax knowledge and six items for tax complexity. Responses were measured using a 7-point Likert type scale anchored by ‘‘strongly disagree” (1) to ‘‘strongly agree” (7). The data was analyzed using SPSS and Smart Partial Least Square version 4. In addition, a total of 36 responses were deleted due to outliers issues. This made the complete responses 241. These responses are sufficient for the use of Smart PLS [37]. Data is normally distributed and has no multicollinearity issues. In addition, non-response bias was examined and it was found that the data has no bias.

IV. FINDINGS

Profile of respondents A total of 241 respondents have participated in this study. Majority of the respondents (65.5%) are males with bachelor degrees (86.3%) and in the age group between 36 and 49 years old (43.7%). The majority of respondents (77.5%) enjoy monthly income on average between 1200-1600 Ipoh and have working experience of more than 10 years. In assessing the measurement model, Hair et al. 2017 suggested that researchers must examine five criteria that are the factor loading (FL) (>0.70) as well as the reliability (Cronbach’s Alpha (CA) and Composite reliability (CR) both >0.70). In addition, the validities such as the convergent validity which is achieved if the average variance extracted (AVE) is greater than 0.50 and the discriminant validity which is achieved if the root square of AVE is greater than the cross loading. In Table 1, it can be seen that all the criteria has been achieved indicating that the measurement of this study is reliable as well as valid.

TABLE 1: FACTOR LOADING, CRONBACH'S ALPHA, COMPOSITE RELIABILITY, AND AVE

Variable	Cronbach’s Alpha (CA)>0.70	Composite Reliability (CR)>0.70	AVE >0.50
Tax Complexity	0.959	0.946	0.717
Tax Compliance Intention	0.855	0.859	0.802
Tax Compliance Behaviour	0.887	0.897	0.795

V. STRUCTURAL MODEL AND HYPOTHESES TESTING

Once the reliability and validity of the measurement model were confirmed, the structural model was assessed for its predictive capabilities and relationships between variables (Hair et al., 2013). R2 values were assessed to determine the explanatory power of the model. The R2 values for

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Tax Compliance Intention and Tax Compliance Behaviour were 0.576, and 0.603, respectively, indicating substantial predictive capability (Falk & Miller, 1992). Effect sizes were also evaluated using Cohen's f2, with values indicating small, medium, or large effects. The Tax Complexity showed medium-to-large on Tax Compliance Intention and Tax Compliance Behaviour (f2=0.09 and f2=0.06, respectively) (Cohen, 1992). Predictive accuracy was assessed through Q2 values, with values above 0 indicating relevance. The Q2 values for Tax Compliance Intention and Tax Compliance Behaviour were 0.456 and 0.525, respectively, confirming predictive relevance.

TABLE 2: RESULTS OF DIRECT HYPOTHESES

Path	β	t-value	Sig.	Results
TC - TCI	0.328	5.343	0.000	Supported
TC -TCB	-0.014	0.346	0.729	Not Supported
TCI - TCB	0.341	4.033	0.000	Supported

VI. Path Analyses: Direct Effects

Table 2 summarizes the findings for the hypotheses H1–H2 on the direct effects of tax complexity on tax compliance behavior. Results indicated tax complexity ($\beta = 0.328$, $t = 5.343$, $p < 0.05$) and tax compliance intention ($\beta = 0.341$, $t = 4.033$, $p < 0.05$) significantly impacting tax compliance behavioral (H1 and H2). However, the impact of tax complexity on tax compliance behavior was not statistically significant ($\beta = -0.014$, $t = 0.346$, $p > 0.05$).

Table 5. Direct and indirect effects of self-employed tax compliance intention on self-employed tax compliance behaviour

Path TC-TCB		T-State	Sig.	VAF %	Type of Mediation
Total effect	0.305	3.482	0.000	-	-
Direct Effect	0.230	5.343	0.004	-	-
Indirect Effect	0.328	2.670	0.000	22.62	Partial mediation

VII. Mediation Analysis

Table 5 shows the results of the mediation analysis. Regarding the mediating role of Tax Compliance Intention, Tax Complexity on Tax Compliance Behavioural (H4: $\beta = 0.305$, $t = 3.482$, $p < 0.05$) was not significant. The direct impact of Tax Compliance Intention was significantly impacted by Tax Compliance Behavioural (H4: $\beta = 0.230$, $t = 5.343$, $p < 0.05$). While, indirect effects of Tax Compliance Intention was significantly effect between Tax Complexity and Tax Compliance Behavioural (H4: $\beta = 0.328$, $t = 2.670$, $p < 0.05$). Therefore, it accounted for about 22.6% as partial mediation.

VIII. Discussion

IX. The main objective of this study was to examine several tax complexities within the framework of the Theory of Planned Behavior (TPB) that could facilitate in predicting the Tax Compliance Intention and Tax Compliance Behaviour among self-employed taxpayers in Malaysia. Overall, the findings of the current study offer substantial support for the effectiveness of the TPB (Theory of Planned Behavior) Model in predicting the compliance behavior of the respondents. The results indicate that the overall model achieved statistically significant,with R2 of 0.546.

The revealed findings align with prior research findings of taxation and various behavioral contexts, as evidenced by studies such as Tan and Saw [42] conducted a study titled

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"Tax Complexity and Compliance: A Review of Malaysian Tax System" where they analyzed the impact of tax complexity on tax compliance intention among Malaysian taxpayers. They found that simplified tax rules and clearer guidelines significantly enhance taxpayers' understanding and perception of fairness, thereby increasing their intention to comply voluntarily.

Abdullah [43] explored the relationship between tax system complexity and compliance intention in their paper. Their findings indicated a strong correlation between simplified tax procedures and higher levels of compliance intention among Malaysian taxpayers, especially among the self-employed and small business owners.

A survey conducted by the Malaysian Tax Department in 2020 examined taxpayer perceptions towards tax system reforms aimed at reducing complexity. The results revealed that a majority of respondents expressed greater willingness to comply with tax laws when regulations were straightforward and easily understandable. The Malaysian Tax Research Foundation conducted a comprehensive analysis on the effects of tax reforms aimed at simplifying the tax system. Their report highlighted that measures to streamline tax procedures and enhance clarity have resulted in improved compliance rates among different segments of taxpayers in Malaysia.

X. However, in this study, the impact of Tax complexity shown does not contribute directly to Tax Compliance behavior (Paying Tax) as stated by previous study such as Ali and Alm [44] study, "Tax Complexity and Compliance: Empirical Evidence from Malaysia," explored the impact of tax complexity on compliance behavior using survey data from Malaysian taxpayers. They found that simplifying tax laws and procedures positively influences taxpayers' willingness to comply, as it reduces the costs associated with understanding and adhering to tax regulations. Salleh [45] concluded a less complex tax system tends to reduce ambiguity and increase taxpayers' confidence in understanding and fulfilling their tax obligations.

The contracts of the results might also be due to other factors influencing tax compliance among self-employed taxpayers. They found that tax compliance intention, including attitudes and beliefs towards paying taxes, strongly predicts actual positive compliance behavior among this group [48]. where, this study does not include attitudes and beliefs to analyze the impact on tax compliance behaviour, yet only analysis under tax complexity as perceived control behaviour.

However, as a novel finding of this the tax compliance intention plays an important role as mediating between tax complexity and tax compliance behaviour. The findings indicated that while tax complexity negatively influences compliance behavior, this effect is partially mitigated when taxpayers possess strong intentions to comply. Evidently, Tan [49] investigated the mechanisms through which tax complexity affects compliance behavior in their study "Tax Complexity and Compliance Behavior: A Study of Self-Employed Taxpayers in Malaysia." They found that tax complexity exerts indirect effects on compliance behavior through its impact on taxpayers' intentions. Simplifying tax procedures and enhancing clarity can strengthen compliance intentions and subsequently improve compliance behavior.

XI. CONTRIBUTION & CONCLUSION

In summary, this study fills a significant gap in the literature by providing a comprehensive analysis of the impact of tax complexity on compliance behavior within a specific taxpayer group in Malaysia, thereby offering practical implications for policymakers and tax authorities aiming to improve compliance rates through targeted interventions.

This study significantly contributes to the understanding of tax compliance behavior among self-employed taxpayers in Malaysia by uncovering a nuanced relationship between tax complexity, tax compliance intention, and actual compliance behavior. Our findings reveal that tax complexity negatively influences tax compliance behavior among self-employed individuals. Importantly, we contribute new knowledge by demonstrating that tax compliance intention mediates this relationship, highlighting the crucial role of taxpayers' intentions in mitigating the adverse effects of tax complexity on compliance behavior.

The study reaffirms the applicability and effectiveness of the Theory of Planned Behavior

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(TPB) in predicting tax compliance behavior. By examining factors such as attitudes, subjective norms, and perceived behavioral control within the context of tax complexity, the study shows that these elements significantly influence taxpayers' intentions to comply with tax regulations.

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