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A Survey on Content, Layout and Accessibility (CLA) of LAW083 MOOC among UiTM Law Foundation Students

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Abstract: *Massive Open Online Courses (MOOCs) are online learning environments designed for large numbers of participants and are typically free, open, and flexible. In 2019, Universiti Teknologi MARA (UiTM) launched UFUTURE, an online platform featuring UiTM MOOC among its integrated features. With the aim of improving learning quality, UiTM MOOC offers diverse learning materials and activities to accommodate students of various learning styles. Recognising its benefits, the Introduction to Law of Contract, Torts and Crimes (LAW083) course, a compulsory subject for law foundation students at the Centre of Foundation Studies, UiTM Selangor Branch, Dengkil Campus (COFS), was adapted into a MOOC. Although previous research has discussed students' perceptions towards MOOC in learning various subjects, there has been no comprehensive study on law foundation students' perceptions of using MOOC for learning LAW083 at COFS. This study employed a cross-sectional survey approach to collect primary data from UiTM Law Foundation students enrolled at COFS during Session 2 of the 2023/2024 semester. Based on Krejcie and Morgan's*

(1970) formula, the sample size for the available population (N=720) was determined to be 251 after screening. The sampling method used for the respondents was purposive convenience sampling, where the online survey was distributed to the target population within the same academic session. This research acknowledges the limitation of sample size, which may affect the applicability of the findings concerning the LAW083 MOOC among UiTM Law Foundation students. Based on the results of the Friedman test that was conducted, the results presented the ranks of three (3) measures: content (C), layout (L), and accessibility (A), or CLA, which were found to be significantly different. The questionnaire assessed students' opinions on the LAW083 MOOC regarding content, layout, and accessibility while also gathering feedback for improvements in these areas. The survey findings will be used to improve the CLA of the LAW083 MOOC. It is recommended for future studies to broaden the sample size and incorporate other qualitative methods such as interviews or focus group discussions to obtain more in-depth insights.

Keywords: *Massive Open Online Courses, online learning, Introduction to Law of Contract, Torts and Crimes, UiTM law foundation students, perception*

1.0 INTRODUCTION

THE EVOLUTION OF MOOC

Massive Open Online Courses (MOOCs) are online learning environments designed for large numbers of participants and tend to be free, open, and flexible (Amado et al., 2022). The evolution of MOOCs can be traced back to email-based courses from the 1990s (Stracke et al., 2019; Smith et al., 1999). Open online learning through self-paced web-based courses emerged soon after the internet gained popularity in the late 1990s and early 2000s (Wiley & Gurrell, 2009). Baturay (2015) stated that the term "MOOC" was first introduced in 2008 by Stephen Downes and George Siemens in their course, titled "Connectivism and Connective Knowledge." Earlier MOOCs did not focus on the content; rather, they emphasised the formation of networks among participants and the sharing of resources and contributions within those networks. This type of MOOC, founded on a 'connectivist' pedagogy, was later referred to as "cMOOC" (Stracke et al., 2019). In 2011,

a different type of MOOC emerged, known as the "xMOOC." This model focused on traditional educator-led instruction, aiming to deliver content to a large public audience (Downes, 2007). In contrast to cMOOCs, xMOOCs provide a more enclosed learning environment where all resources are gathered in one place. The differences between xMOOC and cMOOC are summarised in the table below.

Aspect	cMOOC	xMOOC
Learning Theory	Founded on connectivist theory	Founded on behaviourist theory
Learning Environment	Open, less-structured learning environment	Enclosed, centralised learning environment
Instructor-Learner Interaction	Informal, network-based interaction	More formal, tutor-like experience

Table 1: Differences between xMOOC and cMOOc

Since then, MOOCs have grown significantly, with millions of registered users and hundreds of courses offered by numerous platforms such as Coursera, edX, FutureLearn, Swayam, Udacity, and Udemy (Perifanou, & Economides, 2022). These courses are available around the world and are created by many providers. MOOC represents a significant development in education, offering accessible and often free courses to a wide audience without restrictions of time and location (Siemens, 2013). This aligns with the aspirations outlined in Article 26 of the United Nations Universal Declaration of Human Rights, which states that education shall be free, at least in the elementary and fundamental stages. The majority of MOOCs today are primarily content-based (xMOOC); therefore, they are different from the original connectivist premise of MOOCs (Siemens, 2012).

ADOPTION OF MOOC IN MALAYSIA

In the context of Malaysia, xMOOC has been selected as the format for the development of MOOC in institutions of higher learning (Norazah et. al, 2015). The Ministry of Education Malaysia (MOE) produced the Malaysia Education Blueprint 2015-2025 (Higher Education), with the Ministry's aspirations including: increasing the number of student enrolments, enhancing the quality of teaching and learning, and globalising Malaysian

higher education institutions. To meet these goals, MOOCs have been integrated into higher education. There are three main reasons why MOOCs are used. Firstly, MOOCs can reach a diverse and wide audience, including students of all ages and those not enrolled in higher education, promoting equality in access to learning. Secondly, they enable Malaysian universities to enhance their global brand and visibility, potentially raising quality standards. Third, MOOCs are expected to reduce the costs of delivering education while maintaining quality (Ministry of Education Malaysia, 2015; Norazah et al., 2015).

Universiti Teknologi MARA (UiTM) launched its own in-house developed online platform content delivery called UFUTURE in 2019 by the Institute of Continuing Education & Professional Studies (iCEPS) (Zazaleena et al., 2021). UiTM MOOC is an internet-based platform that offers free courses to students (Siti Noorbaini et al., 2021) and it can be accessed at https://ufuture.uitm.edu.my/mooc/. With the main objective of enhancing the quality of learning and teaching, UiTM MOOC caters to the needs of existing students currently enrolled in the course as well as those who are interested in joining. The LAW083 MOOC provides students with the opportunity not only to access teaching materials but also to participate in game-based activities and take assessments to evaluate their understanding of the chapters offered in the course.

Given the numerous benefits, the Introduction to Law of Contract, Torts, and Crimes (LAW083) was implemented in Session 2 of the 2023-2024 semester. In general, the LAW083 MOOC was developed based on the LAW083 syllabus, which covers the law of contract, torts, and crimes. The purpose of the MOOC is to enable this subject to be taught not only in class but also online, allowing students to learn anytime and anywhere. The course also offers learning materials in various formats such as text, video, and interactive content to accommodate different learning preferences.

1.1 FEATURES OF LAW083 MOOC

Generally, the LAW083 MOOC employs the xMOOC model as it offers a structured learning environment. Additionally, it is formal, with its content aligned with the LAW083 syllabus. The following is the content:

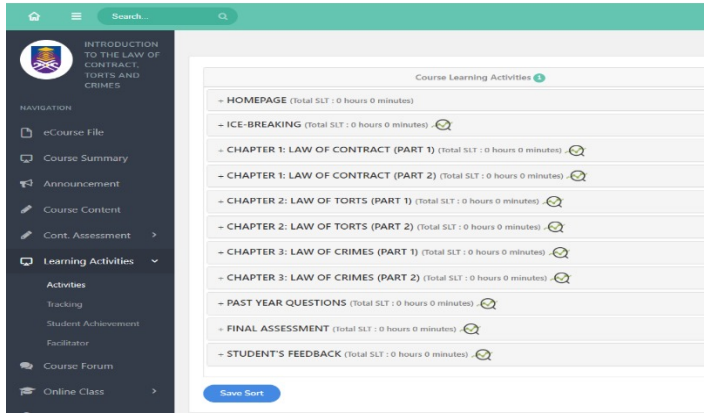

Figure 1: LAW083 MOOC'S contents
(Source: UFuture UiTM)

There are several key components in the content of the LAW083 MOOC. First is the homepage, which provides an overview of the course, including its description, learning outcomes, and course contents. It also shows a list of instructors and a learning roadmap to guide students through the course. Secondly, an ice-breaking session offers students a chance to introduce themselves, helping them feel more comfortable before delving into the course. Third, the content consists of three main chapters: Chapter 1 (law of contract), Chapter 2 (law of torts) and Chapter 3 (law of crimes). Each chapter is divided into two parts: Part I and Part II. Fourth, there are past examination papers to help students understand the format and types of questions, allowing them to better prepare for exams. Next, final assessments are included to allow students to measure their overall comprehension of the chapters. Lastly, a student feedback form is included for students to complete, allowing them to share their overall thoughts and feedback on the MOOC.

The following are the unique features of the LAW083 MOOC:

(i) Various learning materials in different formats
Each chapter in the LAW083 MOOC provides a diverse range of learning materials in multiple formats. These materials are carefully prepared to serve as references that enhance students' understanding of this course.

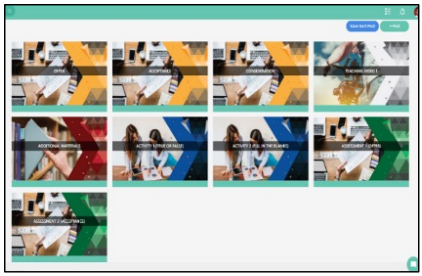

Figure 2(a): LAW083 MOOC'S contents
(Source: UFuture UiTM)

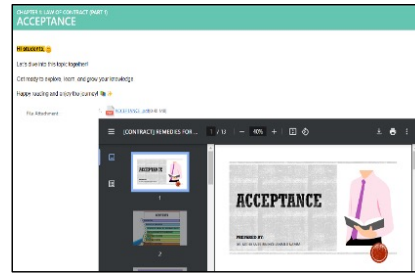

Figure 2(b): Teaching slide
(Source: UFuture UiTM)

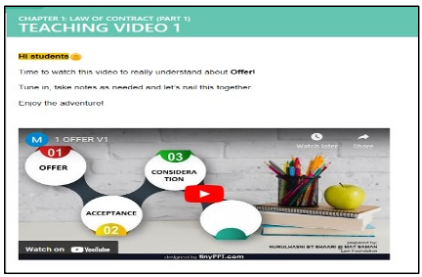

Figure 2(c): Teaching video
(Source: UFuture UiTM)

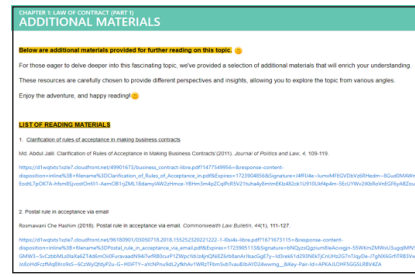

Figure 2(d): Relevant article
(Source: UFuture UiTM)

Figure 2(a) shows the learning materials that are contained in Chapter I, Part II. This Chapter explains the first three (3) elements of a contract, which are offer, acceptance, and consideration in various formats such as teaching slides, video,s and relevant articles as shown in Figures 2(b), (c), and (d). The slides and videos were prepared by lecturers, who have a thorough understanding of the content and scope of the course. For additional materials, several articles were provided by the lecturers, while others were obtained from relevant journals. This also serves as a platform for lecturers to share their research findings with students.

(ii) Interactive activities

To enrich students' learning experience in this course, a variety of interactive activities are offered. These activities were designed to cater to diverse student needs and preferences, providing a more engaging learning experience.

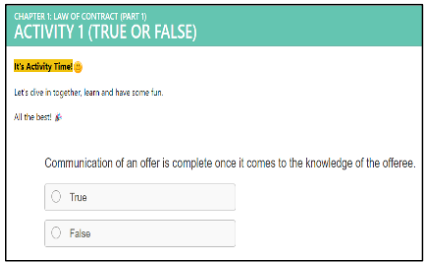

Figure 3(a): True of false
(Source: UFuture UiTM)

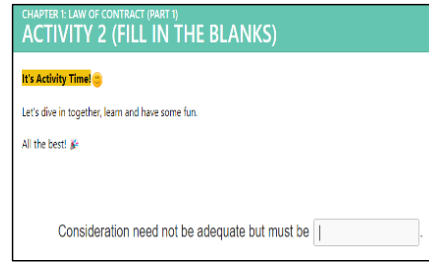

Figure 3(b): Fill in the blanks
(Source: UFuture UiTM)

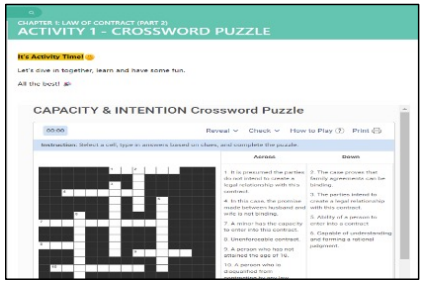

Figure 3(c): Crossword puzzle
(Source: UFuture UiTM)

Figure 3(d): Words search puzzle (Source: UFuture UiTM)

Figure 3 illustrates the various activities provided to help students gain a better understanding of the topics being taught. Among the interactive activities are true-or-false questions [Figure 3(a)], fill-in-the-blank exercises [Figure 3(b)], crossword puzzles [Figure 3(c)], and word search puzzles [Figure 3(d)]. These activities are designed to make the learning process more engaging for students.

(iii) Different forms of assessments

Assessments are also provided to measure the understanding of each chapter studied. They are offered in various forms.

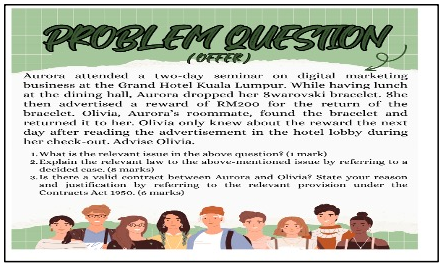

Figure 4(a): Problem based question
(Source: Ufuture UiTM)

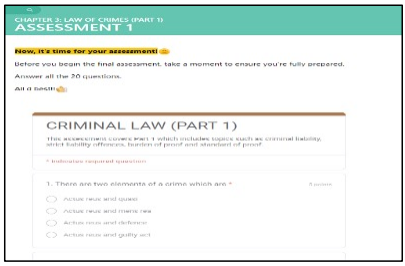

Figure 4(b): Multiple choice questions
(Source: Ufuture UiTM)

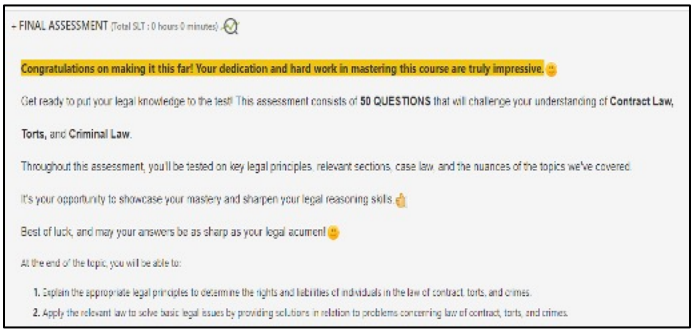

Figure 4(c): Final assessment
(Source: Ufuture UiTM)

Figure 4 shows the two (2) forms of assessments provided to help students self-assess their understanding of the topics being taught. The assessments include problem-based questions [Figure 4(a)], multiple-choice questions in Google Forms [Figure 4(b)], and the final assessment [Figure 4(f)], which consists of 50 questions designed to test students' understanding of all chapters covered in this course.

(iv) Interactive platform for student comments and feedback

To ensure that the LAW083 MOOC promotes two-way communication, interactive platforms for student comments and feedback were provided. These platforms allow students to actively engage with instructors and other students by asking questions, sharing insights, and participating in discussions.

Figure 5(a): Students self-introduction
(Source: UFuture UiTM)

Figure 5(b): Students comments
(Source: UFuture UiTM)

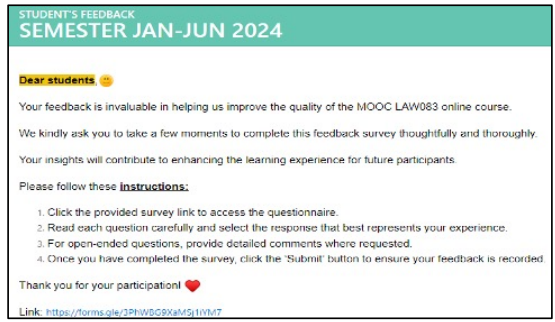

Figure 5(c): Students feedback form
(Source: UFuture UiTM)

Figure 5(a) shows an ice-breaking session where students introduce themselves, share their backgrounds, and explain why they chose to study law. This activity aims to help students feel more comfortable and confident as they progress through the course. Figure 5(b) shows students sharing their answers in the comment section of the assessment. Both the introductions and comments are reviewed and responded to by the instructors to ensure students feel appreciated and motivated to continue with the course. For continuous improvement, students are requested to fill out a feedback form to provide their overall feedback on the LAW083 MOOC.

1.2 RESEARCH PROBLEM STATEMENT

The LAW083 MOOC was developed to enhance students' knowledge of LAW083 and has been used as part of teaching and learning resources at COFS since January 2024. Despite its adoption over the last year, little is known about students' perceptions of the CLA of the LAW083 MOOC. Further improvement of the CLA of the LAW083 MOOC is important, as the examination results of UiTM Law Foundation students from the same cohort, who were enrolled in the LAW083 course during Session 2, 2023/2024 and Session 2, 2022/2023, showed a slight decline in the number of students achieving an A grade. In Session 2 of the 2022/2023 semester, 47% of students received an A, whereas in Session 2 of the 2023/2024 semester, only 28% achieved an A. This represents a 19% decrease in the percentage of students earning an A. Hence, there is a need to explore the law foundation students' perceptions of CLA regarding the use of the LAW083 MOOC to enhance their academic performance.

1.3 RESEARCH OBJECTIVES

There are two (2) main research objectives for this study. The first objective is to measure students' perception of the contents, layout, and accessibility (CLA) of the LAW083 MOOC. The second objective is to identify areas for improving the content, accessibility, and layout of the LAW083 MOOC.

2.0 LITERATURE REVIEW

MOOCs are a product of advancements in technology integration within education. Since 2012, they have served as a platform for disseminating knowledge worldwide, enhancing educational accessibility, and enabling flexible learning experiences. In Malaysia, MOOCs were officially launched in 2015 through Malaysia's national MOOC platform for public higher education institutions called OpenLearning.com (Kumar & AlSamarraie, 2018). Gradually, universities developed and began using their platforms to offer MOOC courses to students, such as UFUTURE at UiTM. This increase in MOOC usage became more evident after the COVID-19 phase, during which countries implemented movement restrictions to curb the pandemic's spread (Tlılı et al., 2022). Studies related to MOOCs have been widely conducted, both internationally (De Moura et al., 2021; Wang et al.,

2023; Kala & Chaubey, 2023) and in Malaysia. Based on the examination of the literature, there are two (2) main themes of studies related to MOOCs conducted in Malaysia: (i) readiness for MOOC adoption and (ii) student perceptions and experiences.

READINESS FOR MOOC ADOPTION

In Malaysia, studies related to MOOCs can be traced back to 2015. Norazah and others (2015) explored MOOCs and their impact on open learning in higher education, offering diverse learners access to free or low-cost educational content and the ability to earn credits. In assessing Malaysia's higher education institutions' readiness to use MOOCs for learning, the researchers used a questionnaire. The questionnaire aimed to measure social readiness, educational readiness, and technological readiness. Although the results of the questionnaire were positive, the researchers felt that this might be influenced by the novelty effect, where students show increased interest due to the newness of MOOC. Recognising the need for studies related to MOOCs to assess the effectiveness of their use in learning, many studies have been conducted in Malaysia in general, and specifically at UiTM, focussing on student perceptions and experiences.

STUDENT PERCEPTIONS AND EXPERIENCES

Under this theme, various aspects were examined by researchers, including the usability of the MOOC-OpenLearning platform, perceptions of MOOCs, the perceived usefulness of the MOOC platform, and user satisfaction. The study aimed to identify factors that significantly impact the acceptance of MOOCs, assess students' experiences, and explore the factors influencing their preferences for using MOOCs. It also sought to identify the challenges that hinder students from using MOOCs. Additionally, the researchers investigated undergraduate students' perceptions of MOOC use and satisfaction, focusing on the platform's usability, quality, and interface, as well as reviewing the MOOC platform's effectiveness as an interactive tool. This is explained in the table below:

No	Author	Aim	Course/ Subject	Research instrument	Population
1.	Adi Syahid and others (2021)	To evaluate the usability of MOOC-OpenLearning from the perspective of undergraduate students at UTHM, focusing on aspects of usefulness, ease of use, ease of learning, and satisfaction.	General	Questionnaire	Undergraduate students from Universiti Tun Hussein Onn Malaysia (UTHM)
2.	Kalthom and others (2017)	To examine undergraduates' perception on the effectiveness of Critical and Creative Thinking (CCT) MOOC in fostering their employability skills.	Critical and Creative Thinking course	Semi-structured interview	Undergraduate students from Universiti Teknikal Malaysia Melaka (UTeM)
3.	Farleen (2021)	To survey which factors have a high impact on the acceptance of MOOC learning modules.	General	Questionnaire	Undergraduate students from UITM Pulau Pinang Branch, Permatang Pauh Campus
4.	Zazaleena and others (2021)	To assess students' experiences in using this online classroom.	Interactive Multimedia course	Questionnaire	Centre of Foundation Studies, UiTM Selangor Branch DengkilCampus
5.	Nurhafizah and others (2021)	To determine factors that influence students' preferences in using MOOCs and to identify the problems that prevent students from using it.	Seven (7) MOOC courses relating to pharmacy	Questionnaire	Faculty of Pharmacy, UiTM Puncak Alam

6.	Siti Nurshahida and others (2022)	To investigate the implementation of what online learners prefer and what they experience while using MOOCs.	Cytology course	Questionnaire	Diploma students in Medical Laboratory Technology, Faculty of Health Sciences, UiTM Pulau Pinang Branch, Bertam Campus
7.	Wan Ismahanisa and others (2022)	To identify the satisfaction among undergraduate students that have experienced MOOC for Microbiology for Environmental Health.	Microbiology for Environmental Health	Questionnaire	Undergraduate students from UiTM Pulau Pinang Branch, Bertam Campus
8.	Hazrat and Izaham Shah (2024)	To investigate the perceptions of postgraduate students towards MOOC, evaluating the effectiveness of MOOC in enhancing the learning outcomes and the challenges students face while using MOOC for learning.	General	Semi-structured interview	Afghan postgraduate students at UiTM
9.	Noor Azlina and others (2024)	To measure the perceived usefulness of the MOOC platform for the Customer Service Principle course and user satisfaction.	Customer Service Principle course	Questionnaire	Faculty Business and Management, UiTM

Table 2: Summary of literature on MOOC usage

Studies on MOOCs have been conducted by various universities in Malaysia. For example, Adi Syahid et al. (2021) examined the usability of the MOOC-OpenLearning platform at Universiti Tun Hussein Onn Malaysia. Their study found that undergraduates had moderately positive perceptions regarding the platform's usefulness, ease of use, ease of learning, and overall satisfaction.

Similarly, Kalthom et al. (2017) explored the impact of MOOCs at Universiti Teknikal Malaysia Melaka (UTeM). Using semi-structured interviews, they investigated undergraduates' perceptions of MOOCs in Critical and Creative Thinking (CCT) courses and their role in enhancing employability skills. The findings indicated that students viewed the CCT MOOC positively, recognizing its effectiveness in fostering key employability skills such as problem-solving and decision-making.

Similarly, at UiTM, while several studies have examined students' perceptions of MOOCs, none have specifically focused on law subjects at the foundation level. Among the existing research, Farleen (2021) conducted a study using questionnaires to identify key factors influencing the acceptance of MOOC learning modules. Another study by Nurhafizah et al. (2021) explored factors influencing students' preferences for MOOCs at the Faculty of Pharmacy, UiTM Puncak Alam, and identified challenges hindering MOOC adoption. Using a questionnaire distributed to students enrolled in seven MOOCs, the study found that students valued the diversity of teaching materials, flexible accessibility, and self-paced learning.

A similar study by Wan Ismahanisa et al. (2022) evaluated undergraduates from UiTM Pulau Pinang Branch, Bertam Campus, who had taken a MOOC for a core subject in a previous semester. The study assessed their acceptance of MOOCs as a blended learning tool through a questionnaire. Likewise, Siti Nurshahida et al. (2022) investigated students' perceptions of MOOCs in a Cytology course among Diploma in Medical Laboratory Technology students at the Faculty of Health Sciences, UiTM Pulau Pinang

Branch, Bertam Campus. Additionally, Zazaleena et al. (2021) focused on foundation-level students at UiTM, specifically in an Interactive Multimedia course, rather than a law subject. Using a questionnaire, the study assessed students' experiences with MOOCs.

The most recent study on MOOCs was conducted by Hazrat and Izaham Shah (2024), which examined the perceptions of Afghan postgraduate students at UiTM Malaysia. The study assessed the effectiveness of MOOCs in enhancing learning outcomes and explored the challenges encountered by students. Using semi-structured interviews, the findings were thematically analyzed and presented.

Additionally, a study by Noor Azlina et al. (2024) employed a questionnaire to measure the perceived usefulness of the MOOCs platform for the Customer Service Principle course and user satisfaction at the Faculty of Business and Management, UiTM.

In summary, research on MOOCs in Malaysia primarily focuses on students' perceptions and experiences in using them as teaching tools. The subjects investigated range from general topics to specific courses taken by students. Research instruments commonly used to assess these objectives include questionnaires and interviews. These studies have been conducted at various universities, including UiTM.

However, while previous research has explored students' perceptions of MOOCs across different subjects, comprehensive studies on law foundation students' experiences with MOOCs, specifically for LAW083 at COFS, remain limited. This research gap highlights the need to examine foundation law students' perceptions of the content, layout, and accessibility of the LAW083 MOOC.

3.0 RESEARCH METHODOLOGY

3.1 METHODOLOGY

This research employed a quantitative methodology and used an online survey instrument to gather primary data. Online data collection was used instead of conventional methods as it is more cost-efficient (Park et al., 2019). This research was approved by the Research Ethics Committee of Universiti Teknologi MARA (RECUiTM) (Ref. No.: REC/08/2024 (ST/MR/173) on 29th August 2024. This section explains the methodology of this research, namely: (a) sampling technique; (b) instrumentation and method of analysis; and (c) development of the questionnaire.

3.2 SAMPLING TECHNIQUE

This study used a survey approach to collect primary data. In this study, law foundation students from the Centre of Foundation Studies (COFS), Universiti Teknologi MARA Dengkil, participated as respondents and were selected using a simple random sampling. Krejcie and Morgan (1970) indicated that the sample size for the available population (N=720) is n=251 after screening. The sampling method used for the respondents was purposive convenience sampling, with the online survey distributed to the target population of UiTM Law Foundation students enrolled at COFS during Session 2, 2023/2024. The inclusion criteria are: (a) students enrolled in the LAW083 MOOC during session 2 of the 2023/2024 semester; and (b) students who have accessed the LAW083 MOOC. The exclusion criteria are: (a) students who were on leave due to illness or emergency; and (b) students who did not consent to be a respondent or complete the questionnaire.

The information in Table 3 introduces the general background of the respondents (n=247) in this study. Of the respondents, females constituted the majority at 82.5% (n=207) while males comprised 17.5% (n=44). Regarding the frequency of access, more than a third, 41.8% (n=105), reported that they accessed the MOOC between one and six days a week, while 32.3% (n=81) accessed the MOOC more than once a month. A smaller portion, 21.9% (n=55), accessed the MOOC once or twice, and only 4.0%

(n=10) of the participants reported daily access. Concerning the devices used, the majority of respondents used laptops at 54.8% (n=228), while those who used tablets, computers, smartphones, and smartwatches accounted for 11.1% (n=46), 31.5% (n=131), 2.6% (n=11), and 0.0% (n=0), respectively.

Variable	Item	Frequency	Percentage
Gender	Male	44	17.5
	Female	207	82.5
Access Frequency	Once or twice	55	21.9
	At least once a month	81	32.3
	Between one to six days a week	105	41.8
	Daily	10	4.0
Devices*	Laptop	228	54.8
	Tablet	46	11.1
	Computer	131	31.5
	Smartphone	11	2.6
	Smartwatch	0	0.0

*Based on the frequency of use

Table 3: The General Background of Respondents (*n*=251)

3.3 INSTRUMENTATION AND METHOD FOR ANALYSIS

The data collection and analysis were conducted using an online questionnaire (Google Form) and IBM SPSS Statistics software, respectively. These data were subjected to descriptive statistical analysis for a general overview and the Friedman test to evaluate differences in agreement among the related group of respondents regarding the satisfaction of MOOC constructs, i.e., the content, layout, and accessibility.

3.4 DEVELOPMENT OF THE QUESTIONNAIRE

The main part of the questionnaire focuses on students' perceptions of three constructs of the LAW083 MOOC platform (Table 4): (a) content, (b) layout, and (c) accessibility. This part contains 17 items and uses a 4-point Likert-type scale (1—strongly disagree to 4—strongly agree) for responses and was developed based on the literature.

Construct	References	Coding	Item
(a)	Wan Nurhayati et al. (2020)	C1	The contents of the MOOC are aligned with the LAW083 syllabus.
		C2	The course materials in the MOOC enhance understanding of LAW083.
		C3	The activities provided in the MOOC are engaging.
		C4	The assessments allow for the evaluation of understanding in LAW083.
		C5	The additional materials in the MOOC are useful for enhancing understanding of LAW083.
		C6	Satisfaction with the quality of the content provided in the MOOC is evident.
(b)	Oh et al. (2019)	L1	The MOOC's visual design is appealing.
		L2	The layout of the MOOC is user-friendly.
		L3	The MOOC's layout is well-organized.
		L4	The MOOC's layout is easy to navigate.
		L5	Overall satisfaction with the experience of using the MOOC's layout is noted.
(c)	Iniesto et al. (2021)	A1	The MOOC allows for learning LAW083 according to individual needs and convenience.
		A2	The MOOC enables learning outside of a fixed classroom environment.
		A3	The MOOC provides free access to all course contents.
		A4	The MOOC can be accessed easily online.
		A5	UiTM's internet facilities facilitate easy access to the MOOC.
		A6	Satisfaction with the overall accessibility of the MOOC.

Table 4: The Questionnaire's Content Development Based on Constructs: (a) Content; (b) Layout; and (c) Accessibility

A pilot study was conducted for the instrument reliability test (n=26), using Isaac & Michael's (1995) sample size determination technique, in which sample sizes for pilot projects ranging from 10 to 30 are adequate. The data were analysed using Cronbach's alpha, indicating an overall high and significant alpha value (α=0.960) based on the constructs shown in Table 5.

	Cronbach's Alpha	N of Items
Content	.947	6
Layout	.878	5
Accessibility	.879	6

Table 5: Conbach's Alpha Item-Total Statistics Based on Constructs

4.0 RESULTS AND DISCUSSION

This section presents the results of the: (a) descriptive statistics analysis; and (b) Friedman test.

4.1 DESCRIPTIVE STATISTICS

Table 6 and Figure 6 present a descriptive statistical analysis of the type of content, layout, and accessibility of the material under consideration based on the Likert scale. Even within the content category (C), it is encouraging to see more than 60% of participants strongly agree with most items in the subscale, especially "C1" with 62.3% and "C2" with 64.4%, which boosts content satisfaction levels. On the other hand, in the layout category (L), there appears to be varied feedback; for instance, "L1" shows that 1.6% strongly disagree, and 8.5% disagree, thus indicating some measure of dissatisfaction. However, "L5" received a more positive response, with 52.2% of respondents strongly agreeing, suggesting that some aspects of the layout were found to be favourable. Concerning accessibility (A), the general rate was favourable towards this attribute, especially for "A3", where 67.6% of respondents strongly agreed, identifying this as an area of strength. Despite content and accessibility being acknowledged as quite satisfactory, in comparison to the other attributes, the layout category needs improvement to better satisfy the users.

		Likert Scale							
		1 Strongly Disagree		2 Disagree		3 Agree		4 Strongly Agree	
	Item	*n*	%	*n*	%	*n*	%	*n*	%
(a)	C1	2	0.8	5	2	86	34.8	154	62.3
	C2	2	0.8	9	3.6	77	31.2	159	64.4
	C3	3	1.2	13	5.3	105	42.5	126	51
	C4	2	0.8	7	2.8	86	34.8	152	61.5
	C5	2	0.8	9	3.6	83	33.6	153	61.9
	C6	2	0.8	8	3.2	88	35.6	149	60.3
(b)	L1	4	1.6	21	8.5	125	50.6	97	39.3
	L2	5	2	11	4.5	120	48.6	111	44.9
	L3	3	1.2	18	7.3	104	42.1	122	49.4
	L4	3	1.2	20	8.1	112	45.3	112	45.3
	L5	4	1.6	7	2.8	107	43.3	129	52.2
(c)	A1	2	0.8	6	2.4	105	42.5	134	54.3
	A2	2	0.8	4	1.6	94	38.1	147	59.5
	A3	2	0.8	6	2.4	72	29.1	167	67.6
	A4	2	0.8	5	2	78	31.6	162	65.6
	A5	9	3.6	28	11.3	106	42.9	104	42.1
	A6	3	1.2	4	1.6	92	37.2	148	59.9

*n: frequency, %: percentage

Table 6: Descriptive Statistics: (a) Content; (b) Layout; and (c) Accessibility

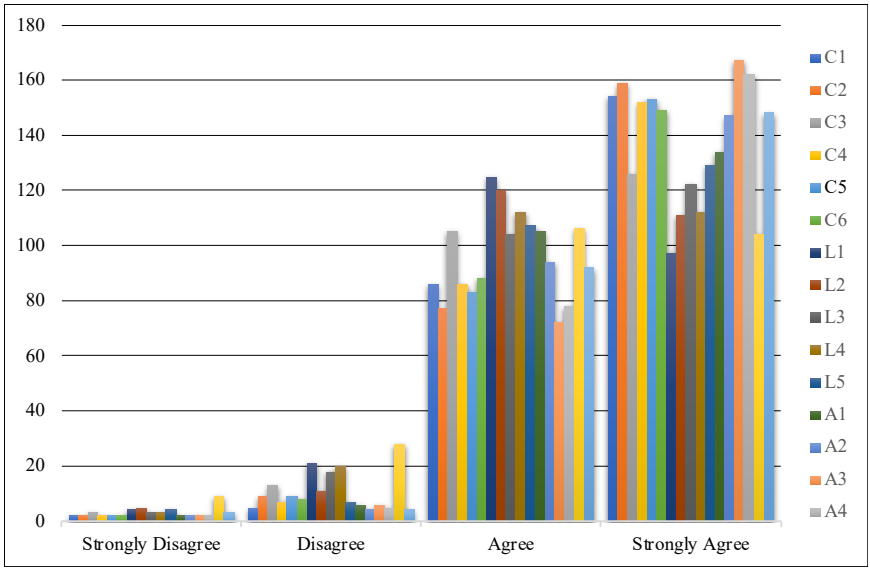

Figure 6: Descriptive Statistics

The Shapiro-Wilk normality test for the content, layout, and accessibility has a significant level of non-normal distribution ($\rho<0.05$), which indicates that the survey may require the use of a non-parametric method of inferential statistical analysis for further examination (Table 7).

	Statistic	df*	Sig.*
Content	.816	26	.000
Layout	.869	26	.003
Accessibility	.869	26	.003

*df: degree of freedom, Sig.: significant level of ρ at 0.05.

Table 7: Normality Tests of Shapiro-Wilk

4.2 FRIEDMAN TEST

This section presents the results from a Friedman test (Table 8) in which the ranks of three measures: content (C), layout (L), and accessibility (A) were found to be significantly different. The Friedman test indicates that "content" (C) received the maximum rank (mean rank: 2.52), which leads to the conclusion that participants viewed this aspect more positively than "accessibility" (A) (mean rank: 2.44), while "layout" (L) scored the lowest (mean rank: 1.04), suggesting that it was the least appreciated, with $\chi 2(2) = 392.278$, $\rho < .05$. The test statistics showed the Chi-square value of 392.278 with 251 samples and an Asymptotic Significance (ρ-value) of less than .001, where the highest acceptable ρ-value in a social science study is typically set at 0.05. This strong statistical significance indicates that the perceptions of the three aspects do differ and suggests the need to determine the reasons for the lower rating of layout relative to content and its accessibility. Finally, these results suggest that layout issues should also be tackled to increase overall satisfaction with the evaluated aspects.

(a)	C: Content	2.52
	L: Layout	1.04
	A: Accessibility	2.44
(b)	*n*	251
	Chi-Square	392.278
	df	2
	Asymp. Sig.	<.001

Table 8: Friedman Test: (a) Mean Ranks; and (b) Test Statistics.

5.0 COMMENTS AND SUGGESTIONS ON CONTENT, LAYOUT AND ACCESSIBILITY

The questionnaire assessed students' opinions on the LAW083 MOOC regarding content, layout, and accessibility, while also gathering feedback for potential improvements in these areas. This section addresses the second research objective.

5.1 CONTENT

In terms of content, students found it useful and helpful in their learning, particularly during exam preparation. This can be observed in the following:

"Mooc really helps me understand the subject better"

"Overall, MOOC helped me a lot in preparing for my tests and finals"

"The contents are easily understandable and really useful to me especially when the final exam is around the corner"

That said, several concerns raised by the students can be categorised into the following two aspects:

(a) Need for updates
Some students suggested that the content, especially slides and additional materials, should be updated regularly.

"Please update MOOC content more frequently"

"Update the slide in MOOC with additional notes"

The feedback shows that students highlighted the need for more frequent updates to the MOOC content, such as slides and additional notes. They also suggested that additional materials be updated each semester.

(b) Lack of quizzes and limited interactive quizzes
Overall, many students appreciated the quizzes but recommended increasing both their number and variety for a more engaging learning experience.
"provide more activities and content for each chapter"

"maybe add more quizzes to make sure students understand better"

"can use the concept of studying in QUIZLET and try applying it for the games to revise, memorise, and enhance understanding. For example, quizzes, questions, and FLASHCARD"

The feedback indicates that students expressed the need to not only increase the number of activities but also to diversify them to help students better understand the course. This is supported by students who suggested using Quizlet game models for revision purposes to enhance their understanding of the course.

5.2 LAYOUT

Students generally found the layout easy to navigate and well-organised. That said, several issues were raised by the students, which can be categorised into two aspects:

(a) Lacking modern design
Some students remarked that the layout lacks modern design and is not very visually appealing.

"The layout is uncluttered but needs a more modern design"

"I hope the layouts can be changed according to today's trend/modern since it can enhance more on students' focus and learning"

"more colorful and cartoons"

"MOOC could be more visually appealing"

The feedback reveals that students appreciated the layout but felt it could be made more modern. The low score for the MOOC layout suggests that students found the content structure unappealing, which hindered their ability to engage with the course. They suggested updating it to align with current trends to enhance focus and learning. Furthermore, they recommended incorporating more colour and cartoons to make the MOOC more visually appealing.

(b) Confusing navigation
Some students claimed that the navigation was complicated and suggested simplifying the layout.

"it is quite complicated to look for material as you have to click on multiple pages to get the contents needed"

This feedback shows that the student found it complicated to navigate the MOOC when searching for materials, as accessing content required clicking through multiple pages.

5.3 ACCESSIBILITY

Students generally found the MOOC easily accessible. However, several issues were raised by the students, which can be categorised into two aspects:

(a) Mobile device compatibility
Some students encountered difficulty accessing certain slides in the MOOC via mobile devices.

"less user friendly on phones compared to the laptop as there are often glitches"

"opening MOOC on phone is a bit hard to navigate"

"Some slides in MOOC are required to be opened through Laptop devices only, which is limited for students who use tablets and smartphones"

The feedback indicates that students reported difficulty accessing the MOOC on mobile devices, often experiencing glitches. Some slides can only be opened on laptops, which limits accessibility for students using tablets and smartphones.

(b) Issues with UITM Wi-Fi
Several students reported difficulties accessing the MOOC via UiTM's Wi-Fi, which restricted their ability to use the platform effectively.

"Students may have trouble accessing MOOC when using UiTM Wi-Fi"

"provide more effective internet services for the community to easily access MOOC"

This feedback conveys that some students reported difficulties accessing the MOOC while using UiTM's Wi-Fi. Furthermore, they emphasised the importance of reliable internet services in ensuring seamless access to MOOCs.

In short, while the LAW083 MOOC is generally appreciated for its content, layout, and accessibility, several key areas require enhancement. Addressing these issues, as highlighted in this section, could improve the overall learning experience and enhance students' understanding of this course.

6.0 CONCLUSION AND RECOMMENDATIONS

Overall, the use of the MOOC for learning LAW083 aligns with the Malaysia Education Blueprint 2015-2025 (Higher Education) to globalise Malaysian higher education institutions. It offers various benefits, including more choices for students to access teaching materials, engage in activities like quizzes and videos, and accommodate diverse learning styles and needs.

For the first research objective, data analysis shows that in the content category (C), over 60% of participants strongly agree with most items, particularly "C1" at 62.3% and "C2" at 64.4%, indicating high content satisfaction. However, the layout category (L) received mixed feedback. For example, 1.6% of respondents strongly disagree with "L1", and 8.5% disagree, indicating some dissatisfaction. In contrast, "L5" received a positive response, with 52.2% of respondents strongly agree, suggesting that some aspects of the layout are favourable. Regarding accessibility (A), the feedback is generally positive, especially for "A3," where 67.6% of respondents strongly agree, marking it as a strength. Although students view the content and accessibility positively, as shown in section 4.0, several issues were raised in their comments and suggestions in section 5.0, which have impacted their MOOC learning experience.

Meanwhile, for the second research objective, student feedback shows that while the LAW083 MOOC is generally appreciated for its content, layout, and accessibility, specific areas need improvement. In terms of content, students highlighted the need for updates, a lack of quizzes, and limited interactive options. The layout was criticised for lacking modern design and its confusing navigation. Additionally, accessibility concerns were raised regarding mobile device compatibility and issues with the UiTM Wi-Fi, which hindered students' ability to access the MOOC effectively.

Based on the aforementioned discussions, the research proposes a set of recommendations to improve LAW083 MOOC in terms of its content, layout, and accessibility:

1. For the content of the MOOC, it is suggested to implement regular updates by establishing a schedule for reviewing course materials. This will ensure that the content remains current and relevant to students' needs. Further, incorporating more interactive activities can better support various learning styles, enrich their learning experience, and keep students motivated.

2. For the layout of the MOOC, it is proposed to redesign it to reflect modern design trends and incorporate more colour and cartoons to make the MOOC more visually appealing. Furthermore, a clear navigation structure is recommended to help students easily access the content.

3. For the accessibility of the MOOC, it is recommended to ensure that all slides and course materials can be accessed on mobile devices, thus removing any restrictions that currently limit access to laptops only. Additionally, it is suggested to conduct regular maintenance checks on the Wi-Fi system to ensure optimal performance in ensuring smooth access to the MOOC.

It is hoped that improving the content, layout, and accessibility will support students of various learning styles, enhance their learning experience, and improve their understanding of this course.

7.0 ACKNOWLEDGMENT

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Exploring the Role of Digital Technology in Enhancing Culinary Students' Pronunciation of French Terms

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Abstract: *This study explores the impact of digital technologies, specifically Computer-Assisted Pronunciation Training (CAPT) systems and Automatic Speech Recognition (ASR), on improving culinary students' pronunciation of French culinary terms. Accurate pronunciation of these terms is crucial for students preparing for professional culinary careers, where effective communication in a global context is essential. The research adopts a qualitative approach, focusing exclusively on insights gathered through interviews and discussions. A sample of 20 culinary students from Universiti Teknologi MARA Pulau Pinang participated, with an experimental group using CAPT and ASR tools and a control group relying on traditional methods. The findings revealed that students using digital tools experienced increased motivation, confidence, and engagement in learning, alongside a better understanding of pronunciation nuances. Challenges in adapting to the technology were also discussed. By concentrating solely on*

qualitative results, this study highlights the potential of technology-assisted pronunciation tools in enhancing student learning experiences and shaping their readiness for professional environments. These findings contribute valuable insights into integrating digital tools within specialized language education, particularly in culinary training.

Keywords: *Automatic Speech Recognition (ASR), Computer-Assisted Pronunciation Training (CAPT), Digital technology, Culinary Education, Pronunciation improvement.*

1.0 INTRODUCTION

The integration of digital technologies in language learning has increasingly demonstrated its effectiveness, particularly in enhancing pronunciation skills in specialized contexts. Research indicates that these tools, especially when integrated with real-time feedback mechanisms, substantially improve learners' pronunciation capabilities. For instance, Silveira et al. (2022) highlight that Computer-Assisted Pronunciation Training (CAPT) systems offer adaptive and flexible practice environments crucial for effective language acquisition. Such systems provide learners with instant corrective feedback, fostering increased awareness and aiding accurate pronunciation development (Burri, 2023). Furthermore, the integration of Automatic Speech Recognition (ASR) technology has proven impactful, as it allows learners to receive immediate, precise feedback in low-stress environments, significantly supporting pronunciation improvement (Inceoglu et al., 2022). Martin et al. (2022) emphasizes the motivational benefits of audiovisual materials; instructional videos provide a personalized touch, helping students experiencing language anxiety by combining visual and auditory stimuli that encourage frequent practice (Herrera, 2023).

The rise of mobile applications has also transformed pronunciation training, offered varied phonological inputs, and enhanced engagement through ASR and peer feedback. A study by Dai and Wu (2021) illustrates that mobile-assisted learning platforms foster interactive environments conducive to engagement and learning (Geng, 2021). These advancements not only promote motivation but also tailor the learning experience to meet diverse learner needs. CAPT systems, equipped with speech recognition, have shown notable improvements in pronunciation accuracy, especially when

used collaboratively. Bogach et al. (2021) assert that CAPT's targeted feedback on phonetic and rhythmic elements significantly boosts articulation skills. Similarly, Tsai (2019) notes that a collaborative learning approach, where peers help interpret feedback, creates an engaging atmosphere for shared pronunciation practice. In support, Nasim et al. (2022) report that students using advanced digital tools outperform their peers who rely solely on traditional methods, underscoring the transformative role of technology in pronunciation learning.

Focusing on culinary education, French culinary terms are integral to the global industry, forming the foundation of professional kitchens worldwide. These terms, rooted in French culture, encompass essential techniques, ingredients, and practices widely adopted across various culinary traditions. However, for many culinary students, especially non-native French speakers, mastering the pronunciation of these terms presents a significant challenge. With the growing emphasis on precision and professionalism in culinary arts, accurately learning and pronouncing these terms is essential for global employability. Addressing this challenge, the integration of digital technology in culinary education offers promising solutions. For example, new technologies such as Virtual Reality (VR) and CAPT have created immersive environments where students can practice and perfect their pronunciation of French culinary terms. Jia and Liu (2019) describe how VR systems like "Words in Kitchen" allow learners to interact with virtual objects while practicing pronunciation, enhancing both engagement and retention.

The incorporation of audio-visual tools and interactive software in pronunciation teaching further enhances learning outcomes. Adawi et al. (2021) reveal that integrating pronunciation-focused multimedia tools in language learning improves the performance and retention of complex culinary terms. Specialized pronunciation media, such as video tutorials and guides, provide a structured and effective learning environment where culinary students can practice at their convenience. Technology-driven pronunciation training also offers real-time feedback, which has proven essential in improving pronunciation accuracy. CAPT systems, using speech recognition software, provide instant corrections and suggestions, enabling students to correct mistakes early in the learning process—a critical factor when mastering precise French culinary terms that align with global culinary standards (Meritan, 2022).

Moreover, the role of technology extends beyond practice; it fosters student confidence. By utilizing digital platforms and interactive exercises, students practice without the fear of public correction, building their skills in a supportive, non-judgmental environment (Samsul et al., 2022). This increased confidence positively influences their professional readiness, enabling effective communication in high-pressure kitchen settings. The flexibility of technology further enhances its impact on learning. Telecollaborative projects and online pronunciation tools offer flexible, convenient learning experiences, accommodating the rigorous schedules of culinary students (Díez, 2021). This flexibility allows students to access resources and practice skills anytime, fitting language learning into their demanding training schedules.

Given these findings, this study investigates the impact of digital tools, particularly CAPT and ASR technologies, on pronunciation accuracy among culinary students at the Universiti Teknologi MARA Pulau Pinang. By examining the effectiveness of these technologies in mastering complex French culinary terms, this research aims to contribute valuable insights into the integration of digital technology within specialized language learning in culinary education.

1.1 RESEARCH PROBLEM AND SIGNIFICANCE

In culinary education, mastering the pronunciation of specialized vocabulary, particularly French culinary terms, is crucial. For culinary students, proficiency in these terms extends beyond linguistic ability; it is a core aspect of their professional development and employability in the global culinary field. Traditional teaching methods often lack flexibility, real-time feedback, and personalized support necessary for accurate pronunciation, leaving many students struggling to develop the required proficiency. This gap highlights a pressing problem in culinary education: the need to equip students with effective pronunciation skills in a field where accuracy and professionalism are paramount.

The importance of this study lies in its potential to revolutionize culinary education through the integration of advanced digital tools, notably Computer-Assisted Pronunciation Training (CAPT) systems and Automatic Speech Recognition (ASR) technologies. Current research highlights these tools' effectiveness in improving pronunciation accuracy and creating a supportive learning environment (Safavi, 2018). By utilizing CAPT and ASR, students receive immediate feedback on their pronunciation, promoting self-directed learning and effective error correction. This study seeks to demonstrate how digital tools can overcome traditional challenges, such as the lack of interactivity and adaptability, to enhance pronunciation training and build students' linguistic confidence.

Moreover, findings from recent studies emphasize the potential of digital tools to empower students with flexible learning options. AI-supported pronunciation education has shown to be particularly effective in enhancing vocabulary retention by enabling students to practice independently and track progress, a feature crucial for busy culinary students balancing demanding schedules (Kazu & Kuvvetli, 2023).

This AI-driven approach to pronunciation training not only addresses a critical challenge in culinary education but also contributes to the broader discourse on the role of technology in specialized language acquisition, offering valuable insights for educators. As technological tools like mobile applications continue to gain traction, they can make learning more accessible, engaging, and tailored to individual student needs, forming a foundation for future innovations in this field.

The following Central Question and Sub-Questions section emphasize the role of digital tools in addressing pronunciation challenges.

1.2 CENTRAL QUESTION

How can the integration of digital technology enhance culinary students' ability to pronounce French culinary terms accurately and confidently?

1.3 SUB-QUESTIONS

1. What is the primary pronunciation challenges culinary students face when learning French culinary terms, and how can technology address these difficulties? (This question explores the specific pronunciation challenges (e.g., phonetic, accent-related) and investigates how technological tools, such as speech recognition software and pronunciation apps, can help overcome these obstacles).

2. How do culinary students perceive the role of technology in improving their pronunciation skills, and what digital tools are most effective? (This question examines students' attitudes towards using technology for pronunciation practice and identifies the tools they find most useful (e.g., apps, CAPT systems, audiovisual resources)).

3. What strategies and resources can educators use to integrate technology into pronunciation teaching, and how can these tools improve student engagement? (This question focuses on pedagogical approaches, including blended learning and interactive digital resources, and their impact on student motivation and participation in pronunciation learning).

4. How can digital technology be used to assess and provide feedback on culinary students' pronunciation of French terms, and what are the most effective methods? (This question explores the use of technology for real-time feedback, self-assessment, and peer collaboration, highlighting effective methods for evaluating and improving pronunciation skills).

5. In what ways does the use of technology for pronunciation training impact culinary students' professional confidence and identity development? (This question investigates how mastering pronunciation with the aid of technology enhances students' professional confidence and shapes their culinary identity, preparing them for careers in the global culinary industry).

2.0 LITERATURE REVIEW

The integration of technology in educational settings has significantly transformed how culinary students learn, especially in mastering the pronunciation of French culinary terms. This shift is essential, as accurate pronunciation is crucial for effective communication in the culinary field, where many terms are derived from French. Recent studies have explored various technological tools and methodologies that enhance pronunciation accuracy and retention, thereby supporting culinary students in developing essential language skills. This literature review synthesizes recent research on the effectiveness of technology-enhanced pronunciation instruction, specifically within culinary education.

To begin with, computer-assisted pronunciation training (CAPT) has emerged as a pivotal tool in enhancing pronunciation among culinary students, providing invaluable real-time feedback essential for mastering complex French culinary terms. This instant correction allows students to practice at their own pace, making CAPT an indispensable resource in culinary education. Furthermore, its individualized approach not only enhances learning outcomes but also supports teachers in effectively scaffolding instruction, and fostering professional development in culinary environments. The integration of CAPT systems into the curriculum aligns with the growing emphasis on personalized learning experiences, which is a cornerstone of modern educational practices (Cengiz, 2023).

Beyond CAPT, audiovisual tools have been widely adopted to improve pronunciation learning in culinary education. Espinoza et al. (2021) found that culinary videos as teaching aids create engaging learning experiences, promoting both comprehension and pronunciation. Audiovisual materials provide context-rich examples, allowing students to imitate and practice pronunciation more effectively. This approach supports the need for dynamic and interactive learning environments, where visual and auditory stimuli play an important role in enhancing vocabulary retention and pronunciation skills. The use of videos not only captivates students' attention but also helps them understand pronunciation nuances associated with French culinary terminology, making learning more enjoyable and practical.

Further, Silveira et al. (2022) investigated the role of digital technologies, such as mobile applications and interactive platforms, in pronunciation instruction. Their research highlights that these digital resources enhance accessibility and flexibility, allowing learners to practice pronunciation independently and efficiently.

For culinary students, who often manage demanding schedules, this flexibility is especially beneficial, enabling them to engage with pronunciation exercises at their convenience. The study underscores the importance of integrating digital tools into daily teaching practices to maximize their impact, ensuring that students can effectively improve their pronunciation skills.

Another notable advancement in pronunciation teaching involves ASR-equipped software that addresses suprasegmental features like intonation and rhythm. Gottardi et al. (2022) examined how ASR systems can provide learners with feedback on these nuanced elements of pronunciation. Their findings suggest that ASR-equipped tools offer unique advantages in helping students refine their speech patterns, which is especially beneficial for mastering the pronunciation of intricate French culinary terms that require attention to intonation and stress (Gottardi et al., 2022). This precision in pronunciation can significantly influence communication effectiveness and professional credibility in the culinary field.

Lastly, collaborative learning approaches, particularly when combined with Computer-Assisted Pronunciation Training (CAPT) systems, have proven effective in enhancing pronunciation instruction. For instance, Sobko et al. (2019) highlight that collaborative learning environments, where peers assist one another in addressing pronunciation challenges, significantly boost motivation and engagement. This integration of technology not only supports individual learning but also fosters peer interaction, making the educational experience more enjoyable and effective, an essential aspect for preparing culinary students for real-world kitchen environments, where communication and teamwork are crucial.

In summary, the integration of technology in pronunciation teaching has yielded promising results for culinary students. CAPT systems, audiovisual tools, and ASR-equipped software provide essential support for mastering the pronunciation of French culinary terms. This technological approach ensures that students are well-prepared for the demands of the global culinary industry. As educational technology evolves, it continues to present new opportunities for improving pronunciation instruction, making it an exciting area for future research and development (Rogerson-Revell, 2021; Silveira et al., 2022). Embracing these innovative teaching methodologies will be vital as the culinary industry grows more interconnected, highlighting the lasting value of pronunciation accuracy in the professional development of culinary students.

3.0 METHODOLOGY

3.1 RESEARCH DESIGN

This study adopts a qualitative approach to explore the impact of technology-assisted pronunciation tools, specifically Computer-Assisted Pronunciation Training (CAPT) and Automatic Speech Recognition (ASR) systems, on culinary students' pronunciation of French culinary terms. A qualitative approach is particularly suitable for capturing detailed insights into students' experiences, perceptions, and challenges, offering a rich understanding of the role these tools play in enhancing learning outcomes (Tsai, 2019).

3.2 PARTICIPANTS

The participants of this study are culinary students from the Universiti Teknologi MARA Pulau Pinang, who are required to master French culinary terms as part of their professional training. The sample consists of approximately 20 students, divided into two groups: an experimental

group using CAPT and ASR tools and a control group using traditional pronunciation methods. This sample size is informed by prior research, which demonstrates that technology-based interventions are effective in improving learning outcomes in similarly sized groups (Cengiz, 2023).

3.3 DATA COLLECTION INSTRUMENTS

The primary data collection methods for this study include semi-structured interviews and focus group discussions. The qualitative data will be collected through semi-structured interviews conducted with individual students to gather in-depth insights into their personal experiences, perceptions, and challenges with using technology-assisted pronunciation tools, such as CAPT and ASR systems. Semi-structured interviews allow researchers the flexibility to explore specific topics in depth while ensuring key research questions are systematically addressed (Rogerson-Revell, 2021).

In addition, focus group discussions will be held to facilitate broader exchanges of ideas and collective reflections among students. Focus groups encourage participants to share their experiences, strategies, and perceptions, providing a richer understanding of shared perspectives on the usability and effectiveness of these tools (Tsai, 2019). Together, these two methods provide a comprehensive approach to gathering qualitative data.

3.4 PROCEDURE

The study will be conducted over 10 weeks and organized into three distinct phases. During the initial phase, participants will be introduced to the study objectives and provided with demonstrations of the CAPT and ASR tools. In the intervention phase, the experimental group will practice pronunciation using these tools, while the control group will continue with traditional methods, such as peer and instructor feedback. In the final phase, data will be collected through semi-structured interviews and focus group discussions.

3.5 DATA ANALYSIS

Thematic coding will be employed to systematically analyze the qualitative data, identifying recurring patterns, common perceptions, and challenges

faced by students while using technology-assisted pronunciation tools (Mortelmans, 2019). This approach ensures the analysis captures both broad trends and subtle individual experiences. NVivo software will be utilized to organize and code the data efficiently, enabling the identification of key themes and patterns (Bonello & Meehan, 2019). The thematic analysis will provide valuable insights into the usability, effectiveness, and challenges associated with CAPT and ASR systems in improving pronunciation learning.

Sub-Questions	Common Themes	Focused Themes	Key Themes for Conceptual Framework
1. What are the primary pronunciation challenges?	Mispronunciation of stress and intonation, lack of phonetic awareness	Difficulty mastering the correct rhythm of French culinary terms when relying on traditional methods	Technological Intervention
2. How do students perceive the role of technology?	Technology as a facilitator for autonomous practice	Students feel more motivated and less anxious using CAPT systems as they receive instant corrective feedback	Learner Engagement and Motivation
3. What strategies and resources are effective?	Integration of digital resources enhances engagement	The use of multimedia, including videos and interactive apps, proved to be highly engaging for culinary students	Learner Engagement and Motivation
4. How can technology provide feedback and assessment?	Immediate feedback and self-paced learning support	ASR tools are particularly effective in providing real-time corrections on stress and rhythm patterns	Technological Intervention
5. How does technology impact professional confidence?	Increased confidence due to self-monitoring and self-correction	Technology provides a non-judgmental space, reducing anxiety and boosting professional readiness	Learning Outcomes

Table 1: Summary of Common, Focused, and Main Themes Derived from Research Sub-Questions for Conceptual Framework

Qualitative insights from interviews and discussion focus groups summarized in (Table 1) further support these findings. Students frequently mentioned that CAPT systems' immediate feedback was instrumental in enhancing their accuracy and confidence. Many expressed a preference for practicing independently with digital tools, which allowed them to control the pace of their learning and reduce anxiety associated with peer evaluation. The flexibility of the technology also enabled students to balance their practice sessions with other academic responsibilities, leading to higher motivation and engagement.

Moreover, students highlighted the role of multimedia elements such as videos and pronunciation apps in making the learning process more enjoyable. These tools not only maintained their interest but also encouraged consistent practice. The non-judgmental nature of ASR feedback provided a safe space for students to experiment with pronunciation, further boosting their confidence and professional readiness.

In summary, the results demonstrate that technology-assisted tools significantly improve students' pronunciation skills across multiple dimensions, including stress, intonation, and overall precision. The experimental group's superior performance underscores the value of integrating CAPT and ASR tools in culinary education. Additionally, the motivational benefits of these technologies contribute to better engagement and enhanced professional preparation. Together, the findings suggest that adopting digital tools can play a crucial role in equipping students with the communication skills necessary for success in the culinary industry.

4.0 CONCEPTUAL FRAMEWORK FROM THE KEY THEMES

The conceptual framework, depicted in Figure 1 as the Technology-Assisted Pronunciation Learning (TAPL) Framework, was developed by synthesizing key themes identified from both qualitative and quantitative findings in this study. The framework is structured into three main components: Technological Intervention, Learner Engagement and Motivation, and Outcomes, each representing a phase in the learning process that starts with digital tool usage and progresses toward professional readiness in pronunciation skills.

The foundational element of the framework, Technological Intervention, focuses on the use of Computer-Assisted Pronunciation Training (CAPT) and Automatic Speech Recognition (ASR) tools. Positioned at the base of Figure 1, this component introduces digital tools that enable self-paced, interactive learning environments. These tools provide essential real-time feedback, allowing students to make immediate corrections in pronunciation areas like stress, rhythm, and intonation—challenges often not adequately addressed by traditional methods. This stage serves as the initiation point for students' pronunciation learning, equipping them with necessary resources that are flexible and supportive of autonomous practice.

The middle layer of the framework, Learner Engagement, and Motivation, reflects how technological tools foster a supportive environment that enhances student motivation. Derived from qualitative findings, this component highlights the CAPT and ASR tools' ability to reduce anxiety by allowing students to practice without external judgment. Students expressed that they felt more in control of their learning and were more inclined to engage in pronunciation practice, thus fostering intrinsic motivation. This component is critical as it bridges the technological intervention with the learning outcomes, emphasizing that student engagement is essential for sustained practice and improvement.

At the top of the framework in Figure 1, Outcomes represent the culmination of the learning process, focusing on Professional Readiness and Pronunciation Accuracy. Through continued engagement with CAPT and ASR tools, students showed improved pronunciation of complex culinary terminology, an essential skill for clear and professional communication in the culinary field. The Outcomes component illustrates the final objective of this framework: to prepare students effectively for professional environments by equipping them with accurate pronunciation and communication skills needed for success in the global culinary industry.

In summary, Figure 1 visually presents the TAPL Framework as a progression from Technological Intervention through Learner Engagement and Motivation to Outcomes. Each component builds logically upon the previous one, creating a structured and research-based pathway from initial technological support to the achievement of professional competencies. This structure illustrates how the integration of digital tools in pronunciation learning can significantly enhance engagement and support skill mastery in preparation for real-world applications.

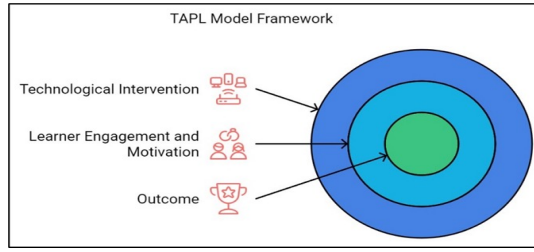

Fig. 1: Technology-Assisted Pronunciation Learning (TAPL) Framework

5.0 DISCUSSION

The findings of this study highlight the enhanced engagement and motivation reported by students using technological tools, aligning with previous research that underscores technology's ability to create independent and flexible learning environments. Specifically, CAPT has been shown to boost learner autonomy and satisfaction, empowering students to practice at their own pace and receive tailored feedback that promotes mastery (Lou, 2024; O'Brien et al., 2022). This element of self-paced learning is essential in language acquisition, particularly in contexts like culinary arts, where mastery over specific terms significantly enhances professional communication.

Furthermore, technological advancements in CAPT and ASR systems have paved the way for highly personalized pronunciation training. Recent studies reveal that systems leveraging machine learning techniques, such as multi-task learning and context-aware models, can detect pronunciation errors and deliver corrective feedback essential for learners without access to traditional instruction (Wu & Ji, 2023; Bi et al., 2023). The success of these systems

in improving pronunciation demonstrated in diverse linguistic contexts, is echoed in research by Tejedor-García et al. (2021), who reported that ASR-based pronunciation assessment improved L2 Spanish pronunciation among Japanese speakers after minimal sessions. The effectiveness of these tools, noted for their capacity to offer immediate, individualized feedback, offers convenience and economic advantages over traditional classroom settings (Gong, 2022). Therefore, as CAPT and ASR technologies continue evolving, incorporating sophisticated algorithms and user-centered designs will likely increase their pedagogical impact.

The implications of enhanced pronunciation skills for culinary students are far-reaching, particularly for articulating French culinary terminology accurately. This ability is crucial in the culinary industry, where precise terminology facilitates effective communication and reflects a sense of professionalism. Research indicates that mastering culinary terms contributes to confidence and professional identity, essential for students aiming for international careers (Li, 2023). By accurately pronouncing these terms, students can confidently engage in professional culinary dialogues, underscoring the value of pronunciation training as a foundational aspect of professional development within the field. Innovative methods such as tongue twisters alongside CAPT have shown considerable effectiveness in refining pronunciation skills, offering educators reliable strategies to enhance students' articulation (Li, 2020; Saleh & Gilakjani, 2020). The dual approach of traditional and tech-based techniques aligns with contemporary educational practices that prioritize learner autonomy and individualized instruction, supporting students in mastering complex culinary language (Tejedor-García et al., 2021).

However, limitations in this study indicate areas for improvement in technology-assisted pronunciation training. The relatively brief intervention period may not fully capture long-term skill retention, a concern reflected in the literature suggesting that extended interventions might provide more comprehensive insights (Nurmala et al., 2023; Iberahim et al., 2023). Another limitation lies in the one-size-fits-all approach of these tools, which may not suit all learners. This issue is consistent with findings from studies advocating for tailored technological approaches to accommodate diverse learning styles (Panagiotidis et al., 2023). Additionally, interpreting feedback from CAPT systems poses challenges for some students, potentially

affecting engagement and pronunciation improvement (O'Brien et al., 2022). Future research should prioritize several key areas to maximize the effectiveness of CAPT systems. First, investigating the long-term effects on pronunciation retention is essential. Current literature points to a gap in understanding how well learners retain skills acquired through CAPT over time, underscoring the need for longitudinal studies (Mahdi & Khateeb, 2019). Furthermore, integrating adaptive learning technologies within CAPT systems could allow for tailored feedback that addresses individual pronunciation challenges, fostering a more effective learning environment (Semerikov, 2021; Su & Zou, 2020). Incorporating immersive technologies like Virtual Reality (VR) into CAPT also shows promise; VR's potential for rich, interactive environments could enhance language learning experiences, especially in simulated culinary contexts where pronunciation practice becomes more contextually relevant (Li, 2020).

Finally, combining CAPT with collaborative learning environments can enrich the learning experience, as peer feedback reinforces learning and enhances engagement in language acquisition (Jie, 2023).

In summary, the findings of this study demonstrate that technology-enhanced tools significantly improve pronunciation learning among culinary students. By incorporating CAPT and ASR systems into the curriculum, educational institutions can equip students with essential communication skills, bolster their confidence, and prepare them for professional success in a globalized culinary industry.

6.0 CONCLUSION

In conclusion, this study demonstrates that the integration of digital technologies, particularly Computer-Assisted Pronunciation Training (CAPT) systems and Automatic Speech Recognition (ASR), significantly enhances culinary students' ability to accurately pronounce complex French culinary terms. The findings underscore the importance of real-time feedback and personalized learning offered by these tools, which result in improved pronunciation accuracy, heightened student engagement, and greater professional confidence. The significance of these results lies in their potential to transform culinary education by equipping students with essential communication skills required for success in global culinary

environments. The study suggests that incorporating technology-driven pronunciation tools into educational curricula can provide substantial benefits, both in immediate learning outcomes and long-term professional preparedness. Overall, this research contributes valuable insights into the role of technology in specialized language education, offering a clear direction for future educational practices and research.

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Evaluating the Effectiveness of MOOCs in Developing Agribusiness Pitching Skills: A Study of Agropreneurship Diploma Students

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Abstract: *This study explores the effectiveness of Massive Open Online Courses (MOOCs) in developing pitching skills for agribusiness students. Pitching skills are critical for agropreneurship students as they seek to secure funding, partnerships, and market access. The study focuses on 27 fourth-semester diploma students in agropreneurship who completed a 4-week MOOC designed to improve business pitching. A mixed-methods approach was used, including pre-and post-course assessments to measure changes in students' confidence and skill comprehension and focus group discussions to gather detailed feedback. Quantitative findings show a significant increase in confidence and understanding of crucial pitching concepts following the course. Qualitative feedback highlights that students valued the accessibility and flexibility of the MOOC but expressed a need for more interactive exercises to better develop practical pitching skills. The study suggests that MOOCs can effectively support specific skill-building in agropreneurship but should incorporate hands-on elements to enhance real-world application. These results offer insights into the role of online courses in niche skill development and provide recommendations for future MOOC design in agribusiness education.*

Keywords: *Agribusiness, Agropreneurship, Entrepreneurship, Massive Open Online Course, pitching*

1.0 INTRODUCTION

The agricultural sector is rapidly evolving, with entrepreneurship becoming a vital skill for students aiming to enter agribusiness. As competition increases, aspiring agropreneurs must develop a range of skills to differentiate their ideas, products, and services, and effectively pitch these to investors, clients, and stakeholders (Higgins et al., 2018). Pitching skills are crucial for securing funding, gaining market access, and building partnerships in agribusiness (Chapple et al., 2022; Fairbairn et al., 2022; Guimtrandy & Burger-Helmchen, 2022). Agriculture is a key sector globally, but there is a need for improved entrepreneurship skills in this area, especially in business pitching. By embedding social learning into MOOCs, business pitching becomes a dynamic and interactive process, enabling learners to refine their skills while benefiting from the collective wisdom and experiences of a global learning community (Bell et al., 2016). This approach not only improves individual pitching abilities but also fosters collaboration, creativity, and resilience, which represent the key traits for entrepreneurial success.

Massive Open Online Courses (MOOCs) have emerged as popular educational platforms, offering diverse and accessible training resources for skill acquisition, including business and entrepreneurship (Chea, 2016). MOOCs' flexibility, affordability, and accessibility make them an appealing option for students, especially those seeking to develop business-specific skills such as pitching (Liyanagunawardena, 2015). MOOCs have become essential for skills training due to their accessibility and scalability, particularly in underrepresented fields like agriculture. Nowadays, MOOCs have revolutionized how people learn, providing access to high-quality content from prestigious institutions. In business education, MOOCs have been used to teach various skills like leadership, finance, and entrepreneurship (Pampouri et al., 2021). Prior research shows MOOCs can be effective but with limitations such as low completion rates and lack of direct interaction (Baturay, 2015; Loh et al., 2024).

Agribusiness entrepreneurship is crucial for driving innovation and sustainability in agriculture. Business pitching is a key skill because it helps entrepreneurs attract investment, partnerships, and market opportunities (Al-Atabi & Deboer, 2014; Bousbahi & Chorfi, 2015; Resei

et al., 2018; Solórzano-García & Navío-Marco, 2019; Vorbach et al., 2019; Żur, 2018). Traditionally, agricultural education has focused more on technical skills, leaving a gap in entrepreneurial training, especially in business communication. The emergence of agriculture-focused MOOCs is addressing this gap by offering content that combines technical agriculture knowledge with entrepreneurial skills like business pitching. It is believed that MOOCs in agribusiness have the potential to empower entrepreneurs by providing them with tools and strategies that can help scale their businesses. The development of MOOC for AGB283 Agriculture Business Pitching is one of the examples of MOOCs that has been successfully published and is currently available on online platforms. On a side note, agropreneurship students often require specialized training to effectively communicate and market their agricultural ventures. However, traditional education formats may not always provide intensive training focused on pitching skills. Thus, MOOCs serve as an accessible alternative to address this gap.

2.0 PROBLEM STATEMENT

Despite the increasing availability of MOOCs, there is limited empirical research on their effectiveness in practical skill development, particularly for niche areas like agribusiness pitching. This gap raises questions about whether MOOCs can adequately prepare agropreneurship students for the unique demands of pitching in the agricultural sector. While several studies have explored MOOCs' impact on general education and skill acquisition, few have focused on assessing specific skill development, particularly in the context of pitching for agribusiness students. This research aims to fill this gap by examining how well a pitching-focused MOOC supports diploma students in agropreneurship by establishing the following research questions.

- Are MOOCs effective in enhancing the pitching skills of agropreneurship students?
- Do students perceive MOOCs as accessible and relevant for learning pitching skills?
- What are the limitations of using MOOCs for practical skill development in agribusiness?

3.0 OBJECTIVE

Objective 1: To evaluate the impact of MOOCs on students' confidence and comprehension of pitching skills in agribusiness.

Objective 2: To assess students' perceptions of the accessibility and relevance of MOOCs as a learning tool for developing agribusiness pitching skills.

Objective 3: To identify challenges and limitations faced by students in applying pitching skills learned through MOOCs in real-world agribusiness contexts.

4.0 RELATED WORKS

The study design employs a pre-post intervention approach to quantitatively and qualitatively assess the effectiveness of a MOOC in improving pitching skills among Diploma in Agropreneurship students in the Faculty of Plantation and Agrotechnology at Universiti Teknologi MARA (UiTM) Sabah Branch, Kota Kinabalu Campus. A mixed-methods approach captures measurable improvements in skills as well as subjective experiences.

4.1 METHODOLOGY

i. Sampling and Participants:

- Population sample: Fourth-semester diploma students in agropreneurship (AT113) with limited prior exposure to formal business pitching training.

ii. Data Collection Instruments:

- Pre- and Post-Course Questionnaire: To gauge students' baseline and post-course confidence, understanding, and perceived adequacy of MOOC resources (Table 1).
- Focus Group Discussions: Conducted post-MOOC to gather in-depth qualitative data on participants' learning experiences, challenges, and course impact.

iii. MOOC Content:

- A customized, 4-week MOOC (https://ufuture.uitm.edu.my/mooc/course_detail.php?course=AGB283website) (Figure 1-4) covering the fundamentals of agribusiness pitching, including topics such as pitch structuring, effective communication, identifying unique selling propositions, and real-world case studies.

4.2 ANALYSIS APPROACH

To evaluate the effectiveness of MOOCs in developing pitching skills for agropreneurship students, a multi-faceted analysis approach was employed. First, comparisons of pre- and post-course ratings on confidence and skill were conducted to quantify improvements, providing insight into participants' growth in pitching competencies. Additionally, changes in participant goals before and after the course were examined to assess the alignment of course content with students' learning objectives and practical needs. Post-course feedback on the accessibility and adequacy of MOOC resources was then analyzed to understand the course's perceived value compared to traditional educational formats. Finally, feedback was gathered on suggested improvements, offering recommendations for refining future iterations of the course. Together, these analyses provide a comprehensive view of the course's impact and areas for enhancement.

4.3 PRE- AND POST- QUESTIONNAIRE QUESTIONS

No.	Pre-Questionnaire Questions	Post-Questionnaire Questions
1	What is your current level of confidence in pitching business ideas to investors? (1 = Very Low, 5 = Very High)	After completing this MOOC, how would you rate your confidence in pitching business ideas to investors? (1 = Very Low, 5 = Very High)
2	How would you rate your understanding of key pitching components (e.g., structure, timing, highlighting unique selling points)? (1 = Poor, 5 = Excellent)	How would you rate your current understanding of key pitching components (e.g., structure, timing, highlighting unique selling points)? (1 = Poor, 5 = Excellent)

3	Have you previously received any formal training in business pitching? (Yes/No)	Did you achieve your initial goals for this course? (Yes/No)
4	What do you hope to achieve by completing this MOOC?	How often do you anticipate practicing or presenting business pitches after this MOOC?
5	How often do you practice or present business pitches? ● Regularly ● Occasionally ● Rarely ● Never	Do you feel the MOOC provided adequate resources for developing your pitching skills? (Yes/No)
6	What is your current level of familiarity with agribusiness-focused MOOCs? (1 = Not Familiar, 5 = Very Familiar)	Which of the following skills improved most as a result of this MOOC? ● Structuring a pitch ● Identifying unique selling points ● Confidence in delivery ● Handling investor questions
7	Do you currently use any online resources or courses to develop your agribusiness skills? (Yes/No)	How do you compare the accessibility of this MOOC to traditional education formats for similar skills? (1 = Much Less Accessible, 5 = Much More Accessible)
8	How accessible do you find online courses for learning practical skills like pitching? (1 = Very Inaccessible, 5 = Very Accessible)	Did the MOOC meet your expectations in terms of practical application and feedback? (1 = Not at All, 5 = Exceeded Expectations)
9	In your opinion, what are the primary challenges you face when pitching your agribusiness ideas?	How would you describe the impact of the MOOC on your career or business opportunities? ● Significant impact ● Moderate impact ● Limited impact ● No impact

10	How important do you believe networking opportunities are to improve your pitching skills? (1 = Not Important, 5 = Very Important)	What improvements would you suggest for future iterations of this MOOC?

Table 1. Lists of Pre-and Post-Questionnaire Questions

Figure 1. Front Cover of the AGB283 MOOC on Agriculture Business Pitching in UFuture Platform

Figure 2. The Learning Activities Interface of the AGB283 MOOC on UFuture

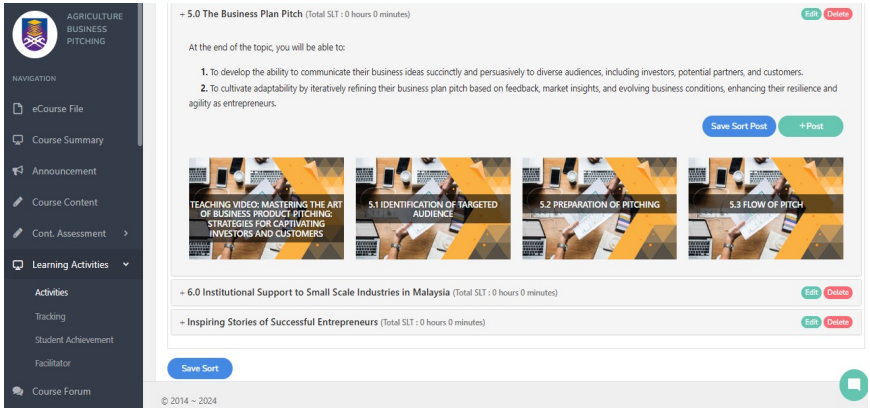

Figure 3. The Business Pitching Learning Activities via UFuture

Average confidence ratings increased from pre-course ($M = 2.8$, $SD = 0.7$) to post-course ($M = 4.1$, $SD = 0.5$), with a paired t-test showing statistical significance ($p < 0.01$). Ratings for understanding key pitching components rose from an average of 3.0 (pre-course) to 4.2 (post-course), indicating improved comprehension. The significant increase in confidence and skill comprehension ratings indicates that MOOCs can effectively build foundational skills in pitching as observed in Figure 4. Students found the MOOC format accessible and flexible via UFuture, particularly for rural students or those balancing studies with work commitments. Nonetheless, students noted a need for hands-on practice opportunities within the MOOC and expressed a need for live feedback or interactive exercises to simulate real-world pitching experiences better. Students highlighted the relevance of course content, with many reporting that they better understood how to structure pitches that align with agribusiness market expectations. Despite the improvements, qualitative data suggests that the MOOC format may lack sufficient opportunities for practical skill application and personalized feedback, a common critique of online learning for hands-on skills (Saharuddin et al., 2024a). Nonetheless, expanding assessment methods, such as incorporating self-evaluations, project-based learning, formative feedback, and peer assessment, aligns seamlessly with the use of Massive Open Online Courses (MOOCs) for lecturing on agricultural business pitching (Uygun & Cesur, 2024).

In addition, 20% of students rated MOOCs as more accessible than traditional classroom formats, mainly due to the flexible, self-paced nature of the course, suggesting that technology-mediated education enhances the overall learning effectiveness of the learners (Abhishek et al., 2023). Compared to traditional classroom settings, the lack of live interaction in MOOCs limits their effectiveness in teaching practical skills like pitching that benefit from feedback and active practice. Common responses have included requests for more interactive components, personalized feedback, and live pitch practice sessions. Many students are likely to perceive the MOOC favorably in comparison to traditional classes due to the MOOC's focus on specific pitching skills relevant to agribusiness.

Nonetheless, the findings are expected to support the growing role of MOOCs as supplementary educational tools in agropreneurship training. Increased confidence and perceived skill improvements indicate that MOOCs can effectively deliver critical business skills, such as pitching, which is essential in agribusiness. However, the demand for more practical, interactive experiences suggests that MOOCs should incorporate case-based learning and mentor feedback to maximize their effectiveness (Saharuddin et al., 2024b).

Figure 4. An original instructional video by the author on pitching guidelines via MOOC

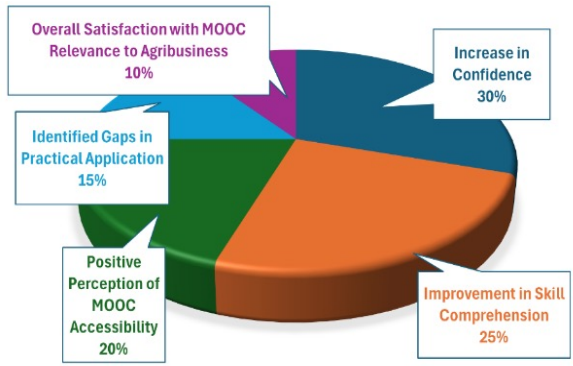

Figure 5. Core findings of the MOOC effectiveness study

This study suggests that MOOCs could serve as valuable supplementary tools in agropreneurship programs, especially in regions with limited access to traditional educational resources. However, integrating MOOCs with live workshops or mentorship sessions could address the practical limitations identified.

5.0 CONCLUSION

This study demonstrates that MOOCs can effectively enhance agropreneurship students' pitching skills, with significant improvements in confidence and comprehension observed. However, the lack of practical application opportunities highlights the need for complementary learning experiences to support skill transfer. The study's sample size is limited to 27 students, which may affect generalizability. Expanding the sample size and investigating hybrid models that combine MOOCs with hands-on training components could contribute to a more comprehensive approach to skill development in agribusiness.

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8.0 AUTHORS' CONTRIBUTION

The research was conceptualized by Joseph, J., who identified the study's focus and designed the methodological approach. Data collection and pre- and post-course assessments were conducted by Joseph, J., who also organized and facilitated focus group discussions. The initial draft of the manuscript was written by Joseph J. who contributed to subsequent revisions, critically reviewed the content, and approved the final manuscript for submission.

9.0 CONFLICT OF INTEREST DECLARATION

I certify that the article is the Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. I testify to the fact that the author has contributed significantly to the work, validity, and legitimacy of the data and its interpretation for submission to IJELHE.

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Transforming AI-Generated Text-to-Image Concepts into Functional Final Designs: A Case Study on Lighting Product Design in Industrial Design Education

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Abstract: *This study explores the integration of generative AI, particularly text-to-image generators, into industrial design education and its role in enhancing creativity during the idea-generation process. Focusing on a lighting product design project, the research examines how students use AI-generated concepts as a starting point and refine them through sketches and 3D models into fully functional designs. Generative AI has significant potential to facilitate creativity by breaking down traditional barriers to ideation and speeding up the concept-generation process. However, turning creative output into practical, manufacturable products can be challenging. The research involved 20 Bachelor of Industrial Design students tasked with transforming AI-generated imagery into functional lighting products. The methodology followed a three-phase process: AI-based concept generation, design refinement through sketches, and final 3D modeling. The findings reveal that while AI tools provide creative inspiration, students need to make substantial refinements to ensure the designs are both practical and user-centered. Main adjustments included form simplification, functional enhancements, and material considerations. This highlights the critical role of human intervention in bridging the gap between AI-generated concepts and fully realized, functional products. This research contributes to the growing understanding of how to incorporate generative AI into industrial design education effectively.*

Keywords: *Functional Design, Generative AI, Industrial Design Education, Text-to-Image Generation.*

1.0 INTRODUCTION

The rapid integration of generative AI into creative industries has opened new avenues for design exploration. Text-to-image generators, in particular, have gained attention in industrial design as tools for quickly visualizing ideas based on textual descriptions. These AI technologies provide designers with immediate visual outputs, offering new perspectives that may not have been considered through traditional sketching methods (Oppenlaender, 2022). The creative potential of these tools allows designers to explore novel forms, styles, and concepts that push the boundaries of conventional design thinking (Liu & Chilton, 2022).

Generative AI can significantly enhance creativity in design education by offering a wide variety of innovative design alternatives in short timeframes, thereby fostering rapid exploration of design possibilities. This enables designers to transcend traditional ideation barriers, spurring inspiration through AI-generated imagery. However, the challenge of aligning these AI-generated concepts with practical design considerations, such as ergonomics and material constraints, tempers this potential (Faruqi et al., 2024; Hashem & Hakeem, 2024). Moreover, while these models excel at generating aesthetically pleasing images, they may struggle to produce visuals that accurately reflect novel functional concepts or support the interpretation of design functionalities (Brisco et al., 2023).

In the field of product design, where both aesthetics and functionality are critical, the ability to quickly generate and explore diverse design concepts through AI can be especially valuable (Crowson et al., 2022). However, while these AI-generated designs can ignite creativity, they often lack the technical precision or practical considerations required for a final product, particularly when designing functional items like lighting products. The question arises: “How do these AI-generated designs influence the final design process?” and “Can students refine and develop these initial ideas into more coherent, functional products that meet specific design criteria?”. The transition from a raw, AI-generated idea to a well-developed, functional design requires students to bridge the gap between creativity and practical application.

This paper explores how industrial design students utilize text-to-image generators during the ideation phase and how these AI-generated designs evolve through the sketching and development process. We examine the methods students employ to enhance and modify AI-generated ideas into practical lighting products.

2.0 PROBLEM STATEMENT

Despite the increasing use of text-to-image generators in design ideation, there remains a significant challenge in translating these AI-generated visuals into functional, user-centered product designs. Text-to-image generators often produce creative but impractical concepts that lack consideration for technical and functional requirements, especially in fields like product design, where factors such as product features related to material choice and user interaction are critical (Qiao et al., 2022; Faruqi et al., 2024). Students, while inspired by the initial AI-generated images, struggle to refine and adapt these outputs into designs that meet product-specific criteria (Dortheimer et al., 2023). This gap between initial ideation and final product design calls for an examination of how AI-generated ideas evolve through the design development process. It is crucial to understand whether the final designs maintain the essence of the original concept while improving upon their functionality and aesthetic logic.

This research aims to analyse the transformation of text-to-image generated designs into refined and functional final design sketches within the context of lighting products. Specifically, the study will examine how students develop and refine AI-generated concepts, ensuring that the final designs meet the intended product features and improve upon the initial ideas in terms of functionality and aesthetic logic.

3.0 OBJECTIVE

Objective 1: To compare the differences between the initial text-to-image generated designs and the final designs created by students.
Objective 2: To evaluate whether the final designs meet the intended functional and aesthetic features required for lighting products.
Objective 3: To explore how the design development process, from AI-generated imagery to final sketches, improves the overall design quality, with a focus on logical refinements and technical considerations.

4.0 LITERATURE REVIEW

4.1 THE ROLE OF GENERATIVE AI IN DESIGN EDUCATION

The integration of generative AI tools in design education has introduced new possibilities for how students approach the ideation and conceptual stages of design. Traditionally, industrial design education emphasized manual sketching, prototyping, and problem-solving as core skills for students to develop. However, the advent of generative AI, specifically tools like text-to-image generators, has expanded the creative boundaries within which students can operate. AI tools allow for the rapid generation of design concepts based on text prompts, providing students with a platform to explore numerous possibilities without the constraints of traditional design methods (Bartlett & Camba, 2024).

Research shows that AI's ability to produce visually diverse concepts aids students in breaking through design fixation (Karimi et al., 2020), allowing them to explore a broader array of aesthetics in a shorter time frame (Hutson & Cotroneo, 2023). Hashem & Hakeem (2024) argue that AI tools like Generative AI not only accelerate the ideation process but also help students overcome creative barriers by presenting unexpected design alternatives, thus expanding their creative horizons. This aligns with the broader view that AI-driven platforms provide opportunities for students to iterate rapidly, test various design concepts, and pivot more effectively when ideas fail to meet functional or aesthetic requirements (Liu & Chilton, 2021).

However, despite these advantages, there are challenges in translating AI-generated ideas into functional products. Many of the concepts produced by AI tend to lack the technical and functional considerations necessary for product design, particularly in fields like industrial design where ergonomics, material constraints, and manufacturability are critical (Hong et al., 2023). Hashem & Hakeem (2024) emphasize that while AI-generated designs can serve as a rich source of inspiration, students must learn to critically evaluate these outputs and refine them to ensure they align with practical design needs, particularly through tailored prompt engineering and focused feedback mechanisms.

4.2 THE CHALLENGES OF TRANSLATING AI-GENERATED DESIGNS INTO FUNCTIONAL PRODUCTS

One of the main limitations of generative AI in industrial design education is the disconnect between creative ideation and the technical feasibility of AI-generated outputs. While AI tools can quickly produce imaginative and diverse concepts, they often neglect essential functional considerations such as usability, material strength, and manufacturability (Qiao et al., 2022). Students frequently struggle to balance their aesthetic ambitions with the practical requirements of design, particularly when working with AI-generated outputs that prioritize form over function (Elnokaly, Elseragy & Alsaadani, 2008). Hashem and Hakeem (2024) further emphasize the importance of teaching students to utilize prompt engineering to gain greater control over AI-generated design outcomes, thereby narrowing the gap between creative exploration and practical implementation.

The need to balance AI-generated outputs with human-centered design principles, including the incorporation of user feedback and ergonomic considerations throughout the refinement process remains critical (Leão, Silva & Costa, 2024). Moreover, AI-generated designs often fail to provide adequate information regarding material selection and production techniques, resulting in a gap between conceptual creativity and real-world feasibility (Faruqi et al., 2024). While AI can serve as a powerful tool for design inspiration, human designers must intervene to make the necessary refinements that align the designs with practical constraints (Weisz et al., 2024).

In industrial design education, this challenge is particularly pronounced, as students are still developing their understanding of how to integrate functional considerations into their work. As students' progress from ideation to final design, they must learn to evaluate and adapt AI-generated concepts to meet the demands of usability, manufacturability, and material durability. This ability to refine and adjust AI-generated designs is critical to bridging the gap between imaginative concepts and fully functional products.

5.0 METHODOLOGY

5.1 RESPONDENT SELECTION

This study involved 20 students in Semester 3 who were registered under the subject Advanced Industrial Design for Manufacturing (IDE510) and enrolled in the Bachelor of Industrial Design (CAAD244) program at the College of Creative Arts, UiTM Kedah Branch. The students were selected based on their participation in a lighting product design project in subject IDE510, which required the use of generative AI tools (recraft.ai, ideogram.ai & stablecog.com) to support the ideation process. The participants were tasked with transforming AI-generated design concepts into fully refined sketches and 3D models for lighting products. All students voluntarily participated in the study, and consent was obtained before data collection.

While the study involved 20 respondents, 5 were selected for detailed presentations to highlight diverse design outcomes. These respondents were chosen based on a set of criteria, including variations in design styles, the level of functionality achieved, and the degree of innovation demonstrated in their final outputs. This selection ensured that the showcased examples represented a wide range of design complexity from straightforward functional adjustments to highly innovative solutions. This approach aimed at aligning the presented data with the study's objective of analysing the transformation of AI-generated concepts into practical final designs.

The data collection and procedure were divided into three key phases: (1) AI-generated concept creation, (2) design refinement through sketches, and (3) the development of 3D models. These phases were aligned with the research objectives, focusing on the transformation of AI-generated imagery into final design solutions.

5.2 PHASE 1: TEXT-TO-IMAGE AI GENERATION

During the first phase, participants were introduced to text-to-image AI tools such as Stablecog.com, ideogram.ai, and Recraft.ai. They were instructed to generate initial lighting design concepts using specific text prompts. These prompts were designed to ensure creativity while maintaining relevance to lighting design. Each student used the following basic prompt structure: *"[Type of lighting], inspired by [subject], [design concept], [aesthetic style]"*.

For example, a student might generate an image using the prompt: "Standing desk lamp, inspired by nature, organic forms, minimalist design style."

The resulting AI-generated images served as the starting point for the design process, providing a creative yet technically incomplete concept for further development. (See Figure 1.0).

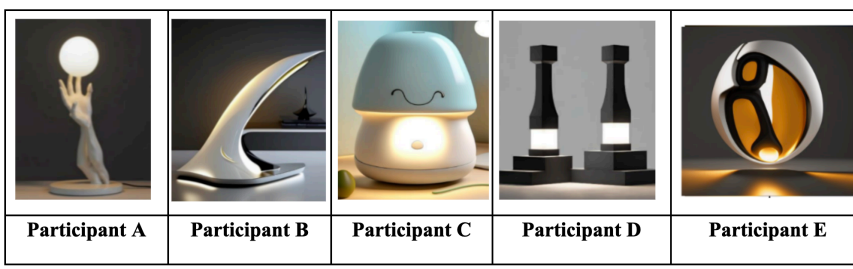


Figure 1.0: Example of AI-Generated Design Images from Selected Participants in Phase 1

5.3 PHASE 2: DESIGN DEVELOPMENT (SKETCHES)

In the second phase, participants were tasked with developing their selected AI-generated images into more detailed and functional design sketches. Students were encouraged to refine the aesthetic and technical aspects of the designs, ensuring that the sketches addressed practical features required for lighting products, such as light source placement, material choices, and user interaction elements (e.g., switches, cords, bulb handles). Students were required to create a series of development sketches that gradually improved upon the AI-generated image, making logical refinements in functionality and aesthetics. These sketches demonstrated the progression from concept to a more feasible product. (See Figure 2.0)

Participant A	Participant B	Participant C	Participant D	Participant E

Figure 2.0: Example of Final Design Sketches from Selected Participants in Phase 2

5.4 PHASE 3: 3D MODEL RENDERING

In the final phase, students transformed their final design sketches into 3D models using 3D Rhinoceros modeling software. The 3D models represented the most refined version of the lighting products, incorporating both the aesthetic and functional improvements made during the sketch development phase. These models allowed for a final evaluation of the design's practicality, usability, and manufacturability. (See Figure 3.0)

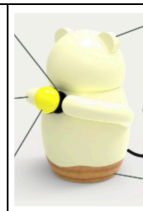
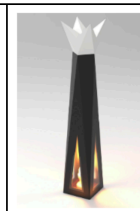
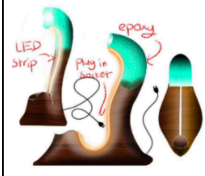
				
Participant A	**Participant B**	**Participant C**	**Participant D**	**Participant E**

Figure 3.0: Example of Final 3D Model Renderings from Selected Participants in Phase 3

The following table summarizes the main transformations across the three phases for each participant, highlighting changes in form, functionality, and aesthetic alignment between the AI-generated designs, final sketches, and 3D models. (See Table 1.0)

Participant	AI-Generated Design	Key Changes in Final Sketch	Key Features in Final 3D Model	Summary of Improvements
A				The design transitioned from an artistic concept to a more functional product with enhancements in balance, usability, and ergonomic considerations. The base and switch improved practicality.
	An organic hand-like structure holds a light source at the top.	Added a base, explored proportions, refined the posture of the hand to ensure balance, and incorporated a switch.	Retains the hand form with added structural stability in the base and resizes the light globe for light bright.	
B				Enhanced usability by integrating a light source and ergonomic elements while maintaining a unique geometric aesthetic. Improved the balance between form and function.

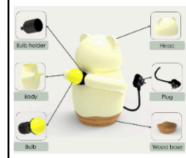
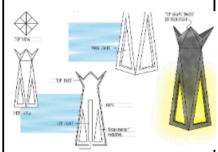
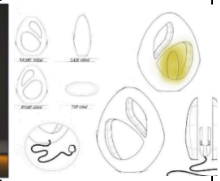
	Sharp, blade-like form with no visible light source or user interaction points.	Added a light source (LED strip), ergonomic modifications for easier interaction, and adjustments to the form for improved user-friendliness.	The 3D model retains the sharp geometric form but adds a visible light source and refines material use, such as wood and acrylic.	
C				The playful aesthetic is preserved, with major improvements in functionality, such as defined lighting and user interaction points, enhancing practicality while maintaining the fun design.
	Cute, character-like lamp with soft edges but undefined lighting elements.	Defined the light source, added functional switches, and refined proportions for better user-friendliness and visual appeal.	Retains the playful, abstract form but incorporates practical switches and a defined light source.	
D				Successfully balances a minimalist aesthetic with usability improvements, such as functional lighting and better accessibility through height and control adjustments
	Minimalist design inspired by a chess piece, vertical lines, and no clear light source or user controls.	Adjusted the height for usability, refined the form, and added interaction points like switches and a light compartment.	Maintains the minimalist form with the addition of a functional light source and interaction points.	
E				The design evolved from an artistic light sculpture to a more practical, ergonomic lamp. The refined proportions increase usability, while the secure placement of the light source ensures functional stability.
	Oval-shaped, abstract design with a central glowing light source, covered in a sculptural, organic form.	Refined to a more logical round form that meets the internal lighting compartment. Adjusted proportions for stability and usability.	Retains the abstract oval form, now featuring a smoother surface, with the light source visibly secured and an opening for user interaction.	

Table 1.0: Comparative Analysis of AI-Generated Designs, Final Sketches, and 3D Models in Lighting Product Development

6.0 DESIGN TRANSFORMATION ANALYSIS

This section presents the findings based on the comparison and evaluation of the design process, focusing on the content and qualitative aspects of the transformation from AI-generated designs to final sketches and 3D models. The comparative analysis was conducted by the researcher, who has considerable expertise in industrial design, thereby providing a comprehensive and reliable evaluation. The analysis followed a predefined rubric that emphasized functionality, aesthetic quality, and usability. This rubric, based on the principles of functional design, included parameters such as ergonomic considerations, material feasibility, and alignment with aesthetic goals. The researcher's academic background and professional expertise in industrial design established a solid foundation for the effective evaluation of the transformation process.

6.1 COMPARISON OF AI-GENERATED DESIGNS AND FINAL SKETCHES

The analysis begins by comparing the preliminary AI-generated designs with the final sketches drawn by the students. Several significant distinctions were observed, particularly concerning form, functionality, and user interaction:

a) Form Refinement: Students made notable refinements to the original forms provided by the AI-generated outputs. While the AI-produced designs tended to focus more on abstract shapes or aesthetic forms without functional constraints, the final sketches reflected a clear attempt to simplify and rationalize the forms to better suit the needs of a lighting product. For instance, designs that were too creative or complicated were modified to make sure the product was stable and balanced.

b) Functional Adjustments: The AI-generated designs often exclude essential functional components, like light sources, switches, and support structures. In the final sketches, students corrected these flaws by incorporating essential elements, ensuring that the designs were both aesthetically pleasing and functional for practical use. The shift from abstract to functional emphasised the students' capacity to critically evaluate and modify the AI-generated results.

c) Aesthetic Consistency: The relationship between the AI-generated designs and the final sketches varied. Some students successfully retained the core aesthetic elements, such as minimalist or geometric forms, while integrating functional elements like buttons and bulb sockets. However, other students had to deviate from the original form due to practical constraints. For example, incorporating functional elements like switches, adjusting the height for ergonomic reasons, and placing light sources logically required modifications that altered the aesthetic.

6.2 EVALUATION OF FINAL DESIGNS' FUNCTIONAL AND AESTHETIC FEATURES

The evaluation of the final designs focused on whether they met the intended functional and aesthetic requirements for lighting products.

a) Functional Elements: The final designs successfully incorporated essential lighting features, such as light source placement, switches, and user interaction components. Students demonstrated the ability to adapt their designs to include these features without significantly compromising the design's aesthetic appeal, although some adjustments were necessary to meet functional needs.

b) Aesthetic Quality: Many of the final designs maintained a strong aesthetic connection to the original AI-generated images, particularly in terms of overall style and form. However, in cases where functionality took priority, some aesthetic elements were modified to improve usability or ensure the design's feasibility in production. The balance between aesthetics and functionality was a recurring theme, with students needing to adjust their designs to achieve both.

6.3 IMPROVEMENT IN DESIGN QUALITY THROUGH THE DEVELOPMENT PROCESS

The development process, from AI-generated imagery to final sketches and 3D models, demonstrated clear improvements in design quality, particularly in terms of logical refinements and technical considerations.

a) Logical Refinements: Throughout the design process, students made critical adjustments to enhance the practicality and usability of their designs. This included adding stability elements, adjusting proportions, and ensuring that light sources were placed appropriately for the intended function. The iterative sketching process allowed students to reflect on and refine their initial ideas, resulting in more logically structured and clear final designs.

b) Technical Considerations: The transition from sketches to 3D models highlighted the increasing attention to technical details. Students demonstrated a growing awareness of material selection, manufacturability, and ergonomics, ensuring that their final designs were not only aesthetically pleasing but also feasible for real-world production. These technical considerations marked a significant improvement over the AI-generated designs, which lacked such practical elements.

7.0 CONCLUSION

This study demonstrates that while text-to-image AI generators can provide valuable creative inspiration, they are limited in producing fully functional and feasible product designs. The students were able to refine and adapt these initial AI-generated concepts through an iterative design process, resulting in improved functionality, technical feasibility, and user interaction.

The findings highlight the need for human intervention in transforming AI-generated designs into practical products. AI serves as a valuable ideation tool, but the final design process requires critical thinking, technical knowledge, and iterative refinement. The balance between aesthetic consistency and functional requirements remains a key challenge, and design education must continue to emphasize the integration of both to

ensure well-rounded design outcomes. Moreover, the study underscores the importance of iterative design development in bridging the gap between conceptual creativity and practical usability. Students demonstrated a growing awareness of how to adapt AI-generated outputs into feasible and user-friendly products, reinforcing the value of hands-on design experience combined with AI ideation tools.

Building on the findings of this study, several paths for future research emerge. First, expanding the application of AI-generated design beyond lighting products to other categories, such as furniture, consumer electronics, or wearable technology, could offer valuable insights. These fields bring different functional and technical challenges, which may impact how AI-generated designs are adapted for usability, manufacturability, and aesthetics. Investigating these diverse product categories could help determine whether the patterns observed in this study are consistent across other design disciplines.

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10.0 AUTHORS' CONTRIBUTION

Mohd Hamidi Adha Mohd Amin led the writing of the manuscript, organized the data collection, and conducted the data analysis. The author also contributed to refining the research, analysis, and manuscript.

CONFLICT OF INTEREST DECLARATION

I certify that this article is the original work of the authors. The article has not been published previously and is not under consideration for publication elsewhere. I testify to the fact that the Author has contributed significantly to the work, the validity and legitimacy of the data, and its interpretation for submission to IJELHE.

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The Implementation of The Lifelong Learning Micro-Credential Course Among Students from Universiti Tanjung Pura, Pontianak, Indonesia

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Abstract: *Micro-credential course is a short course which offers a flexible, targeted way to help people develop knowledge, skills, and competencies. Animation and Videos in Microsoft (MS) PowerPoint are under the lifelong learning category of the Micro-credential course. It is a short course that was developed to help users learn animation features and create videos using Microsoft PowerPoint 365 to make presentations and interactively prepare notes. This course was developed using the ADDIE model, with various kinds of tools and was compiled into one platform. The target users for this course are students, academicians, and anyone interested in making a more creative and dynamic presentation. Lifelong Learning Animation and Videos in MS PowerPoint is an intermediate course where students*

will be taught how to create animation using text and images besides learning how to produce videos in Microsoft PowerPoint by using audio, slideshow, and screen recording. This course covers four topics with various learning materials and can be completed within thirty days. Activities and formative and summative assessments were provided to evaluate the student's understanding after they have learned every topic. There are forty-two students from the Medical Faculty, Universitas Tanjung Pura, who have enrolled in this course. Statistical analysis of the results shows that sixty-four percent of the respondents feel that the course is interesting and easy to understand. In the future, this course can be added with advanced features in Microsoft PowerPoint.

Keywords: *Animation, Micro-credential, Videos*

1.0 INTRODUCTION

Micro-credential is an online short course or module which is offered to achieve certification of learning. According to Caetano (2022), Micro-credential allows learners to join their preferred Micro-credentials course and do their training, according to their needs. Micro-credential focuses on bite-sized modules which allow learners to complete a set of modules in a shorter period compared to the traditional degree with three to four years of study duration (Che Ahmat et al, 2022).

This Micro-credential course is an intermediate course that is open to the public who are interested in learning how to create a more interactive presentation by using Microsoft PowerPoint. The course has been implemented for medical students from Universitas Tanjung Pura, Pontianak, Indonesia to help them in their presentation preparation.

2.0 PROBLEM STATEMENT

The usage of Microsoft (MS) PowerPoint is most common as a traditional presentation tool using simple design techniques and animation. This program is utilised for corporate presentations as well as in university and secondary educational institutions for project presentations, effective teaching and learning slides, and video presentations, which can be readily

transmitted in mp4 format. This application is more versatile than free online presentation tools, making it the preferred alternative for students and teachers in preparing their presentations. Thus, the development of the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint is to help users learn Microsoft PowerPoint to develop a unique presentation by adding creative animations and converting the presentation slides into interactive videos, providing an optimal solution for novices to acquire fundamental to intermediate skills. Besides that, learners will also learn how to use more advanced features such as the recording tab and create screen and audio recordings using MS PowerPoint.

3.0 OBJECTIVE

1. Creative animation: to create a more creative animation
2. Interactive video: to create a more interactive video
3. Recording tab: use recording tab in MS PowerPoint

4.0 RELATED WORKS

4.1 MICRO-CREDENTIAL

Micro-credential is a "…term that encompasses various forms of certifications, including 'nano-degrees', 'micro-masters', 'credentials', 'certificates', 'badges', 'licenses' and 'endorsements' (UNESCO, 2019). A Micro-credential (MC) is a component of a digital credentialing ecosystem that has been made feasible by digital communications technologies that have created communities of interest (Milligan & Kennedy, 2017).

Oliver (2019) offers a highly synthesised definition of Micro-credential as "...digital certification of assessed knowledge, skills, and competencies which is additional, alternate or complementary to or a component of formal qualifications". This definition addresses the various uses of Micro-credentials, including the potential for Micro-credentials to replace traditional credentials.

4.2 INTERACTIVE MULTIMEDIA, ANIMATION, AND VIDEOS

Interactive multimedia is a learning medium which consists of a combination of several multimedia aspects such as images, videos, animations, and sounds in a platform, and allows users to interact directly (Tsoukala, 2021). It can attract students' attention while making the learning process more fun and enjoyable, besides being able to change students' interest in learning (Nugroho et al., 2020). Therefore, interactive multimedia could visualize learning materials which are hard to deliver in the traditional medium (Barianos et al., 2022).

Nowadays, there are many software which can be used to create animations and videos. The availability of free or low-cost tools to create this animation and videos is most favored by designers, teachers, and students. Instructors need to emphasize developing meaningful content with a clear storyboard and apply educational theory-based instructions to make animation and videos more creative and interactive (Kurniawati, 2020).

4.3 MICROSOFT POWERPOINT

Microsoft PowerPoint is a software incorporated in Microsoft Office which is specifically used for presentations (Movitaria & Shandra, 2020). There are many versions of Microsoft Office but compared to other versions, Microsoft Office 365 is a subscription service that has the most up-to-date modern productivity tools from Microsoft. This version comprises the latest features, fixes, and security updates (Microsoft, 2023).

Apart from that, Microsoft PowerPoint is regarded as one of the most suitable software not only for presentation but also for creating learning content. Besides its main functionality used for slideshow presentations, MS PowerPoint also provides other means of presenting instructional content in the most creative way (Mittelman, 2023). As such, MS PowerPoint can be a preparation software where instructors can create animation or add video recordings to make content more interactive.

5.0 METHODOLOGY

Currently, several methods can be used in developing instructional design. The ADDIE model is used in developing this Micro-credential course which consists of Analysis, Design, Development, Implementation, and Evaluation (Setiyani et al., 2020). ADDIE model provides a streamlined, structured framework that helps users create an effective learning product (AIHR, 2023). Figure 1 shows the steps involved in the ADDIE model.

Figure 1 Steps in the ADDIE model

The analysis involves the problem statement where most of the Microsoft PowerPoint users only used it to create simple presentations. They are unaware of the new features provided by Microsoft PowerPoint 365. Thus, to enhance their presentation skills, a Lifelong Learning Micro-credential course was developed to help users create more creative and interactive presentations using animations and video recording in Microsoft PowerPoint.

In the design phase, a storyboard was developed to identify the tools to be used, plan the teaching materials formats, and outline activities and assessments that will be implemented in the course. Learning hours were also identified to ensure the course follows the suitable learning time according to the Malaysian Qualification Agency (MQA) specifications.

Meanwhile, in the development phase, the Lifelong Learning Micro-Credentials Animation and Videos in MS PowerPoint used Microsoft PowerPoint 365 as the main tool for creating learning materials. Besides that, various free online tools were also used such as Canva, to design images, logos, and backgrounds, Capcut, Clipchamp, Kapwing, and Filmora, used to edit videos while AnyFlip, functions to create eBooks. On top of that, videos were uploaded and published on YouTube while UFuture, known as a Learning Management System, was developed to facilitate students' and instructors' engagement towards all the courses being offered in UiTM acted as the main platform to integrate all materials.

Once the development stage had been completed, Alpha testing was performed to evaluate the course according to certain requirements. This evaluation process involved experts in assessing the course content, language, and design. The course will be made available to users once it fulfills all the requirements in the testing process.

In the implementation phase, Beta testing was done in which students who have enrolled in the course are required to answer an online Entrance survey for a literacy test on the course. A Partially Completion Certificate will automatically be generated for students who have completed the course. However, to get a full certification, students must complete all the assessments provided. The assessments will then be evaluated by instructors and students must pass and achieve a certain range of marks for them to be awarded a Fully Completion Certificate. Figure 2 shows the sample of Partially Completion Certificates and Fully Completion Certificates achieved by students from Universitas Tanjung Pura, Pontianak, Indonesia.

Figure 2 Partially Completion Certificate and Fully Completion Certificate achieved by students.

Lastly, the evaluation stage serves to ensure the developed product is suitable or needs some improvement. Students will need to answer an online Exit survey to reflect their understanding and feedback on the course. The results of the survey were discussed in the Results and Discussions sections. Figure 3 below shows the development of the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint based on the ADDIE model.

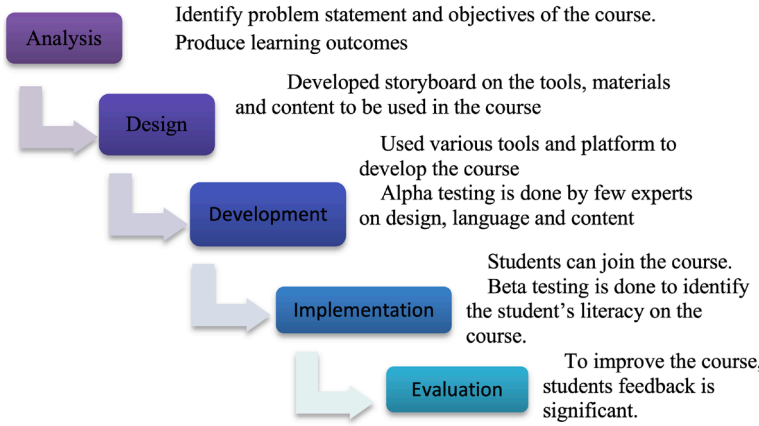

Figure 3 Development of the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint based on the ADDIE model.

6.0 RESULTS AND DISCUSSIONS

This study involved 42 undergraduate students aged 19 to 25 years old from the Medical Faculty, Universitas Tanjung Pura, Pontianak, Indonesia. To examine the impact of the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint courses on these students, a self-rating process was undertaken. This involved the participants completing the Entrance Survey before commencing the courses and the Exit Survey upon course completion. The online survey consists of questions about the respondent's background and the students' software literacy. The data collected from the Entrance-Exit Survey (EES) was subsequently employed to evaluate the effectiveness of the teaching and learning methods employed in the courses. Figure 4 shows the respondents' background based on their age.

Figure 4 Respondents' background based on age.

All participants (100%) reported having prior experience using Microsoft PowerPoint. Interestingly, a substantial majority (78%, n=33) of the students utilized Microsoft PowerPoint for creating slide presentations. Furthermore, a noteworthy subset (21%, n=9) of the participants demonstrated a more advanced usage of MS PowerPoint, employing it for both slide and video presentations.

Table 1 presents the score differences between participants' EES for each research question. The scores range from -4 to +4, where negative values indicate a decline in proficiency, zero signifies no change and positive values represent an improvement. The survey covers five research questions (RQ1 to RQ5), with the number of respondents for each score difference recorded.

Referring to the RQ1, which assesses general proficiency in using MS PowerPoint, most respondents (19) showed improvement (+1). Additionally, (14) respondents demonstrated improvement (+2), (3) showed improvement (+3) and (2) indicated improvement (+4). Four respondents remained constant with no change in proficiency (0).

Meanwhile, for RQ2, which focuses on literacy in creating text animation in MS PowerPoint, a significant number of respondents (14) showed improvement (+3). Moreover, (7) respondents demonstrated improvement (+1), (11) showed improvement (+2) and (2) indicated improvement (+4). Four respondents remained constant with no change in proficiency (0).

With regards to RQ3, exploring proficiency in creating image animation in MS PowerPoint, many of the respondents (17) showed improvement (+4). Additionally, (4) respondents demonstrated improvement (+1), (8) showed improvement (+2) and (11) indicated improvement (+3). Two respondents remained constant with no change in proficiency (0).

RQ4, which assesses proficiency in screen recording using MS PowerPoint, a significant number of respondents (13) showed improvement (+3). Moreover, (7) respondents demonstrated improvement (+1), (9) showed improvement (+2) and (11) indicated improvement (+4). Two respondents remained constant with no change in proficiency (0).

Finally, based on RQ5, which focuses on exploring proficiency in slide show and audio recording using MS PowerPoint, a significant number of respondents (16) showed improvement (+2). Additionally, (13) respondents demonstrated improvement (+1), (7) showed improvement (+3) and (3) indicated improvement (+4). Six respondents remained constant with no change in proficiency (0).

The positive difference scores indicate that the majority of the respondents experienced improvement in their skills and knowledge after participating in this Micro-credential course. However, the data also highlights variations in progress among participants, with some facing challenges or remaining constant in their proficiency. Table 1 shows the result of the Entrance-Exit survey.

Entrance-Exit Score		-4	-3	-2	-1	0	+1	+2	+3	+4
RQ1: How would you rate your literacy in using MS PowerPoint?	Respondents	0	0	0	0	4	**19**	14	3	2
	Percentage (%)	0	0	0	0	10	**45**	33	7	5
RQ2: How would you rate your literacy in creating animation using text in MS PowerPoint?	Respondents	0	0	0	0	4	7	11	**14**	6
	Percentage (%)	0	0	0	0	10	17	26	**33**	14
RQ3: How would you rate your literacy in creating animation using image in MS PowerPoint?	Respondents	0	0	0	0	2	4	8	11	**17**
	Percentage (%)	0	0	0	0	5	10	19	26	**40**
RQ4: How would you rate your literacy in screen recording using MS PowerPoint?	Respondents	0	0	0	0	2	7	9	**13**	11
	Percentage (%)	0	0	0	0	5	17	21	**31**	26
RQ5: How would you rate your literacy in slide show and audio recording using MS PowerPoint?	Respondents	0	0	0	0	3	13	**16**	7	3
	Percentage (%)	0	0	0	0	7	31	**38**	17	7

Table 1: Entrance-Exit Survey

Figure 5 illustrates respondents' feedback on the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint course. Participants' opinions on the course's efficacy were assessed based on factors like interest and ease of comprehension. Notably, 64% found the content both interesting and easy to understand, indicating effective course design. Additionally, 14% noted that while interesting and comprehensible, the

tutorial contained substantial information. Notably, 10% found it interesting, while 5% emphasized its ease of understanding. These diverse responses highlight a generally positive course reception, while specific feedback provides insights for refining the learning experience and accommodating various learning preferences.

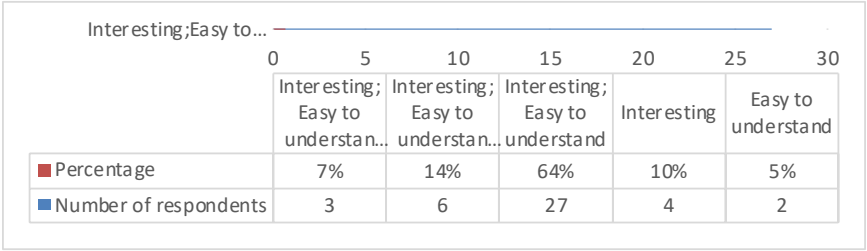

Figure 5 Respondents' feedback on the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint course

7.0 CONCLUSION

Microsoft PowerPoint is commonly used to create slideshows mostly for presentation purposes. However, most users are not aware of the unique functions and features that MS PowerPoint provides. Therefore, the Lifelong Learning Micro-Credential Animation and Videos in MS PowerPoint was developed for those who are interested in learning and using Microsoft PowerPoint to make presentations more powerful and interactive. As Micro-credential is a short course, this course can be done within a month with the completion of a few learning hours per week. Currently, more than 100 students have enrolled in this course including 42 students from the Medical Faculty, Universitas Tanjung Pura, Pontianak, Indonesia. Some of the students managed to complete the course with a Partially Completion Certificate while few of them were awarded the Fully Completion Certificate. The result of the research shows that most students found that this course is interesting and easy to understand. In the future, additional modules can be added to enhance the reliability of this course.

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10.0 AUTHORS' CONTRIBUTION

Wan Anisha led the writing of the manuscript, Azlina prepared the methodology, Syarifah Adilah focused on the related work, Rafizah conducted the survey and analysis, and Saifulnizam designed the figures.

11.0 CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all authors have contributed significantly to the work, validity, and legitimacy of the data and its interpretation for submission to IJELHE.

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Open & Distance Learning (ODL): Factors That Affect Mathematics Results from Undergraduate Students' Perspective

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Abstract: *Open and Distance Learning (ODL) is a learning mode in which learners and educators are separated by time and location. The new norm of the educational system that is being implemented provides students with significant opportunities to learn without boundaries. Nonetheless, the deployment of online and remote learning by higher education institutions has highlighted difficulties relating to academic achievement among students. Students enrolled with ODL have been reported to confront many individual, institutional, and instructional challenges. Therefore, this study investigated the factors that affect Mathematics results during ODL. This study used a quantitative approach and distributed online surveys to collect data from the respondents. Students from the Faculty of Education majoring in Mathematics were chosen as the population while only students who took Calculus 3 were chosen as the sample of the study. Frequency analysis and descriptive statistics were used to summarise and describe the demographic data. Besides, correlation analysis was used to determine the relationship between students' self-regulated learning, teachers' teaching practices,*

and learning facilities toward Mathematics results. In addition, regression analysis was used to determine which factors affect Mathematics results the most. The findings showed that there is a significant relationship between students' self-regulated learning, teachers' teaching practices, and learning facilities toward Mathematics results. Furthermore, the results revealed that self-regulated learning is the factor that affects Mathematics results the most during Open and Distance Learning (ODL). Generally, the study presented that the major factor that affects students' academic achievement is their self-regulation followed by teachers' teaching style and learning facilities. Therefore, students, teachers, and educational institutions may utilize the findings of this study to improve students' academic performances in the future.

Keywords: *Open and Distance Learning, Self-Regulated Learning, Teachers' Teaching Practices, Learning Facilities*

1.0 INTRODUCTION

Open and Distance Learning (ODL) is a structured learning whereby students and instructors are separated by time and place. It has indeed been implemented around long before the COVID-19 pandemic and evolved over decades. Early formats used include Correspondence Courses which date back to the early 20th century when educational materials were mailed to students. The rise of the internet in the late 20th and early 21st centuries has led to the development of online courses and degree programs, making ODL more accessible and flexible and becoming a popular trend among university students. The pandemic accelerated the adoption of ODL as a necessity. In the year 2020, many more universities in Malaysia implement Open and Distance Learning (ODL) emphasising the online learning and Learning Management System (LMS) format to help students and teachers to continue the teaching and learning process even from their own homes. The shift during COVID-19 highlighted the importance of ODL in providing uninterrupted education, especially during crises. The new norm educational systems applied enable the students to receive substantial opportunities to learn without boundaries.

However, with the new norms in education, come new experiences and challenges. The implementation of online and distance learning by higher education institutions highlighted issues related to academic performance among students compared to conventional educational methods. Hence, many studies are interested in exploring the challenges of online and distance learning which may be the factors that affect students' academic performance. The concept of the Open and Distance Learning (ODL) system focuses on open access to education and training to unbind students from time and place constraints and to offer flexible learning opportunities for individuals and groups of students. Despite the broadening of ODL and its advantages, students enrolled with ODL have been shown to face many individual, institutional, and instructional challenges. Adult students are well established to enter higher education regardless of many risk factors such as age, full-time or part-time employment, dependents, and a lack of academic preparation. These aspects have been proven to be the obstacles for some adult learners to succeed in academics. It is a confusing phenomenon when there is a clear consensus in the literature regarding dropping out, especially in ODL. Institutions must be able to recognize the reasons for students dropping out of school, for example, some students find it hard to make friends, make it impossible to settle down at the beginning of their course, or are not pleased with the quality of teaching, not feeling contented with their timetables and finally precarious financial or family circumstances along with programme or course related reasons such as workload and difficulty (Mahlangu, 2017).

Besides, teachers' teaching practices can be one of the factors that influence students' achievement through ODL. According to Althause (2015), there have been very few studies showing a significant relationship between teacher efficacy and student performance. Althause (2015) also stated that when teachers who are rated with poor and moderate abilities teach the students, it shows that the students will produce the lowest achievement scores in Mathematics. Presence teaching is influenced by the quality of the courses. The behaviours of teaching presence in an online learning environment differ from the face-to-face classroom, as educators must communicate effectively when separated by time and place from the students. Efficient learning facilities in online courses require the teachers to engage in activities that help students build a better understanding during the course. The increment of online course delivery in higher education also

increases the burden on teachers to design and organize courses, facilitate learning, and provide direct instruction for students separated by time and place. Understanding the perceived teaching presence of educators and their associated behaviours is needed to address the best way to prepare the faculty for online teaching in higher education learning environments (Gurley, 2018).

Other than students' self-regulation and teachers' behaviour, learning facilities also have an impact on students' Mathematics achievement through Open and Distance Learning (ODL). According to Altameem (2013), the availability of the Internet and Wi-Fi facilities are important services in the form of basic amenities and there is a significant impact on the accessibility of learning material at a university. Research on online teaching and academic facilitation has been ongoing and shows fairly consistent results (Rajadurai, Alias, Jaaffar & Wan Hanafi 2018). Malay Mail (2020) established that one cannot assume that all tertiary students enjoy unlimited internet access or possess gadgets like desktops or laptops that freely allow them to attend online classes even though the students and lecturers can overcome the technical difficulties. Students who live in rural areas cannot enjoy good internet access as students who live in urban areas due to the speed and coverage of the Internet which mostly depends on the family's finances and home location. These will most probably have an impact not only on the quality of learning but also on the quality of teaching since there is a high risk for the students to be left behind if the classes are entirely conducted online. According to Varshneya (2017), learning technology that is installed by institutions does not review students' needs and content availability thus it becomes an obstacle to the students. Due to that, students have lacked interest in online learning and discontinued the course (Varshneya, 2017).

As a consequence of the issues, this research studied the Factors that Affect Students' Mathematics Results during Open and Distance Learning (ODL). Factors that were studied in the research were self-regulated learning, teacher's teaching practices, and learning facilities.

2.0 LITERATURE REVIEW

Open and Distance Learning (ODL) is an educational approach that allows learners to access learning opportunities without being restricted by geographical location, time, or conventional classroom settings. While Open and Distance Learning (ODL) serves as a vital medium for education, especially in situations where face-to-face contact is not possible, several factors significantly influence its effectiveness and the overall quality of learning including self-regulated learning, teacher's teaching perspective, and learning facilities. How each of these components plays a role in the effectiveness of ODL related to Mathematics academic achievement is explained in the next subsection.

2.1 SELF-REGULATED LEARNING (SRL)

Self-regulation is described as the capability to control one's thoughts, behaviours, or emotions, and it allows a person to adjust his or her behaviour to the demands of a scenario. Self-regulated learning (SRL) defines the ability to sustain attention and suppress extraneous information in a learning environment which lays the groundwork for successful academic outcomes. SRL also refers to the process where learners take control of their learning, including setting goals, monitoring their progress, and reflecting on their understanding. For example, students with superior self-regulation abilities evaluated by self-reports have been shown to answer faster in Mathematical problems which might be due to their exceptional potential to ignore distracting thoughts and focus on the subject. On the other hand, students without ample self-regulation in learning are more likely to struggle with Mathematics achievement (Nemati et al., 2020).

Based on the research of The Role of Self-Regulated Learning in Students' Success in Flipped Undergraduate Math Courses, the findings showed that self-efficacy on metacognitive and environment control strategies has a significant positive correlation with the mathematics achievement (Sun, Xie & Anderman, 2018). This indicates that the higher the level of students' self-regulation in learning, the higher the motivation of the students to complete Mathematics assessments online. Thus, the students produced higher grades in the online homework. Consequently, students will confidently take action in monitoring their understanding of the courses, reflect on their learning

strategies, and complete the learning goals successfully when they gain more confidence in their ability to learn Mathematics. Thus, based on the research it can be concluded that students' self-regulation does influence students' Mathematics achievement, especially in Calculus I and II.

Furthermore, Rameli and Kosnin (2016) studied the challenges experienced by students in Mathematics learning for the themes related to self-factors and found that there are two elements involved, which are students' negative perception of Mathematics and student's low self-regulation. The results of the study showed a high frequency of students' negative perceptions towards Mathematics and students' low-self regulation. This indicates that students with low self-regulation influenced mathematics achievement. The results from this study regarding the low self-regulation students faced challenges in Mathematics learning are equivalent to the findings from many other research where the authors reported that students faced a tough time in regulating their learning. As a result, the students received poor marks in their academics. Rameli and Kosnin (2016) also stated that it is extremely crucial to implement learning regulations during the transition of students from primary school to secondary school because it is one of the elements in higher-order thinking skills. It highlighted that students with high control in self-regulated learning can conquer higher-order thinking questions found in Mathematics.

In contrast with the study above, Cho and Heron (2015) have different results from their study. The respondents who participated in the research were enrolled in self-paced remedial online Mathematics courses. The findings from Pearson correlations showed that there is no correlation between students' final grades and students' motivation. In addition, the results indicate that students' final grades were not affected by intrinsic goal orientation, metacognitive self-regulation, and critical thinking. At the same time, other analyses of Pearson correlations proved that motivation, including intrinsic goal orientation, task value, self-efficacy for learning, and learning strategies such as metacognitive self-regulation, and critical thinking are found to have positive relationships with students' satisfaction and Mathematics online learning. Hence, it can be concluded that there is no significant relationship between self-regulation and students' final grades in Mathematics learning.

In conclusion, the self-regulated learning students are different among the students themselves where some researchers found that there is a significant correlation between students' self-regulation and Mathematics grades while other researchers discovered the contrary. Therefore, this study is conducted to investigate the relationship between students' self-regulation and their Mathematics results.

2.2 TEACHERS' TEACHING PRACTICES

Teachers' teaching practices are teaching styles that are implemented by teachers in their lessons. Effective, nurturing, and responsive teaching practices and interactions are keys to all learning techniques. Teaching practices and interactions are responsive to students' learning development. Teaching practices involved lesson schedules, classroom routines, and instruction or communication styles of the teachers. Hence, teachers' teaching practices will influence the reactions of the students in the classrooms.

Bal-Taştan et al. (2018) discussed the impacts of teachers' efficacy and motivation on student's academic achievement in science education among secondary and high school students. The results showed that there is a moderately significant, positive, and linear relationship between teacher self-efficacy in teaching practices and students' academic achievement. Besides, it also revealed that there is a moderate, significant, and positive relation between each dimension of teacher self-efficacy with students' academic achievement where the instructional strategies dimension of teacher self-efficacy showed the highest correlation when analysed with academic achievement. It can be concluded that the research indicated that there is a relationship between teacher's teaching practices and students' academic achievement. Thus, professional and efficient classroom instructions by the teachers lead to a better academic result.

According to Khan et al. (2017), one of the teacher's teaching practices elements is having good communication. The findings of the study displayed that teacher's communication skills affect students' academic performance. The study also found that most students believed that they learn best from teachers who apply effective communication skills while giving instructions or having conversations with them. When teachers perform good teaching

practices during the lesson, it would be able to strengthen the relationship between the teachers and the students as it could improve the level of understanding among the students during the learning process. Once the teachers can tackle students' understanding, it will be easier to teach the students as well as maintain their academic results.

Meanwhile, a study by Ahmad et al. (2017) focused on the factors related to students' performance in Calculus. The research is about students' preference towards teachers' behaviour such as 'the lecturer that I prefer the most to teach Calculus is kind', 'the lecturer that I prefer the most to teach Calculus is fierce', and 'the lecturer that I prefer the most to teach Calculus is tolerance'. Based on the collected data of this study, showed that there is no significant relationship between students' preference for teachers' behaviours in Calculus class and students' Calculus achievement. To conclude, according to this study, teachers' behaviour in Calculus class does not influence students' Calculus final grades.

Furthermore, the research conducted by Mensah, Okyere, and Kuranchie (2013) is in line with Ahmad et.al (2017) in which one of the objectives of the study was to find the correlation between teachers' attitudes during the teaching process and students' Mathematics performance. The studies revealed an insignificant correlation between teachers' attitudes and students' Mathematics performance even though there is a positive correlation between them. At the beginning of the research, the researchers supported findings that showed students' Mathematics performance is influenced by teachers' attitudes during the teaching process. However, the results failed to prove a significant relationship between teacher's attitudes and students' achievement in Mathematics. The researchers also stated that students' performance not only depends on teachers' attitudes throughout the lesson session but also a combination of other factors. All in all, teachers' attitudes are said not to be the main factor that influences students' Mathematics achievement. It can be concluded that each teacher has their teaching practices which differ from one another. Therefore, some researchers found that teachers' teaching practices did have an impact on students' academic performance while others did not. Taking the findings as references, this study explored the relationship between teachers' teaching practices and students' Mathematics results.

2.3 LEARNING FACILITIES

ODL at certain times is difficult to implement by all educational institutions considering their students' backgrounds. Lack of learning facilities among the students is one of the issues that have been discussed among the authorities in the education field. Learning facilities such as electronic devices, internet access, and educational platforms are examples of learning facilities that need to be considered during online learning. This might be a limitation for some students to attend online classes and may affect their academic performances.

According to Altameem (2013), individuals' access to technology consistently impacts the use of online learning. Some students may depend on sharing gadgets such as computers or laptops at learning centers of the local community since not all students can access online classes with personal computers at their house compared to certain areas such as homes, cybercafes, training institutions, workplaces and institutions where users get the equal amount of internet coverage. Thus, it proves that there is a significant relationship between poor internet connection and challenges in ODL among students. Moreover, the user's ability to connect to the full range of learning content relies on the network coverage and bandwidth. To implement ODL, technology access is very important, and it was pointed out by many researchers. At the same time, this study revealed that poor internet connection is not the only problem but internet access too as it is very costly for certain students who come from families with unstable economies. Overall, this research also showed that environmental factors like poor network coverage have influenced students' academic achievement when they cannot attend online classes boundlessly.

Hargittai and Dobransky (2017) stated that socioeconomic status is one of the factors that impact ODL as well as academic achievement among adult learners. This is because students require a high payment to be able to obtain Wi-Fi or mobile data to access online learning. Unfortunately, students with economic issues can access online learning, thus leaving them behind in education compared to their peers.

Previous studies showed that a lack of learning facilities influenced the academic performance of students. Financial problems are a common issue among students who cannot afford to buy electronic devices and the Internet to join online classes. Other than that, internet accessibility is also deemed to be an issue for some students who live in rural areas. Poor network coverage makes the learning process more difficult and sometimes impossible. Even though they have gadgets and afford to buy the internet, network coverage is one of the factors that need to be considered during online and distance learning.

2.4 CONCEPTUAL FRAMEWORK

In this study, the three factors which are self-regulated learning, teachers' teaching practices, and learning facilities are incorporated into a conceptual framework to examine their relationship with improving Mathematics academic results. Figure 1 portrays the said conceptual framework applied in this research study.

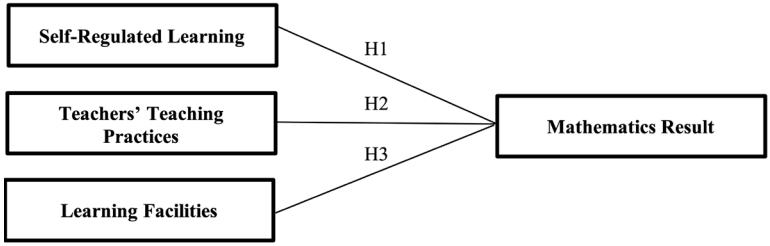

Figure 1: Conceptual Framework

The summary of the hypotheses statements are as follows:

H1: There is a significant relationship between self-regulated learning and Mathematics results during ODL.
H2: There is a significant relationship between teachers' teaching practices and Mathematics results during ODL.
H3: There is a significant relationship between learning facilities and Mathematics results during ODL.

3.0 METHODOLOGY

This study was conducted through a survey using a questionnaire method to study the factors that affect Mathematics results from undergraduate students' perspectives during ODL. The study utilized descriptive, correlation, and regression analysis to meet the research objectives and to test the research hypothesis by using Google Forms for the data collection process and Statistical Package for Social Sciences (SPSS) for analysis.

3.1 RESEARCH DESIGN

This study applies quantitative research design while also using a descriptive research approach. The first section of the survey questionnaire consists of students' demographics such as gender, Calculus 3 results, mobile carrier, gadget used for ODL, and location during ODL. The second section focuses on students' self-regulated learning which contains six questions. Meanwhile, the third section addresses teachers' teaching practices, the fourth section emphasizes the effects of learning facilities, and the last section of the survey questionnaire highlights the values of Mathematics with each section containing six questions, respectively. The questionnaire uses the Likert Scale method with one (1) being strongly disagree, two (2) disagree, three (3) neutral, four (4) agree, and five (5) strongly agree.

3.2 SAMPLING

The population of this study involved students from the Bachelor of Science Education (Hons.) Mathematics from the Faculty of Education. This research employed a simple random sampling method using formulas by Krejcie and Morgan (1970) with data collected from 62 respondents from the Mathematics Education students at the Faculty of Education. A questionnaire along with a set of test papers was provided to respondents when conducting this quantitative study.

3.3 RELIABILITY TEST

This study utilized Cronbach's alpha to investigate the internal consistency of the questionnaires collected from the respondents. All variables of the study displayed high internal reliability as shown in Table 1 below. This test allows for further analysis and discussion.

Variables	No of Items	Cronbach's Alpha	Cronbach's Alpha Item Deleted
Self-regulated learning	6	0.936	0
Teachers' teaching practices	6	0.902	0
Learning facilities	6	0.837	0

Table 1: Reliability Test

Table above provides an overview of Cronbach alpha of the three variables. According to the data gathered, all variables are considered as reliable as the value ranges from 0.8 to 0.9. Self-regulated learning was calculated at 0.936, followed by teachers' teaching practices at 0.902 and learning facilities at 0.837.

4.0 RESULTS AND DISCUSSIONS

4.1 DEMOGRAPHIC

Table 2 shows the summary of the questionnaire distributed and returned by the respondents through Google Forms. A total of 62 respondents, in which 100% of them answered and returned the questionnaire. In addition, based on Table 3, shows that most of the respondents were female students with 80.6% (n=50) compared to male students with 19.4% (n=12).

Number of Questionnaires Distributed	Number of Questionnaire Return	Percent Valid Questionnaire
62	62	100%

Table 2: Summary of the questionnaire that is distributed

Gender	Frequency	Percent
Male	12	19.4%
Female	50	80.6%
Total	**62**	**100%**

Table 3: Respondent's gender

4.2 DESCRIPTIVE STATISTICS

Table 4 below shows the means for each variable. Referring to descriptive statistics, the results exhibit that self-regulated learning is considered to be an important factor in influencing Mathematics results proven by its highest mean (mean=4.02), followed by teachers' teaching practices (mean=3.47) and learning facilities (mean=3.47).

Variables	Mean	Standard Deviation	Total Respondents
Self-regulated learning	4.02	0.932	62
Teachers' teaching practices	3.47	1.067	62
Learning facilities	3.47	1.051	62

Table 4: Mean for each group variable

4.3 CORRELATION ANALYSIS

Based on Table 5, all variables were found to have significant correlation and can be classified as follows:

- Self-regulated learning towards Mathematics results has a strong positive correlation.
- Teachers' teaching practices toward Mathematics results have a moderate positive correlation.
- Learning facilities towards Mathematics results have a moderate positive correlation.

		Mean of Mathematics Result
Self-regulated learning	Pearson Correlation	0.628**
	Sig. (2-tailed)	0.000
	N	62
Teachers' teaching practices	Pearson Correlation	0.487**
	Sig. (2-tailed)	0.000
	N	62
Learning facilities	Pearson Correlation	0.410**
	Sig. (2-tailed)	0.000
	N	62

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

Table 5: Correlations' result

4.4 ANALYSIS OF VARIANCE

Table 6 shows the R2 value which indicates that 41.4% of the variance in the outcome of the factors that affected students' Mathematics results during ODL can be predicted from the variables of self-regulated learning, teachers' teaching practices, and learning facilities. However, the remaining 58.6% of the factors that affected students' Mathematics results during ODL cannot be explained by the research model but by other variables that are not included in this research.

Model	R	R Squared
1	0.643	0.414

Table 6: Model Summary

Table 7 displays an F-test value of 13.637 which is deemed significant. Based on the result, the regression model was found to be suitable where the independent variables were valuable in explaining the variance of the dependent variable.

Model	Sum of squares	df	F	Sig.
1	Regression Residual Total	3 58 61	13.637	.000[b]

Table 7: ANOVA[a]

a. Dependent Variable: Mathematics Result

b. Predictors: (Constant), Self-regulated learning, Teachers' teaching practices, Learning facilities

According to Table 8 below, the coefficient for self-regulated learning was 0.385. Thus, for every unit increase in self-regulated learning, it is expected that a 0.385-point increase in the Mathematics result. Self-regulated learning is found to be statistically significant for the values of Mathematics (p=0.000). It shows that the biggest factor that influences the Mathematics result is self-regulated learning since the significance was less than 0.05 and the unstandardized coefficient was the highest.

The main function of regression analysis is to determine whether the research hypotheses are confirmed or rejected. The analysis is defined as a model that gives a straight-line relationship between two or more independent variables and a dependent variable. Therefore, table 8 exhibits the three variables that were clarified through regression analysis which used multiple linear regression. Based on the table, the highest beta was found to be self-regulated learning at 0.385, followed by teachers' teaching practices at 0.148, and lastly learning facilities at -0.012. The lowest beta indicates the least important factor among the independent variables and dependent variables. Hence, the significant results show that only one independent variable which was self-regulated learning, is considered to be significant because it was identified to be less than 0.05. Therefore, the remaining independent variables (teachers' teaching practices and learning facilities) show that there was no relationship with the dependent variable.

The regression equation for the predicted Mathematics results is: =2.540 + 0.385 (self-regulated learning) + 0.148 (teachers' teaching practices) - 0.012 (learning facilities).

Model	Unstandardized Coefficients	Sig.
	B	
(Constant)	2.540	0.000
Self-regulated learning	0.385	0.000
Teachers' teaching practices	0.148	0.193
Learning facilities	-0.012	0.909

a. Dependent Variable: Mathematics Result

Table 8: Coefficientsa

5.0 CONCLUSION

Based on the findings, the results of this study can be concluded as follows:

	HYPOTHESES	ACCEPTED/ REJECTED
H1:	There is a significant relationship between self-regulated learning and Mathematics results during ODL.	ACCEPTED
H2:	There is a significant relationship between teachers' teaching practices and Mathematics results during ODL.	REJECTED
H3:	There is a significant relationship between learning facilities and Mathematics results during ODL.	REJECTED

The main factor that influences the mathematics results according to the independent variables was found to be self-regulated learning. This is supported by Nemati, Gawrilow, Nuerk, and Kühnhausen (2020), who found in their research that there was a relationship between self-regulation and Mathematics performance among German and Iranian college students. Apart from that, Fauzi and Widjajanti (2018) suggested that there is a positive relationship between self-regulated learning on student achievement. The authors also added that self-regulated learning

is necessary nowadays for all levels of education. Self-regulated learning may influence students' failure to attain learning success. Hence, in their study, the students became frustrated with their schoolwork which required additional self-directed learning. Nonetheless, self-regulated learning is a combination of academic learning and self-control skills that make learning easier, therefore students are more motivated.

The findings of this study are beneficial in providing early exposure to students to understand that academic achievement depends more on themselves compared to other factors. The outcome of the study also allows students to identify their level of self-regulation in learning. If the results show that their self-regulation level is weak, students may take measures to improve it. This is because individuals with low self-regulated learning are more likely to achieve lower academic results since they are unable to control their behaviour, emotions, or thoughts when they face difficulties in the learning process. Low self-regulated learning leads to a lack of motivation, stress, and laziness. As a result, it will affect academic performance. Therefore, this study is beneficial for students to recognize their self-regulated learning so that they can improve their weaknesses.

Besides that, the outcomes of this research are also useful to teachers. Teachers will be able to observe students' perceptions of their teaching practices. They could identify the suitability of teaching practices for students. Since each student has a different character and level of understanding, therefore suitable teaching styles that meet their nature should be considered. This study is helpful for teachers to recognise their students who need more attention in class. Essentially, low-performance students commonly seek more attention and at the same time feel less confident to ask questions to teachers. Generally, this study is advantageous to teachers as it assists teachers in identifying the effectiveness of their teaching practices to maintain or enhance students' academic performance.

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A Tool-Centric Framework for Teaching Undergraduate Computer Science Students on Operating System Design

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Abstract: *Teaching and learning operating system (OS) design is a core part of computer science education, which is highly demanding for both teaching and learning. This paper presents a tool-centric framework that aims at enhancing teaching operating system design for undergraduate students in computer science. The framework integrates multiple educational tools and methodologies with the aim of making the course more appealing for students while improving their comprehension and hands-on experience in OS design. The proposed framework extends existing educational theories and practices by focusing on aspects such as computational thinking, collaborative learning, and gamification in the learning process. The theoretical basics of this framework, the practical use of such a framework, and the expected influence on students' learning outcome will be further explained in this paper. Empirical evidence, detailed examples and comparisons with existing frameworks underscore its potential impact on student learning outcomes.*

Keywords: *collaborative learning, computational thinking, gamification, operating system design, tool-centric framework*

1.0 INTRODUCTION

Operating systems represent the core of computer functionality; controlling hardware resources and providing essential services for application software. Therein lies such a significant complexity in the design of an OS, ranging from process management to memory management, file systems, security protocols, among others. Teaching such concepts requires multiple approaches in view of the diverse learning styles and backgrounds typical of students. Most traditional pedagogical approaches hardly engage students and deepen their conceptual understanding of such complex concepts. Research indicates that students often struggle with abstract concepts in OS design, leading to a lack of confidence and motivation (Gesing et al., 2022; Zahir, 2024). This paper presents a tool-centric framework that leverages modern educational technologies and methodologies in enriching the teaching and learning of OS design. The framework's novelty lies in its systematic incorporation of computational thinking, collaborative learning, and gamification, offering an engaging and effective learning experience.

2.0 PROBLEM STATEMENT

While traditional approaches often leave students disengaged and struggling with abstract ideas, the increasing complexity of operating systems concepts necessitates innovative teaching strategies that can simplify and clarify core concepts. Research indicates that integrating tools that support collaborative learning can significantly enhance educational outcomes in computer science (Gesing et al., 2022; Zahir, 2024). For instance, Anohah (2016) emphasizes that pedagogical principles must form the foundation for the inclusion of features in learning management systems, which can be adapted to create a more engaging learning environment for OS design. Furthermore, the use of simulation tools allows students to visualize and manipulate OS concepts, making abstract ideas more tangible (Weitl-Harms, 2023). By adopting a tool-centric approach, educators can provide students with access to a variety of resources, including simulation tools, collaborative coding environments, and gamified learning platforms.

3.0 OBJECTIVE

Objective 1: To propose a tool-centric framework for teaching operating system design to undergraduate computer science student.

Objective 2: To explore the theoretical foundations of the framework, its practical usage, and the expected impact on students' learning outcomes

4.0 INTEGRATING COMPUTATIONAL THINKING

Computational thinking (CT) is a critical skill in computer science education, and involves problem-solving, algorithmic thinking, and system design. For effective integration of CT in OS design education, unplugged activities may prepare better conceptual development before the effective use of technology. (Peel et al., 2022). This approach aligns with findings by Kharb (2023) , who identifies that logical and operational thinking must be developed through practical activities. This type of activity involves students in the conceptual issues of OS design and encourages them to also indulge in deeper abstract work. Additionally, frameworks that support the integration of CT into science education can be adapted to OS design, providing a structured approach to teaching complex topics (Cabrera et al., 2023). Real examples can be used to help students visualize some of the ways in which an operating system utilizes the resources. For example, the theoretical material regarding resource management by an operating system may be illustrated better using real-life examples of such operating system resource management.

4.1 GAMIFICATION AS A LEARNING TOOL

Gamification is one of the successful learning strategies widely used in modern learning/teaching methods to encourage students and raise their motivation to learn. In an example related to computer science students, elements of gamification have been combined with the ZORQ framework to make learning more playful for them. The ZORQ framework, for instance, utilizes gamification elements to create an interactive learning environment for computer science students (Weitl-Harms, 2023). Game-based learning can make the OS design courses even more dynamic and engaging by showing students there is a way to experiment with OS concepts in a risk-free

environment. Gamification, as various studies prove, tends to make better learning outcomes and increase student satisfaction (Awada et al., 2020). Furthermore, the Scalable Game Design curriculum provides a chance to explore ways in which game design might contribute to computer science education by enhancing computational thinking skills (Webb et al., 2015). By introducing different tools-merit boards, badges, and challenges-into the learning process, a teacher encourages students to be responsible for their learning and builds up both competitive spirit within them and a collaborative learning environment.

4.2 COLLABORATIVE LEARNING ENVIRONMENTS

Collaborative learning environments, particularly those supported by computer-mediated communication, have been found to foster student learning in subjects of STEM. Evidence provided by Zahir (2024), and "The Efficacy of Students' Knowledge Construction Process in Computer-Supported Collaborative Learning (CSCL) Environment: A Malaysian View" (2023) affirms this notion. The CSCL approach maintains that collaboration, technology, and pedagogy are the triplet bases for facilitating effective learning experiences. Generally, designing the OS course with a collaborative project and peer-to-peer learning increases that sense of community in which students feel supported by others and encouraged to share knowledge in their learning journey. This also aligns with the findings from Goode et al. (2020), who indicated that equity-focused teacher professional development is an important factor for driving inclusive environments in learning. Collaborative learning not only increases the level of OS concept understanding, but also develops essential soft skills such as teamwork and communication, which are critical in the tech industry.

4.3 PRACTICAL APPLICATIONS OF THE FRAMEWORK

The proposed tool-centric framework can be implemented through a series of practical applications which relate to the core components of OS design. With such process scheduling algorithms, students are able to derive insight using the simulation tools, playing with different strategies by observing in real-time the results of their application. Group projects may make use of interactive coding platforms where students will be designing and implementing simplified operating systems, thereby reinforcing their

learning through putting key concepts into practice. The Lab4CE is an example of a remote laboratory that may be used in practical computer science to enhance engagement (Broisin et al., 2015). By providing students with access to real-world tools and environments, educators can bridge the gap between theory and practice, preparing students for future careers in technology.

4.4 ASSESSMENT AND FEEDBACK MECHANISMS

Effective assessment strategies are crucial for evaluating student learning and providing constructive feedback. The framework incorporates various assessment methods, including peer assessments, self-reflections, and project-based evaluations, to ensure a comprehensive evaluation of student performance (Pasterk et al., 2019). By utilizing a variety of assessment tools, educators can gain insights into student understanding and identify areas for improvement, ultimately enhancing the learning experience. This approach is supported by the findings of Nagai et al. (2019), which emphasize the importance of formative assessments in developing competencies in computer science education. Additionally, incorporating feedback mechanisms that allow for continuous improvement can help students take ownership of their learning and foster a growth mindset.

4.5 PROPOSED TOOL-CENTRIC FRAMEWORK FOR TEACHING OS DESIGN

Figure 1 shows the tool-centric framework for teaching operating system design. The framework consists of 8 main steps: identifying learning objectives, integrating educational tools and methodologies, integrating computational thinking, collaborative learning, gamification elements, student-centered learning process, evaluation and assessment, and improving the understanding of operating system design.

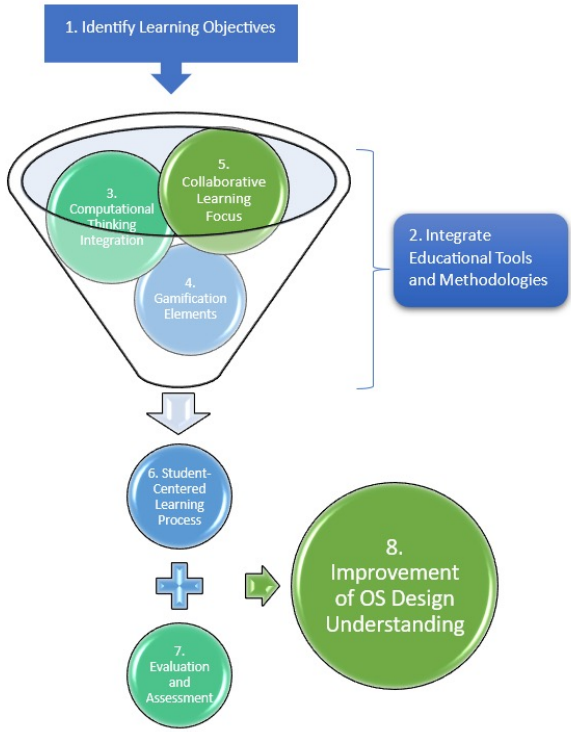

Figure 1: Tool-Centric Framework for Teaching OS Design

This shows a structured framework with the key components and their relationships.

1. Identify Learning Objectives:
Define specific learning goals, such as understanding OS concepts (e.g., memory management, process scheduling) and developing computational thinking skills. This foundational step sets clear expectations for students and aligns with the overall framework.

2. Integrate Educational Tools and Methodologies:
Introduce various tools, such as simulation platforms, collaborative coding environments, and game-based learning elements, tailored to the OS curriculum. The goal here is to equip students with interactive resources that support active learning and hands-on practice.

3. Computational Thinking Integration:
Use exercises that promote problem-solving, algorithmic thinking, and systems thinking in the context of OS design. For example, activities might include unplugged activities or real-world scenarios illustrating resource management.

4. Implement Gamification Elements:
Introduce game-based elements like leaderboards, challenges, and badges to boost engagement and motivation. By creating an interactive and competitive learning environment, gamification supports deeper exploration of OS concepts in a risk-free setting.

5. Collaborative Learning Focus:
Foster teamwork and knowledge sharing through peer-to-peer learning, group projects, and coding collaboration platforms. This collaborative element not only improves comprehension of OS concepts but also helps students develop essential soft skills.

6. Student-Centered Learning Process:
Adapt the framework to different learning styles and encourage self-paced learning. This approach makes the learning process more flexible, allowing students to engage with OS concepts in ways that suit their preferences.

7. Evaluation and Assessment:
Utilize formative assessments such as Quizzes and Practical Assignments, peer reviews, and self-reflections to gauge student understanding and provide feedback. This stage ensures students receive constructive guidance to improve their learning outcomes and understand areas for growth.

8. Improvement of OS Design Understanding:
Encourage an iterative process where students can revisit concepts and refine their skills based on feedback. This final stage supports a growth mindset, allowing students to deepen their understanding of OS design over time.

4.6 EXISTING FRAMEWORKS COMPARISON

Considering the current frameworks that exist for teaching undergraduate computer science students about operating systems (OS) design, approaches, tools, and pedagogical strategies implemented in the academic context have been evaluated. Below is a summary of the frameworks and methods traditionally in practice, plus their pros and cons.

Framework Type	Strengths	Weaknesses	Best Suited For
Lecture-Based Approach	Conveys the theory well with proper structure	Doesn't really cover practical work	Good understanding on theory
Project-Based Learning	Involves practical experience of the subject	Very time exhausting and detailed	Exposure in practical learning
Hybrid Approach	Mix of theoretical and practical knowledge	Simulation might be unrealistic	Overall knowledge
Case Study Based Learning	In-depth knowledge of the Industry workings & large scale systems	Is harder to grasp most times	In-depth knowledge
Gamification and Interactive Tools	Interesting and rapid feedback techniques	Sometimes, the concept can be too vague	New learners
Blended Online Learning	Works with a broader audience since it is very flexible	There is limited time in to interact other students	Self-learners, students who are not on campus
Modular or Layered Approach	Good would be the modular design focus	There is a chance of losing the bigger picture	Concentrated study of OS design|

Table 1: Summary of Framework Type for Teaching OS Design

Existing frameworks, such as ZORQ (Weitl-Harms, 2023) and Scalable Game Design (Repenning et al., 2015), focus on specific aspects like gamification or computational thinking. Unlike these, the proposed framework integrates multiple pedagogical strategies, providing a holistic approach to OS education.

For instance:

ZORQ Framework: Emphasizes gamification but lacks collaborative learning components.

Scalable Game Design: Focuses on game-based learning for computational thinking but does not address hands-on OS design tasks.

The proposed framework bridges these gaps by combining gamification, collaborative learning, and simulation tools to address diverse learning objectives.

4.7 EMPIRICAL EVIDENCE

The framework's effectiveness was evaluated through a pilot program involving 30 undergraduate students. Students were introduced to simulation tools, collaborative platforms, and gamification elements. Pre- and post-assessments revealed a 35% improvement in comprehension scores, while qualitative feedback indicated increased engagement and motivation.

1. Case Study: A group project required students to design a simplified OS kernel using a collaborative platform. The project fostered teamwork and critical thinking, with 85% of students reporting enhanced understanding of core OS concepts.

2. Result and Discussion: The pilot study demonstrated that students engaged with the framework achieved deeper understanding and higher retention of OS concepts. Key findings include:

    a. Improved Comprehension: Students demonstrated significant improvement in process management and resource allocation tasks.
    b. Enhanced Engagement: Gamification elements, such as leaderboards and badges, motivated students to participate actively.
    c. Skill Development: Collaborative projects improved teamwork and communication skills, essential for industry readiness.

3. Limitations: Limitations of the study includes limited sample size, duration of the study, and challenges in integrating the framework into existing curricula.

4.8 CHALLENGES AND CONSIDERATIONS

While the framework presented in this proposal has many advantages, it also needs to present and address the existing or potential challenges that might arise with the application of this framework. Educators may face difficulties in integrating new technologies into existing curricula, particularly in institutions with limited resources. The ideal scenario would be that the need for equitable access of all students to the required apparatus and tools is guaranteed in the success of the framework. Surmounting these would require efficient planning and team coordination from educators, administrators, and providers of technology. The insights from Kulikova and Yakovleva (2022) regarding pedagogical management in digital environments can inform strategies for overcoming these obstacles. Furthermore, ongoing professional development for educators is crucial to ensure they are equipped to effectively implement the framework and adapt to evolving educational technologies.

5.0 CONCLUSION

The proposed tool-centric framework in teaching operating system design to undergraduate computer science students is an unprecedented step forward in educational methodology. This should integrate active and collaborative learning with gamification and computational thinking to further increase student motivation and elicit deep understanding of the more difficult operating system concepts. While computer science continues to evolve, innovative methodologies by educators also must do so, which in turn will provide students with challenges they have to surmount in the future. When this framework is successfully implemented, it could be the framework that would revolutionize a method of education in OS, with knowledgeable and skilled students to maneuver in a world of ever-changing technologies.

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8.0 AUTHORS' CONTRIBUTION

The article's premise was devised, written, and revised by Putit, S. Sulastri. Putit conducted the review and revisions, and gave the article submission approval Khedif, LYB. conceived the article and managed its development.

9.0 CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to IJELHE.

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Evaluating the Efficacy of Digital Design Platform in Improving Public Speaking Proficiencies

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Abstract: *In the wake of COVID-19, educational institutions worldwide rapidly shifted from traditional in-person instruction to fully virtual or hybrid classrooms. This study investigates the role of multimedia design guided by the Cognitive Theory of Multimedia Learning (CTML) in enhancing student engagement within an online Public Speaking course at UiTM Sarawak, Malaysia. Specifically, three CTML components are examined: video animation, video organization, and working memory overload. A purposive sampling approach yielded 103 student participants, representing an 80.62% response rate. Data was collected via a structured questionnaire comprising 22 items adapted from established CTML and engagement scales. Descriptive and inferential statistics, including Pearson's correlation and multiple regression, were employed to analyse the relationships between the CTML factors and student cognitive engagement. The findings demonstrate that video organization ($r = .722$) exhibits the strongest positive correlation with cognitive engagement, followed closely by video animation ($r = .703$). Working memory overload ($r = .698$) also shows a moderate yet significant positive relationship with student engagement. Regression results further identify video organization as the most influential predictor ($\beta = .335$, $p < .05$), underscoring the critical importance of logical structuring and coherent flow in multimedia-based instructional materials. These results suggest that thoughtfully crafted video*

content particularly when supported by online design tools such as Canva can reduce extraneous load, improve information retention, and foster deeper engagement. Consequently, educators are encouraged to integrate well-organised animations, visual cues, and measured pacing into their online teaching practice. Future research should explore the long-term effectiveness of such multimedia interventions and extend investigations to various academic disciplines.

Keywords: *Cognitive Theory of Multimedia Learning, Cognitive Engagement, Online Distance Learning, Graphic Design Online Tool, Canva*

1.0 INTRODUCTION

Educational institutions, including universities and schools, are obligated to comply with the decision made by the government on movement controls even after the rise and subdued of Covid-19. When it comes to assisting teachers in delivering courses in a safe atmosphere from the comfort of their own homes via a virtual platform, technology is a seamless tool. Despite this, problems emerged, such as the unequal distribution of technology capabilities and the poor quality of the digital content of educational materials (Muflihin et al., 2024; Razak, 2021). Therefore, universities in Malaysia, such as Universiti Malaya, Universiti Sains Malaysia, and Universiti Teknologi MARA, have adopted fully virtual asynchronous and synchronous learning styles. This is in addition to changes in the educational landscape that have been brought about by the pandemic and technological advancements in Malaysia (Valmay et al., 2024; Razak, 2021 & Chin, 2020).

Seeing that it was difficult to use only online learning platforms, it is more important for educators to use other educational tools. Some examples of these tools include gamified online quiz platforms such as Quizziz or Kahoot, online video conferencing platforms such as Zoom (Mikhailov et al., 2024; Kristof, 2020; Stafford, 2020), and social media online video-sharing and hosting platforms such as YouTube (Gill et al., 2020). In spite of the fact that technological advancements are beneficial to educators in the process of teaching and learning, educators must also take into consideration the instructional learning approaches in order to maximise the potential, independence, and interests of their students. Guilmette et al.

(2019), King, McQuarrie, and Brigham (2021), and Satriani et al. (2022) are the referenced authors. For the purpose of illustration, the most important aspect of adopting asynchronous learning mode for online distance learning (ODL) at Universiti Teknologi MARA (UiTM) Sarawak is the process of developing excellent instructional learning environments.

Using a fully online learning strategy to instruct students in public speaking is a somewhat uncommon practice. Due to the fact that students in the Public Speaking course have expressed concerns about enrolling in online public speaking, the instructors have been forced to take into consideration any lingering problems with the idea and design of the course (Allen, 2006; Corum, 2013; Hunt, 2012; Teng & Wang, 2021). Learning through the course is intended to be delivered in a manner that is analogous to that of a traditional classroom setting. On the other hand, it would prevent the implementation of strategies that would successfully adapt the pedagogy and content to a digital setting (AlAli et al., 2024; Schwartzman, 2007; Liu & Elms, 2019; Bond et al., 2020). According to Valentini et al. (2001) and, Robinson and Hullinger (2008), the internet, the web, and educational technology have all contributed to the transformation of education. Other stakeholders in education, such as students, teachers, and institutions, have also played a role in this transformation. According to Pallof and Pratt (2001), the efficacy of online learning is primarily measured by the way it achieves learning outcomes, which include student grades, attitudes, and the degree to which students are satisfied with online learning. It is also essential to evaluate the quality of the learning experience based on the student and the level of students' involvement, which is defined as the extent to which students make an effort to read about a topic, practise, and find solutions to issues (Kuh, 2003).

Without a proper multimedia instructional design, even the full capabilities and user-friendly interface of video meetings could not be implemented, particularly in the context of distance learning (Stafford, 2020; Knoster, 2021). There is no significant difference in the performance outcomes of students when they receive their education either in-person or online. In addition, the utilisation of multimedia in the classroom has proven to be an essential component in enhancing student engagement, strengthening instructional methodologies, and ultimately enhancing student outcomes (Allen et al., 2016) However, attitudes regarding the level of success

that may be achieved through online learning have recently shifted. As a consequence of this, the teaching staff continues to be cautious regarding the efficacy of online learning in terms of providing high-quality educational experiences (Allen, Seaman, Poulin, & Straut, 2016; Manu et al., 2021).

The purpose of this research is to investigate the ways in which successful multimedia design can be included into the construction of video-based learning through the utilisation of online graphic design tools such as Canva for educational technology. Canva.com online design tool and Cognitive Theory Multimedia Learning (Mayer, 2001) were employed in order to ascertain which multimedia aspects university instructors may utilise in order to construct their video-based learning.

2.0 LITERATURE REVIEW

Online graphic design tool is utilised as a component of a project in order to facilitate the creation of a live multimedia learning experience. The term "student engagement" refers to the "cognitive, emotional, and behavioural effort students put into a course, as assessed by their time, involvement, feelings, and communication with instructors and peers" (Dixson, 2015). This definition was provided by the Department of Education. The social contact that occurs between teachers and pupils, which is fostered by the presence of teachers in the classroom, ultimately results in the formation of a rich and meaningful sense of community within the classroom. According to Bowers and Kumar (2015), the results are an increase in employee engagement and a decrease in employee turnover. Richard E. Mayer and other cognitive researchers collaborated to develop instructional technology for learning, with a particular focus on the ways in which multimedia might improve the learning process. When the artist or instructor constructs internal representations using words and visuals, this is an example of multimedia learning. An application of the theory is made to the problem of organising educational practices that involve multimedia and employing more effective cognitive strategies in order to support successful learning. The strategies suggested are as follows: (1) selecting relevant words for the processing of verbal working memory; (2) selecting relevant pictures for the processing of visual working memory; (3) organising the selected words into a verbal model; (4) organising the selected pictures into a pictorial model; and (5) integrating the verbal and pictorial representations with each other and with prior knowledge.

It is possible for instructors to express both verbal and nonverbal instructor immediacy behaviours with the assistance of video technology. Borup et al. (2011), Griffiths and Graham (2009), and Collins et al. (2019) agree that the use of this technology is extremely important for shaping the perceptions that students have of the social presence of their academic teachers. The interaction between students and teachers is considered by Collins et al. (2019) to be the most significant kind of engagement in online learning. This is because it helps to maintain students' interest in the material being taught. Increasing the social presence of instructors and the level of student involvement in online classrooms can be accomplished through the utilisation of asynchronous video, which is an effective method that is made possible by technological advancements that allow for enhanced communication.

According to Dilani and Arezou (2018) and Ng et al. (2022), the level of maturity is currently increasing as a result of technological innovation. The next stage for instructors is to choose appropriate educational resources for their students to use. Researchers are going to make use of Canva media for their educational purposes. In order to make studying public speaking more appealing and effective, the use of this tool is intended to accomplish this purpose. That Canva has the potential to be used as a multimedia learning tool is the innovative element of the program. According to Desai and Kulkarni's (2022) theory, learning media, in particular online learning, are designed and deployed to enhance subject matter appeal and boost student involvement in their studies. The process of learning using Canva would be consistent with this idea. The content that was generated is quite appropriate and assists both teachers and pupils in carrying out their educational responsibilities.

In addition, Canva may be utilised for the creation of graphics and content for social media platforms, including logos, posters, and advertising banners (Kartiwi and Rostikawati, 2022). Canva is a web-based design tool that allows users to create a wide variety of designs that are visually beautiful or useful. The adaptability and depth of Canva's benefits are demonstrated by the versatility. There are a variety of elements that may be utilised in Canva, including but not limited to graphics, posters, presentations, flyers, and brochures. By registering with Canva, customers are able to establish a connection with Google Mail prior to selecting and creating designs.

Immediately following the addition of content by users, the design can be downloaded and distributed. Canva is an application that can assist users in developing their creative abilities when it comes to the creation of articles, presentations, and posters. images and pictures. The Canva design program was used to produce all of the instructional materials that are utilised in this study.

According to Oh et al. (2022), audio or pictorial animation calls for a wide variety of technical abilities as well as collaboration in order to produce a product that is of sufficient quality. The cognitive abilities of students are only able to capture one facet of their whole learning experience, and that is the outcome. Over the course of the past few years, there has been a substantial and remarkable shift in the educational experience that animation students in higher education have. According to Oh et al. (2022) and, Liu and Elms (2019), all that is required for students to have a positive learning experience is for the learning process to be fascinating, enjoyable, and straightforward for them. As a consequence of this, it is important to point out that the design of an animated video plays a key part in catching the interest and attention of pupils. According to Theobald (2017), Allcoat and von Muhlenen (2018), and Liu et al. (2019), the most effective hooks for engaging student attention and improving viewer satisfaction are character design, dialogue scripting, and voice acting. Therefore, the first hypothesis can be proposed as:

H1: Animation in instructional video-based learning can significantly influence student engagement

A multidimensional construct would indicate the burden that doing a given task exerts on the students' cognitive students' cognitive systems (Pass & Van Merrenboer, 1994). The working memory must process the cognitive load associated with a particular instructional message (Sweller et al.,2011) There are three different types of cognitive load namely germane load, extraneous burden, and intrinsic load. Regardless of how the learning challenge is presented, intrinsic load represents the native complexity of the

learning task (Sweller et al., 2011). The instructional message and learning task are the only external workloads that students must deal with since they must exert effort to complete the assignments they have been given. Hence, the second hypothesis can be proposed as:

H2: Organization Load Instructional Video-based Learning can significantly influence student engagement

Working memory would manipulate knowledge in active consciousness. Working memory inputs received from sensory and transform to a concrete pictorial and verbal representation. However, the capacity of remembering one piece in human's is limited and divided approximately to seven segments (Mayer & Pilegard, 2018). When students' working memory is cognitively overwhelmed with unnecessary information, the students are unable to pay attention to specific pieces of information that have been presented. In the CTML perspective, students' selection, organisation and integration of novel information. Thus, it constitutes the causal mechanisms through which learning exists, able to make sense of new information and finally promoting learning engagement. Similarly based on previous research exploring the impacts of prior knowledge of instructional learning contents inhibits the learning enhancement (Mayer & Pilegard, 2018). The third hypothesis can be proposed as:

H3: Working Memory Overload in Instructional Video-based Learning can significantly influence student engagement

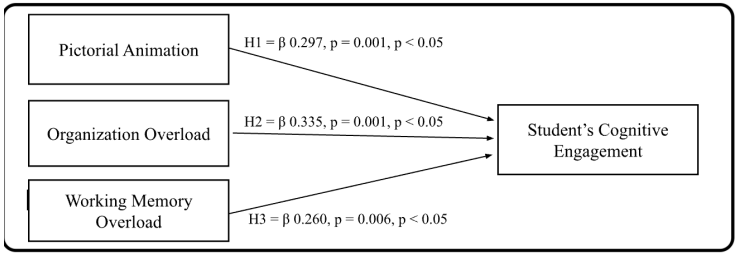

Figure 1: Conceptual Model adapted from Knoster (2021)

3.0 METHODOLOGY

This study was guided by the Cognitive Theory of Multimedia Learning (CTML) to examine how specific multimedia elements namely pictorial animation, organizational load, and working memory overload impact student engagement in an online Public Speaking course offered at UiTM Sarawak, Kota Samarahan, Malaysia. The CTML framework, which emphasizes the effective integration of visual and auditory information to facilitate knowledge acquisition while minimizing unnecessary cognitive demands, served as the theoretical underpinning for the research design and instrument development. Data for this study were gathered through a cross-sectional survey. The population comprised 129 students enrolled in the targeted Public Speaking course. A purposive sampling approach was used to focus on those students currently taking or retaking the course, as they were deemed most likely to offer relevant insights into their learning experiences. Out of the 129 students invited to participate, 104 valid responses were obtained, yielding an 80.62% response rate. According to Fincham (2008), such a high response rate is considered significant in survey research, enhancing the generalizability of the findings within this specific instructional context.

A structured questionnaire was developed to capture the constructs of interest. Building on prior studies by Knoster (2021) and Liu and Elms (2019), the instrument was designed to measure three core elements aligned with CTML principles. The student engagement component was informed by Reeve and Tseng's (2011) conceptualization of "agency," which highlights cognitive, emotional, and behavioral dimensions of active participation in learning.

By incorporating insights from established literature, the questionnaire ensured content validity and theoretical coherence.

The questionnaire featured multiple items for each construct, using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). For instance, items related to pictorial animation examined how often students perceived animations, graphics, and voiceovers to be engaging

or helpful; items on organizational load assessed whether the instructional content was logically structured and easy to follow; and items on working memory overload explored whether students felt overwhelmed by the amount of information presented at one time. The section on student engagement included prompts that probed how well students could focus, relate new information to prior knowledge, and remain motivated throughout the learning process.

Data collection was conducted online, ensuring that all students had convenient access to the survey via their course platform. Students were informed about the research objectives, assured of the confidentiality and anonymity of their responses, and given the freedom to withdraw at any stage without penalty. These measures complied with ethical standards for research involving human participants, safeguarding the integrity and voluntariness of the data collection process.

Once the surveys were completed, data were subjected to several statistical analyses. First, descriptive statistics were calculated to summarize demographic details and the overall response patterns for each variable. Means and standard deviations were examined to gain an initial understanding of how students rated the different dimensions of pictorial animation, organizational load, working memory overload, and engagement. Next, reliability analyses were performed to ensure the internal consistency of the survey scales. Following the guidelines by Nunnally (1978) and Sekaran and Bougie (2010), Cronbach's alpha values of .70 or higher were taken to indicate acceptable reliability. All variables in this study exceeded this threshold, confirming that the questionnaire items consistently measured the intended constructs.

With reliability verified, Pearson's correlation analyses were conducted to explore the strength and direction of the relationships among the independent variables (pictorial animation, organizational load, and working memory overload) and the dependent variable (student engagement). This step provided insight into whether greater emphasis on visual animation, better organization, or reduced cognitive burden corresponded to higher engagement levels. Finally, multiple regression analysis was performed to

determine the unique contributions of each independent variable to student engagement, controlling for the influence of the others. This approach helped isolate which factors had the strongest predictive power regarding student engagement in the online Public Speaking course.

By grounding each stage of the research process in the CTML framework, this study effectively integrates theoretical perspectives on how visual and verbal information should be presented to optimize learning. The deliberate focus on organizational load and working memory constraints aligns with Mayer's (2001) contention that multimedia design plays a critical role in shaping cognitive processes. Consequently, this methodology affords a comprehensive view of how carefully structured multimedia materials incorporating targeted animations, coherent organization, and well-managed information flow may enhance learning outcomes and student engagement in virtual academic settings.

4.0 FINDINGS AND DISCUSSION

Purposive sampling was used to determine the population size. Descriptive analysis has been conducted and indicated 103 respondents answered the survey. Around 97.1% (100 respondents) took the Public Speaking course and only 2.9% (3 respondents) repeated the course in the previous semester. The analysis proceeded with gaining more insight into the identification of the study by 103 respondents through descriptive analyses of all the items. Five-point Likert scale was used in this study with 1 = Strongly Disagree, 2 = Disagree, 3 = Disagree, 4 = Agree and 5 = Strongly Agree. The highest mean value with a mean score of 1.03 and the standard deviation is 0.169.

Factor	Measurement Item
Pictorial Animation	1) Voice acting – I was able to concentrate when there is a voice explaining the lesson to me in this instructional video. 2) Picture – The use of pictures in this instructional video makes my learning more enjoyable. 3) Text colour – The use of text colour in the instructional video is interesting. 4) Visual cue and graphic – I find the visual cue, transition and graphic use in this instructional video make my learning more interesting.
	5) Music – I find the music background in the instructional video makes my lesson more enjoyable. 6) Background or set design – Overall I find the instructional video helpful to my learning.
Organization Overload	7) I was able to organize the material presented in this instructional video in a logical manner. 8) I could connect the ideas from this instructional video to one another in a coherent fashion. 9) I understood the relationships between the various parts of this subject. 10) I had the ability to logically model concepts from this lesson as they applied to one another. 11) I understand how the various parts of this lesson worked jointly to form the ideas I was learning.
Working Memory Overload	12) The amount of information presented in the instructional video lesson was tolerable. 13) I don't have a hard time keeping up when watching the instructional video because the transitions are reasonable. 14) I felt comforted trying to keep up with the amount of information presented in this instructional video-based learning. 15) This instructional video-based learning made me feel calm because of the amount of information I was asked to learn all at one time.

Cognitive Engagement	16) I find the animated instructional video-based learning is interesting to watch. 17) I enjoy watching the animated instructional video-based learning for Public Speaking's online class. 18) The animated instructional video-based learning for Public Speaking's online class grasps my attention and helps me concentrate. 19) I try to relate what I'm learning from public speaking's instructional video to what I already know. 20) When I am working on task assessment for Public Speaking, I try to connect what I had learned from the instructional video with my own experiences. 21) I try to make all different ideas fit together and make sense after watching the instructional video. 22) Overall, I find the instructional video able to help me understand the topic's concept.

Table 1: Cognitive Theory Multimedia Learning & Cognitive Engagement Measurements.

The reliability of scales depicts the scales are free from random error and have high internal consistency. Nunnaly (1978) and Sekaran and Bougie (2010) recommended a minimum level of .700 of Cronbach alpha values and above is considered greater reliability. In the current study, the Cronbach alpha coefficient of all variables is above .700 which is between .798 to .881 respectively.

Variables	No. of items	Cronbach's alpha Reliability Analysis (n=103)
Independent Variables		
Video Animation	6	.798
Video Organization	5	.881
Video Memory Overload	4	.844
Dependent Variables		
Student Cognitive Engagement	7	.873

Table 2: Reliability Analysis

Pearson Product-Moment Correlation Coefficient was used to assess the strength and direction of between independent variables (Video Animation, Video Organization, Video Memory Overload) and dependent variables (Cognitive Engagement). The reliability of the instrument was determined by the Cronbach's Alpha value from Hair et. al. (2020). Based on the table above, Video animation (r=.703, n=103, p<.0005) and Video organization (r=.722, n=103, p<.0005) have a high and positive correlation toward Cognitive Engagement. However, Video Memory Overload (r=.698, n=103, p<.0005) has a moderate and positive correlation toward Cognitive Engagement.

Variable		**Student Cognitive Engagement**
Video Animation	**Pearson Correlation**	**.703****
	Sig. (2-tailed)	0.000
	N	103
Video Organization	**Pearson Correlation**	**.722****
	Sig. (2-tailed)	0.000
	N	103
Video Memory Overload	**Pearson Correlation**	**.698****
	Sig. (2-tailed)	0.000
	N	103

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

Table 3: Pearson Correlation

The result depicts that Video Organization has the highest beta coefficient with the value of β 0.335 (p=0.001, p<0.05). Video Organization has the strongest and unique contribution toward Cognitive Engagement when the variance supported by all other independent variables in the model is controlled for. This is followed by other variables such as Video Animation (β 0.297, p=0.001, p<0.05) and Video Memory Overload (β .0.260, p=0.006, p<0.05). The overall finding shows that three independent predictors (Video

Organization, Video Animation and Video Memory Overload) are indicated as unique, statistically significant and best contribute to the prediction of the dependent variable (Cognitive Engagement). The findings of the study by Nives and Tomislava (2020) corroborate this, showing that learning media created through the application of Canva are well-suited for usage in education, especially in the online learning setting.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	1.275		0.945	1.349	0.180
	Video Animation	0.346		0.106	0.297	3.273	0.001
	Video Organization	0.453		0.127	0.335	3.577	0.001
	Video Memory Overload	0.385		0.137	0.260	2.804	0.006

Table 4: Dependent Variable (Student's Cognitive Engagement)

5.0 CONCLUSION

This study examined the impact of a graphic design online tool, Canva, on student engagement in a public speaking course through the lens of the Cognitive Theory of Multimedia Learning (CTML). The findings reveal that Canva can significantly enhance students' cognitive, emotional, and behavioral engagement, validating the potential of multimedia tools in educational settings. Specifically, video animation, organization, and working memory load were found to be pivotal in influencing student engagement levels, with organized multimedia design showing the strongest impact on students' cognitive involvement. This aligns with the CTML framework, suggesting that well-structured multimedia content can optimize students' cognitive resources by helping them effectively process information.

The analysis underscores the importance of balancing multimedia elements such as animations and visual aids in educational content to avoid cognitive overload. Tools like Canva offer diverse design features that aid instructors in creating engaging, visually appealing instructional materials, thereby fostering a conducive learning environment. By enhancing organization and minimizing extraneous load, these tools improve the ability of students to retain and synthesize information effectively. Video organization, in particular, was found to be crucial, as it allows for a logical flow that aids in comprehension and memory retention, which directly contributes to higher cognitive engagement.

Overall, this study supports the integration of multimedia design tools into classroom settings to enrich learning experiences and enhance engagement, especially in courses where visual communication plays a key role. Future researches could explore the long-term effects of such tools on student learning outcomes and expand the scope to different academic disciplines. By leveraging multimedia technology, educators can better align instructional methods with cognitive learning processes, ultimately improving student learning and engagement.

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8.0 AUTHORS' CONTRIBUTION

All authors offered valuable feedback and contributed to shaping the research, analysis, and manuscript.

9.0 CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to IJELHE.

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Online Video Usage in Undergraduate Research Presentations and Learning Satisfaction: A Comparative Study of Male and Female Students

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Abstract: *The academic field is an important learning platform in a country's education system and students are valuable assets to the country. The primary purpose of this study was to identify gender-related differences in the relationships among perceived usefulness, perceived ease of use, attitude, need for achievement, and learning satisfaction with the use of online videos for undergraduate research project presentations. Specifically, this paper studies the mediating effect of the need for achievement on the proposed relationships. The study employed a cross-sectional survey with systematic sampling. The data were collected from 200 students at the Faculty of Administrative Science and Policy Studies, Universiti Teknologi MARA (UiTM). The model was tested using Structured Equation Modelling (SEM). The findings can be summarised as follows: (i) both female and male students' learning satisfaction is influenced by perceived usefulness, perceived ease of use, and attitude, and (ii) both males and females are expected to have a high need for achievement, with female students requiring a more goal-oriented personality than male students to perform well in their learning. The findings provide practical support for the development of new educational strategies to assist universities, faculties, and higher learning institutions in enhancing their existing student development programs or projects.*

Keywords: *perceived usefulness; perceived ease of use; attitude; need for achievement; learning satisfaction*

1.0 INTRODUCTION

Many studies have been conducted to examine student satisfaction with the use of equipment or applications for online learning. Alqurashi (2019) measured student satisfaction based on the class atmosphere, relationships among students, and student-and-lecturer relationships. Student satisfaction is assessed through students' perception of the value of learning, experience, self-development, and the desire to take similar courses. A study by Quadir and Zhou (2021), which measured student satisfaction through the features of the platform used for synchronous online learning, found that features of the platform that are attractive and comfortable to use could influence student satisfaction with online learning. Universiti Teknologi MARA (UiTM) has actively utilized an online learning platform since the COVID-19 pandemic. UiTM has used online platforms for both the pandemic and post-pandemic undergraduate viva presentations at the Faculty of Administrative Science and Policy Studies. Therefore, this research initiative was conducted to survey student satisfaction with online video presentations.

To determine the factors influencing students' satisfaction with online presentation, the Technology Acceptance Model (TAM) was referenced. The TAM model is often used to explain the acceptance of technology and information systems (Alfadda & Mahdi, 2021). Davis (1989) introduced the TAM to explain user acceptance of computer technology based on clear theoretical justification. Two constructs related to internal beliefs, which are critical determinants in TAM, are perceived usefulness and perceived ease of use (Yadav & Shanmugam, 2024). Thus, the first two factors influencing student satisfaction with online presentations are perceived usefulness and ease of use. The third factor is students' attitude toward the use of technology, which measures the seriousness with which students approach tasks that are meaningful through video presentations.

This study also examines the mediating effect of the need for achievement on the relationships between perceived usefulness, perceived ease of use, attitude, and student learning satisfaction. The need for achievement refers to the desire to take on difficult tasks, where people with a high need for

achievement have control over their behavior and enjoy complex challenges (Davis, 1989). Thus, the need for achievement could be mediated by perceived usefulness, perceived ease of use, and attitude in influencing student learning satisfaction. Moreover, this study also aims to compare male and female students. Ramírez-Correa et al. (2015) noted that studies often consider gender as a moderating variable in the TAM, especially in the context of online learning. Such studies generally support the idea that gender affects the intention to use information technology and the direction of online learning readiness. However, empirical evidence from previous studies investigating gender differences has produced conflicting results. For example, several studies, such as Shahzad et al. (2021) at higher education institutions, have found a significant difference between gender and the tendency to accept online learning. On the other hand, findings from several studies did not show a significant relationship between gender and online learning acceptance and satisfaction. Adams et al. (2022) and Formoso (2018) found that male students are more ready for online learning than their female counterparts. Due to these gender differences, an empirical study was conducted to investigate whether there is a significant difference in learning satisfaction between female and male students using online video presentations. It is hoped that through this study, we can better understand the role of gender differences in the use of technology. Therefore, the main objective of this research is to examine the mediating influence of the need for achievement on the role of perceived usefulness, perceived ease of use, and attitude in determining student learning satisfaction.

2.0 PROBLEM STATEMENT

Online learning is an approach that uses digital technology to connect lecturers and students, and it can be applied at all levels of education (Dengel et al., 2023; García-Morales et al., 2021). Online learning became especially necessary during the COVID-19 pandemic, when face-to-face meetings between students and lecturers were replaced by online meetings using video conferencing applications such as Cisco WebEx, Zoom, Skype, MS Teams, and Google Meet. The development of online learning requires two types of resources: digital resources and technology (Tang et al., 2021; Wang et al., 2024). Digital resources include educational videos, video conferences, social media networks, and other digital materials (Tang et al., 2021), while the technological resources consist of computers, laptops, tablets,

smartphones, and televisions (Brown et al., 2022). Even if lecturers or students have both types of resources, access to quality internet connectivity remains a significant challenge in the teaching and learning process (McLean & Attardi, 2023; Rahmatpour et al., 2024). Internet access is also a common issue in online learning (Brown et al., 2022; Tang et al., 2021). However, Malaysia's internet infrastructure is continually improving, and Malaysian telco companies offer a variety of affordable services. Nevertheless, students may still face internal challenges in online learning, such as a lack of self-discipline, motivation, and focus (Mishra et al., 2020).

3.0 OBJECTIVES

Objective 1: To identify gender-related differences in the relationships among perceived usefulness, perceived ease of use, attitude, need for achievement, and learning satisfaction in the context of using online video for undergraduate research project presentations.

Objective 2: To examine the mediating effect of the need for achievement on the relationships among perceived usefulness, perceived ease of use, attitude, need for achievement, and learning satisfaction in the context of using online video for undergraduate research project presentations.

4.0 LITERATURE REVIEW & THEORETICAL FRAMEWORK

4.1 LEARNING SATISFACTION

Customer satisfaction is a crucial issue not only across all industrial sectors but also in educational institutions. Satisfaction arises from an emotional response to an activity (Rahmatpour et al., 2024). For students, satisfaction encompasses the quality of teaching and learning, which is influenced by factors such as the competence of the lecturer, the teaching techniques and methods employed by the lecturer, the social environment, and the quality of services offered. Students act as customers to educational institutions and have specific needs that must be addressed by the institution's management (Trinh et al., 2024). Therefore, the success and excellence of students begin with a comfortable, high-quality teaching and learning environment. A learning environment that meets students' needs is a key factor driving

individual success and satisfaction (Hassan & Mohd Hassan, 2024). According to Trinh et al. (2024), student satisfaction has become a critical concept in higher education, as it is often used as a measure in university rankings. Thus, evaluating student satisfaction is essential and must be carried out by educational institutions to assess customer satisfaction.

Satisfaction is a consideration or decision that reflects the level of use of a product or service feature. It represents a positive learning experience. Empirical studies have found that the success of online learning is closely linked to student satisfaction (Jiang et al., 2021). Satisfaction is a key factor in determining the quality of online education. Furthermore, student satisfaction contributes to academic achievement (Jiang et al., 2021). Four factors affect student satisfaction with online learning: i) communication and interaction between instructors and students; ii) total time on task; iii) engagement and active learning; and iv) collaboration among classmates (Rajabalee & Santally, 2021). Student satisfaction in online learning increases when the learning is well-planned, encourages reflection, and provides a suitable platform for interaction and collaboration (Landrum et al., 2021). Several studies have been conducted to measure student satisfaction with online learning. However, in terms of undergraduate research education, studies are limited to higher education settings. With research evaluation, it has become a challenge for lecturers to implement effective online learning for research education due to the lack of decisions and discussions about the effectiveness of the learning methods.

4.2 TECHNOLOGY ACCEPTANCE MODEL (TAM)

Several models have been developed to analyze and understand the factors that influence the acceptance of technology. The Technology Acceptance Model (TAM) is a framework used to understand how users accept and adopt technology. TAM was developed in 1986 by Fred Davis in his doctoral thesis. Initially, TAM was designed to explain how users accept new information technology, such as management information systems or software. However, with technological advancements, TAM has also been applied in various technological contexts, including mobile technology, social media, and the Internet of Things (IoT) (Yadav & Shanmugam, 2024). Since its introduction in 1986, TAM has continued to evolve and improve. The TAM model explains that a user's perception influences

their attitude toward the benefits of using information technology or online learning (Alfadda & Mahdi, 2021). The model illustrates how perceived usefulness and ease of use impact technology acceptance. This research utilized constructs modified from the TAM model: perceived ease of use, usefulness, and attitude, all of which can predict student learning satisfaction (Alfadda & Mahdi, 2021).

Perceived ease of use refers to the belief that technology can be easily understood and used. Indicators of ease-of-use in information technology include being easy to learn, improving user skills, and being easy to operate (Davis, 1989). On the other hand, perceived usefulness is defined as the belief that technology will benefit those who use it. Technological usefulness includes making tasks more accessible, increasing productivity, enhancing effectiveness, and improving performance. The third variable is attitude (Alfadda & Mahdi, 2021). In TAM, attitude is conceptualized as a person's acceptance or rejection of a system, influenced by their experience with technology in their work (Davis, 1989). Other researchers have noted that attitude is a crucial factor influencing individual behavior. A person's attitude consists of cognitive, affective, and behavioral components.

TAM is a reliable model for assessing various learning technologies. Previous studies have also proven that TAM's core variables; perceived usefulness and perceived ease of use, significantly influence the acceptance of learning technologies. TAM-Extended has been developed by adding new variables such as cognitive absorption, performance expectations, and social influence (e.g., Al-Adwan et al., 2023; Lin & Yu, 2023). With these developments, TAM continues to be refined and optimized for use in various emerging technological contexts. The application of TAM has helped organizations understand how users adopt technology and ensure that the technology is well received (Al-Adwan et al., 2023). This study extends TAM by incorporating the need for achievement as a mediator variable. The study posits that the relationship between perceived usefulness, perceived ease of use, attitude, and learning satisfaction in the context of using online video for undergraduate research project presentations may be mediated by the need for achievement.

4.3 NEED FOR ACHIEVEMENT AS A MEDIATOR

The need for achievement refers to the urge to excel, reach a certain standard, and strive for success. Some individuals have an intrinsic drive that compels them to succeed (Landrum et al., 2021). These individuals pursue personal achievement rather than seeking external rewards. They have a desire to do things better or more efficiently than before. Through analyzing thousands of personal stories, McClelland (1985) discovered that humans are not simply creatures of satisfaction—there is a deeper drive that fuels their actions. He identified three core internal needs: the need for achievement, the need for affiliation, and the need for power. According to McClelland, life experiences shape these dominant needs from birth, with one need taking priority over the others. McClelland (1985) found that high achievers distinguish themselves from others by their desire to improve.

The factors that reflect a person's high need for achievement are: 1) situations where they can be personally accountable for solving a problem, 2) a tendency to set moderate goals and take calculated risks, and 3) a desire for feedback on their performance (McClelland, 1995). Individuals with a high need for achievement take personal responsibility for their performance outcomes because doing things well satisfies their intrinsic needs. Students with a performance orientation tend to be goal-focused, self-confident, willing to take risks, and seek feedback to enhance their performance (McClelland, 1995). In contrast, students who prioritize the need for affiliation and power may focus more on social relationships and influencing others than on their own performance. Educators can use this knowledge to motivate less motivated students by providing clear goals and constructive feedback to help improve their performance.

4.4 DIFFERENCES BETWEEN MALE AND FEMALE STUDENTS

Gender is not only concerned with biological differences between men and women but also includes psychological, social, and cultural differences between the sexes. Additionally, the achievement gap between male and female students is a global phenomenon. Empirical studies have shown that female students tend to achieve higher academic performance than their male counterparts (McClelland, 2005). This academic achievement disparity in favour of female students has raised concerns about gender imbalance (Ramírez-Correa et al., 2015). The issue is also linked to learning satisfaction and support. Yusoff and Azman (2020) found differences in the learning support and involvement between male and female students, which affect academic achievement. Female students receive higher levels of learning support and engagement than male students. Studies have also highlighted gender differences in academic achievement. For instance, Chung et al. (2020) found that learning styles, skills, and strategies tend to favor female students more than male students. Previous research has also suggested that female students tend to be more positive and attentive toward university work than male students (Adams et al., 2022; Shahzad et al., 2021).

However, when it comes to technology in learning, studies have found that male and female students adapt to technology differently across various dimensions. Male students, for example, may adopt certain technologies more quickly than female students, and vice versa (Chung et al., 2020; Loureiro et al., 2020). These studies, however, show some inconsistencies. This research aims to explore the differences in learning satisfaction between male and female students using technology and the underlying reasons for these differences. Therefore, this study examines and compares the mediating influence of the need for achievement on the relationships between perceived usefulness, perceived ease of use, attitude, and learning satisfaction. Based on these observations, the following hypotheses are proposed:

H1a: The need for achievement mediates the relationship between perceived usefulness and learning satisfaction regarding online video usage for undergraduate research presentations of male students.

H1b: The need for achievement mediates the relationship between perceived ease of use and learning satisfaction regarding online video usage for undergraduate research presentations of male students.

H1c: The need for achievement mediates the relationship between attitude and learning satisfaction on online video usage for undergraduate research presentations of male students.

H2a: The need for achievement mediates the relationship between perceived usefulness and learning satisfaction on online video usage for undergraduate research presentations of female students.

H2b: The need for achievement mediates the relationship between perceived ease of use and learning satisfaction regarding online video usage for undergraduate research presentations of female students.

H2c: The need for achievement mediates the relationship between attitude and learning satisfaction on online video usage for undergraduate research presentations of female students.

Figure 1 portrays the conceptual framework of the study.

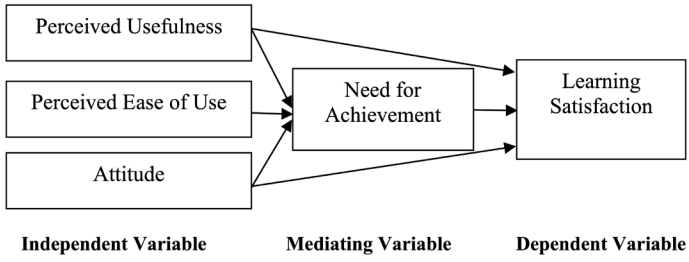

Figure 1. Conceptual Framework

5.0 METHODOLOGY

This study's research design follows a non-experimental, quantitative approach using survey research to explore and describe student satisfaction with online video presentations. The population for this study consisted of final-year students at the Faculty of Administrative Science and Policy Studies, Universiti Teknologi MARA (UiTM) Seremban Campus. The sample size was determined based on Kline's (2005) guidelines for analyzing structural equation models (SEM). Kline (2005) suggests that a sample size of 100 is considered small, 100 to 200 is medium, and a sample over 200 is significant. Therefore, the sample size for this study was 200 respondents, with 100 respondents selected from each gender. A systematic sampling technique was employed.

The research instrument was adapted from the questionnaires used in studies by Al-Fraihat and Sinclair (2020), Ho et al. (2020), and Vodă and Florea (2019). The measurement scale used in the questionnaire was a Likert scale, with five response options: (1) strongly disagree, (2) disagree, (3) uncertain, (4) agree, and (5) strongly agree. The researchers ensured the study was conducted with integrity, following the procedures set by the institution. This research received approval from the Ethical Committee at Universiti Teknologi MARA (UiTM) in October 2021. Table 1 summarizes the items used in the study.

Variables	Items
Perceived Usefulness	U1. Using the online learning system improves my learning performance. U2. Using the online learning system promotes my learning effectiveness. U3. Using the online learning system gives me greater autonomy and flexibility. U4. I find the online learning system valuable and comfortable in my learning
Perceived Ease of Use	E1. Interacting with the online learning system requires little mental effort. E2. The online learning system is easy to use. E3. It is easy to become skillful at using the online learning system.
Attitude	A1. Using the online learning system is a good idea. A2. The online learning system provides an attractive learning environment.
Need for Achievement	N1. I excel in what I do. N2. I will continue until everything is perfect. N3. I am a hardworking person. N4. I do more than what people expect me to do. N5. I plunge into tasks with all my heart.
Learning Satisfaction	L1. I am satisfied with the performance of the online platform. L2. I enjoy using the online platform in my study. L3. The online platform satisfies my educational needs. L4. Overall, I am pleased with the experience of using the online platform.

Table 1. Measurement of the Variables

The final data were input into SPSS software for analysis using structural equation modelling (SEM). The approach used was Confirmatory Factor Analysis (CFA) to analyze the measurement model. Six fit indices were used: Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Normed Fit Index (NFI). In this study, the Chi Square/ Degree of Freedom ratio (χ^2/df) was less than 5 (< 5), which is in line with Kline (2005). The Root Mean Square Error of Approximation (RMSEA) value was less than 0.08 (< 0.08), as recommended by Hair et al. (2010). Convergent validity (CV) refers to how closely a test relates to other tests measuring the same or similar constructs. According to Hair et al. (2010),

CV values are obtained based on factor loading, average variance extracted (AVE), and composite reliability (CR). Factor loading and CR values must exceed 0.60 and 0.70, respectively, as suggested by Hair et al. (2010). AVE values should exceed 0.50 (Byrne, 2010). The bootstrapping method was also employed to confirm the mediating effect.

6.0 FINDINGS

6.1 DEMOGRAPHIC PROFILES

A total of 200 questionnaires were collected from respondents of both genders. In terms of Cumulative Grade Point Average (CGPA), 46 students (21.5%) had a CGPA of more than 3.50, followed by 110 students (55%) with a CGPA between 3.00 and 3.50, and 44 students (23.5%) with a CGPA of less than 3.00. The results also showed that 123 students (61.5%) received an A for their research proposal, while 77 students (38.5%) received a B. When evaluating barriers to device and network access, most students reported facing difficulties with online learning (n = 167, 83.5%).

6.2 CONFIRMATORY FACTOR ANALYSIS

The male model fits well (χ 2/df = 3.312, $p < 0.001$, NFI = 0.930, GFI =0.911, TLI = 0.920, CFI =0.916, and RMSEA =0.025). The female model fits are as follows: χ 2/df =3.235, $p < 0.001$, NFI =0.920, GFI = 0.940, TLI =0.930, CFI =0.941, and RMSEA =0.032).

6.3 CONVERGENT AND DISCRIMINANT VALIDITY

Based on Table 2, it is evident that each indicator of the research variables has a factor loading value exceeding 0.60. The data also show that the Average Variance Extracted (AVE) and Composite Reliability (CR) values exceed 0.50 and 0.60, respectively, as recommended by Hair et al. (2010). All indicators are thus considered valid for the research and can be used for further analysis.

Variables	Items	Item Loadings		AVE		CR	
		M	F	M	F	M	F
Perceived Usefulness	U1	0.722	0.678	0.820	0.753	0.860	0.840
	U2	0.711	0.685				
	U3	0.700	0.747				
	U4	0.723	0.786				
Perceived Ease of Use	E1	0.614	0.764	0.830	0.767	0.823	0.826
	E2	0.626	0.766				
	E3	0.610	0.730				
Attitude	A1	0.731	0.801	0.810	0.742	0.842	0.805
	A2	0.772	0.742				
Need for Achievement	N1	0.854	0.814	0.820	0.779	0.802	0.852
	N2	0.849	0.823				
	N3	0.820	0.817				
	N4	0.807	0.767				
	N5	0.742	0.743				
Learning Satisfaction	L1	0.714	0.772	0.840	0.769	0.812	0.842
	L2	0.739	0.746				
	L3	0.690	0.730				
	L4	0.687	0.687				

Note: Average Variance Extracted, AVE; Composite Reliability, CR; Male, M; Female, F

Table 2. Value of Factor Loading, AVE, and CR

The discriminant validity assessment ensures that the constructs have the strongest relationships with their indicators (Hair et al., 2010). As shown in Tables 3 and 4, discriminant validity is achieved because the square root of the Average Variance Extracted (AVE) is greater than the correlations, and the correlation values between the constructs are greater than 0.50 but less than 0.85 (Fornell & Larcker, 1981).

Variables	1	2	3	4	5
Perceived Usefulness	**0.906**				
Perceived Ease of Use	0.634	**0.911**			
Attitude	0.657	0.676	**0.900**		
Need for Achievement	0.571	0.579	0.763	**0.906**	
Learning Satisfaction	0.502	0.608	0.641	0.599	**0.917**

Note: The squared root of AVE is shown in bold on a diagonal

Table 3. Discriminant Validity of Construct (Male Data)

Variables	1	2	3	4	5
Perceived Usefulness	**0.868**				
Perceived Ease of Use	0.614	**0.876**			
Attitude	0.591	0.583	**0.861**		
Need for Achievement	0.678	0.559	0.571	**0.883**	
Learning Satisfaction	0.569	0.632	0.557	0.641	**0.877**

Note: The squared root of AVE is shown in bold on a diagonal

Table 4. Discriminant Validity of Construct (Female Data)

6.4 STRUCTURAL MODEL

As shown in Table 5, for male data, the results confirm that the relationship between perceived usefulness ($\beta = 0.004$, $p < 0.001$), perceived ease of use ($\beta = 0.006$, $p < 0.001$), attitude ($\beta = 0.005$, $p < 0.001$), and learning satisfaction is partially mediated by the need for achievement. Therefore, H1a, H1b, and H1c are supported. In contrast, the female data show that the relationship between perceived usefulness ($\beta = 0.004$, $p < 0.001$), perceived ease of use ($\beta = 0.005$, $p < 0.001$), attitude ($\beta = 0.004$, $p < 0.001$), and learning satisfaction is fully mediated by the need for achievement. Thus, H2a, H2b, and H2c are supported. Additionally, Hayes' mediation method was used to assess the mediating effect. If the Boot LLCI and Boot ULCI ranges do not include the value zero (0), the estimate is considered significant, and a mediation effect is present. The results confirm the mediation effect of the need for achievement on the relationships between perceived usefulness, perceived ease of use, attitude, and learning satisfaction for both genders. These results are presented in Table 5.

Standardized Direct Effects	Std. Estimate M			Std. Estimate F		
PU ⇨ LS	0.048***			0.010		
PEU ⇨ LS	0.054***			0.004		
A ⇨ LS	0.056***			0.002		
NA ⇨ LS	0.089***			0.076***		
PU ⇨ NA	0.042***			0.050***		
PEU ⇨ NA	0.073***			0.063***		
A ⇨ NA	0.052***			0.057***		
Standardized Indirect Effects		**95% Confidence Interval**			**95% Confidence Interval**	
		Lower Limit	**Upper Limit**		**Lower Limit**	**Upper Limit**
PU ⇨ NA ⇨ LS	0.004***	0.002	0.015	0.004***	0.002	0.103
PEU ⇨ NA ⇨ LS	0.006***	0.003	0.018	0.005***	0.003	0.082
A ⇨ NA ⇨ LS	0.005***	0.002	0.122	0.004***	0.002	0.057

*Note: ***Paths are significant at the 1% level ($p < 0.01$). ***Indirect effects are significant at the 1% with bootstrap at 5000 and bias-corrected percentile method. Male, M; Female, F; Perceived Usefulness, PU; Perceived Ease of Use, PEU; Attitude, A; Need for Achievement, NA; Learning Satisfaction, LS.*

Table 5. Results of the Hypothesised Model

7.0 DISCUSSION AND CONCLUSION

Drawing on the Technology Acceptance Model (TAM), the primary purpose of this study was to identify gender-related differences in the relationships among perceived usefulness, perceived ease of use, attitude, and student learning satisfaction. This study also examined the mediating role of the need for achievement. For male students, the need for achievement partly mediates the relationship between perceived usefulness, perceived ease of use, attitude, and student learning satisfaction. This suggests that while perceived usefulness, ease of use, and attitude influence learning satisfaction,

the need for achievement does not necessarily play a decisive role in this relationship. In contrast, for female students, the need for achievement fully mediates the relationship between perceived usefulness, perceived ease of use, attitude, and learning satisfaction. This indicates that achievement is crucial for the perceived usefulness, ease of use, and attitude to influence female students' learning satisfaction.

In other words, female students tend to be more self-motivated, driven to set challenges, and seek continuous feedback on their performance. They prefer tasks with clear goals and measurable results. Therefore, teaching methods adopted by lecturers are essential in determining the effectiveness of teaching and, ultimately, student learning satisfaction. However, many studies report that most lecturers still rely on conventional teaching methods. It is crucial for lecturers to adopt new technologies that create a dynamic learning environment, enhancing students' knowledge and skills. Despite awareness of technological developments, many lecturers are hesitant to incorporate new technologies into teaching (Singh et al., 2024). Hence, lecturers should receive both training and motivation to use technology effectively in the classroom.

From a practical standpoint, educational institutions should provide the necessary hardware and software support to both educators and students, ensuring they meet industry needs (Muhamad Yusof et al., 2024). Transitioning from traditional teaching methods may be challenging but is achievable with proper technological facilities and student motivation to embrace digital learning. Institutions and educators should work to create an awareness of digital learning among students and offer the necessary tools for success. Additionally, educators' ability to identify technological challenges and offer solutions will be vital in fostering understanding (Trinh et al., 2024). Governments and telecommunication sectors must collaborate to improve access to high-speed Internet and provide digital devices to underserved students. Community learning centres with technological resources can bridge the digital divide, and programs such as tablet distribution for underprivileged students can accelerate these efforts. Subsidies for low-income families' Internet access could also serve as a short-term solution. Ongoing training in educational technology for lecturers is equally important, including knowledge on software, online tools, and digital teaching techniques. Technical support for lecturers to address issues

swiftly is essential, and the creation of communities of practice among educators can further encourage the widespread use of technology.

It is essential for educators to understand their students' learning needs to develop strategies and teaching methods tailored to the students' diverse needs. By identifying the limitations in student learning, educators can choose the most appropriate teaching methods and activities to enhance student comprehension (Yadav & Shanmugam, 2024). Additionally, educators should modify their teaching approaches based on students' backgrounds, offering ideas and analogies that resonate with them (Noor & Hadi, 2024). Educators must also continuously improve their knowledge of technology, pedagogy, and content to remain effective and relevant in their roles (Wang et al., 2024). With sufficient competence, educators can better prepare students to excel in the global academic arena (Noor, 2023). Moreover, it is crucial to develop digital learning content that reflects the local context, such as Bahasa Melayu materials aligned with the national syllabus. Collaborations with technology companies can help accelerate this process. Furthermore, educational institutions should provide guidance on digital safety for students, offering workshops to raise awareness about online safety.

Educational technology has revolutionized how instructors access information and deliver content. Through interactive systems, instructors can assess students' understanding in real time, adapt teaching to meet needs, and foster problem-solving skills (Hisham et al., 2025). Technology also improves the learning experience by making it more engaging, flexible, and responsive to student needs. In conclusion, while some may view educational technology as a challenge, it can offer new ways for students to engage with course material effectively and meaningfully.

Platforms like YouTube and social media are not distractions but can be integrated into future lesson plans. Our data suggest three key findings: (i) female students tend to be more goal-oriented than male students; (ii) male students do not necessarily need a strong need for achievement to experience learning satisfaction; and (iii) other factors, beyond individual personality, may play a more significant role in male students' learning satisfaction. The findings of this study validate the TAM theory and contribute to the literature, especially within an Eastern context. This research helps provide

intervention recommendations for enhancing university students' learning satisfaction. By extending the TAM framework within the Malaysian setting, this study fills gaps in previous research and emphasizes the role of need for achievement in fostering online learning satisfaction.

However, this study does have limitations. First, survey methods carry the risk of Common Method Variance (CMV), which can distort relationships between variables (Podsakoff et al., 2003). Harman's test showed that the amount of CMV was insignificant, with the first extraction factor explaining only 30.89% of the total variance. To mitigate CMV in future studies, researchers should apply Harman's single-factor test. Second, the sample size was relatively small, limiting the ability to generalize the findings. Future research should extend this model and methodology to larger and more diverse samples. Third, this study used a cross-sectional design, which only captures data at a single point in time and cannot establish causal relationships. Future research should adopt a longitudinal approach to provide more comprehensive insights into the phenomenon.

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9.0 AUTHORS' CONTRIBUTION

Nurul Hidayana, M. N. designed and organized the experiments, while Hasnatulsyakhira, A. H. conducted the experiments and prepared the data. Nurul Hidayana, M. N. led the manuscript writing, with all authors providing valuable feedback and contributing to the research, analysis, and manuscript development.

10.0 CONFLICT OF INTEREST DECLARATION

We certify that this article is the original work of the Authors and Co-Authors. It has not been previously published nor is it under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We attest that all Authors have made significant contributions to the work, the validity and legitimacy of the data, and its interpretation for submission to IJELHE.

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Fostering Novice Programmer in Learning Basic Concept in C++ Programming Using Micro Credential Variable in C++

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Abstract: *E-learning has rapidly grown into a global phenomenon. Most educational institutions are currently utilizing it. There are many courses developed to support e-learning education through Massive Open Online Course (MOOC) and Micro-Credential (MC) in Universiti Teknologi MARA. Students from multiple disciplines such as engineering, information technology, and business computing are required to study basic C++ programming. The C++ programming language is the foundation of all software and current programming languages. C++ has evolved into an important language for the development of high-speed processing-power applications such as autonomous devices, the internet of things, and video games. Students are asked to construct a C++ programming code step by step using the textbook without knowing the relationship between concepts, for example variables and data types. As novice learners, they will face problems in learning C++ program within a short period. As a result, many students who are unable to grasp the most fundamental concept of programming are unable to write basic programs and are also unable to acquire and understand more complex concepts in the future. MC Variable in C++ (MCVC++) is one of the courses that is designed to help novice programmers to learn basic concepts in C++ programming. The learning*

outcomes for this course are that students will be able to understand the fundamental concepts of variables in C++ and learn how to declare, use, and apply variables effectively in programming. This paper explains the development process of the MCVC++ course and evaluates its effectiveness among students from UiTM.

Keywords: *action research model, C++ programming, Micro Credential, novice programmer*

1.0 INTRODUCTION

With the rise of online learning, many approaches are being applied to the process to make it easier and more flexible. Massive Open Online Course (MOOC) and Micro-Credential (MC) approaches are a present technological innovation of teaching and learning in the modern higher education environment. As is well known, there are many key advantages of online learning including flexibility and convenience, cost saving, self-paced learning and accessibility. MC is designed to provide learners with a rapid and efficient method of acquiring specialized skills or knowledge relevant to their careers or personal interests. A noteworthy feature of this change is the emergence of micro-credentials as a competitive substitute for conventional degree programs, providing a more adaptable and focused method of learning and identifying skills (Ahmat et al., 2021). Educational institutions, online learning platforms, and professional organizations frequently provide these credentials.

Identifying problems is essential to effectively enhance learning and teaching. Learning programming at university takes years and requires a significant commitment from students even to obtain the most basic certification. Students prefer a more adaptable and intimate learning environment. Considering these factors, Micro-credential (MC) is used to introduce a smaller set of programming courses based on the MARA University of Technology (UiTM) syllabus that can be completed in a short period of time. UiTM is one of eight Malaysian Higher Education Institutions that are stepping up efforts to create flexible and appealing study materials for candidates taking short-term courses. Various short-term

courses are offered through these micro-credential programs and can be used as credit in learning as long as they meet the Malaysian Qualifications Agency (MQA) criteria. The development of the Micro-credentials program is critical to UiTM because it is self-directed and will be effective in future.

2.0 PROBLEM STATEMENT

Programming is relevant to many technological disciplines, and many university students are learning its fundamentals. Unfortunately, individuals, especially novice programmers, frequently encounter difficulties even in basic courses. This effort aims to alleviate the challenges associated with learning programming in order to aid in the development of learning materials for basic programming courses.

3.0 OBJECTIVE

1. **Development of the MC Variable in C++ (MCVC++) Materials:** Discuss the development process and the types of materials used in the MCVC++ course.
2. **Study the effectiveness of MCVC++:** Analyse the student performance on their assessment to determine the effectiveness of MCVC++.

4.0 LITERATURE REVIEW

4.1 C++ PROGRAMMING

C++ is a popular and enduring general-purpose programming language used to create programs across a wide range of application domains. Despite the fact that it was introduced a long time ago, C++ is now the fourth most popular programming language (Cass, 2021). Compared to more advanced and practical programming languages such as Java, Python, and Ruby, C++ can serve as a good starting point for learning programming from the ground up. Nonetheless, due to the nature of formal language, many students continue to struggle with C++ (Aung et al., 2022).

Learning computer programming is a difficult task for a novice (Prasad et al., 2021). Data from around the world show that an increasing number of students do not want to pursue a major in computer programming in higher education (Papadakis, 2020). One reason why novice fail to learn programming is that they struggle with relational reasoning (Corney et al. 2011) due to some variable misconceptions (Kohn,2017). As a result, they are often unable to accurately understand the fundamentals of programming (Prasad et al. 2021) or to combine the various statements and structures of the programming language into a valid program (Sana'a et al., 2020). It has long been studied how to identify the difficulties that novice programmers face. Lister et al. (2004) discovered in their findings from a multi-national study that after studying their first programming course, students frequently fail to trace the execution of even short pieces of code.

4.2 MICRO CREDENTIAL

A Micro-credential is a learning certification for a smaller set of courses or modules designed to provide learners with knowledge, skills, values, and competencies in a specific micro field of study (Selvaratnam & Sankey, 2020). At the most basic level, Micro-credentials validate specific skills or competencies gained through a course. They can be digital or physical. They differ from traditional degrees and certificates in that they are typically awarded for accomplishments achieved in shorter or more flexible time periods. Unlike conventional transcripts, which are controlled by institutions, students will have control over their micro-credentials and will be able to distribute them digitally (Matkin et al., 2020).

5.0 METHODOLOGY

In this study, we applied an action research model. Action research is a research method that tries to examine and address a problem at the same time. This model was created by Kurt Lewin, an MIT professor in 1944. Figure 1 shows the diagram of the action research model. In this model, there are four (4) main steps known as planning, action, analysis and conclusions.

Figure 1: *Action Research Model*

Based on the model, the planning stage design is applied, whereby we define the content requirements, the content presentation, the number of assessments, and style. In the action stage, we begin implementation based on the planning. Once the content is ready, we upload it to the online platform known as UFuture, provided by the Institute of Continuing Education and Professional Studies (iCEPS), UiTM. UFuture is an online learning platform built to serve students and instructors. Once the material and contents are ready, evaluations are conducted by individuals assigned by iCEPS to ensure the MC Variable in C++ (MCVC++) course meets iCEPS UiTM's requirements. Once the MCVC++ achieves the required marks, the course will be published and made accessible to students.

The video content material for MCVC++ are develop using variety of software like Canva, MS Power Point, Filmora and ClipChamp. Kapwing is one of the software that is used to edit the video content. The content materials also come in various forms like infographic, cartoon conversation, code writing, and simple example explanation. Figure 2 below shows the various types of content material used in MC Variable in C++.

Figure 2: *Variety of video notes content for MCVC++*

MCVC++ has designed various styles of assessment to make sure the student is able to interpret and explain what they have learned. The questions are designed in the form of objective questions, structured questions and writing a complete program. Figure 3 shows the layout of the various types of assessments applied in MCVC++.

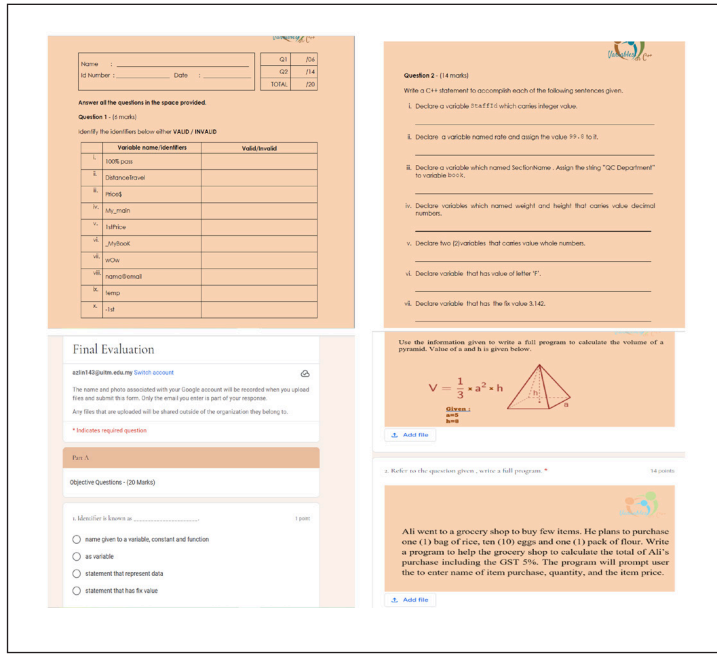
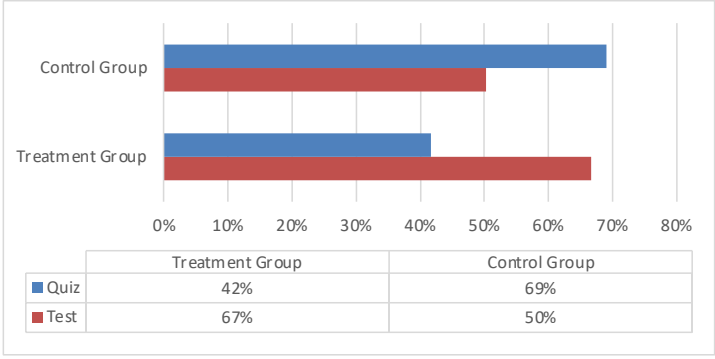


Figure 3: *Layout of various type assessment in MCVC++*

6.0 RESULT AND DISCUSSION

In this study, we perform the analysis on two distinct groups. The data is derived from these two groups: the treatment group consisting of 36 students enrolled in Fundamentals of Computer Problem Solving (CSC128) supplemented with MCVC and the control group comprising 97 students studying CSC128 without this additional component. The subsequent section involves a comparative evaluation of their respective academic performances, focusing on coursework outcomes, including quiz and test.

Figure 4 illustrates the comparative analysis of performance between the treatment and control groups, measured through two evaluation metrics: quiz and test. At the start of the semester, the quiz outcomes exhibited a distinct trend. The treatment group's average percentage was lower, specifically at 42%, while the control group demonstrated a comparatively higher performance with an average of 69%. However, a notable shift transpired during the mid-semester test evaluation. The treatment group displayed substantial improvement, achieving an impressive average of 67%, surpassing the control group's average performance of 50%. This transition underscores the treatment group's improved proficiency in test evaluations. These findings suggest a favourable impact resulting from the integration of MCVC++, contributing positively to students' academic accomplishments and overall educational experience.



	Treatment Group	Control Group
Quiz	42%	69%
Test	67%	50%

Figure 4: *Average Scores of Quiz and Test for the Treatment and Control Groups*

7.0 CONCLUSION

MCVC++ is an MC course that has been developed to help students understand the basic concept of C++ programming. This course is designed to help students understand and master C++ programming skills. The content of this course is presented in a way that allows students to easily understand and practice in everyday life. This study shows that students' performance has improved in their assessment since they joined the MCVC++.

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10.0 AUTHORS’ CONTRIBUTION

All authors offered valuable contributions to shaping the research, analysis, and manuscript.

11.0 CONFLICT OF INTEREST DECLARATION

I/We certify that the article is the Authors’ and Co-Authors’ original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to IJELHE.

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