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Ms. Haslinda Noradzan
Ms. Nor Azilah Mohd Asarani
Mr. Fazyudi Ahmad Nadzri
Mr. Zawawi Temyati

# Assessing the Potential of Laboratory Instructional Tool through Synthesia AI: A Case Study on Student Learning Outcome

**Jacqueline Joseph**
*Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, UiTM Sabah Branch, Kota Kinabalu Campus, Locked Bag 71, 88997 Kota Kinabalu, Sabah, Malaysia*
**jacqueline@uitm.edu.my*

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*Abstract: This research study aims to investigate the effectiveness of utilizing Synthesia Artificial Intelligence (AI), an advanced instructional tool, in enhancing laboratory experiments. The research focused on evaluating the impact of incorporating Synthesia AI as a supplementary learning resource on student learning outcomes in laboratory settings. Synthesia AI is a cutting-edge technology that revolutionizes students' immersive learning experience. With its advanced machine learning algorithms, Synthesia AI can generate photorealistic video content featuring virtual actors and presenters that can be programmed to speak in multiple languages, accents, and even emotional tones. In this study, an instructional-based laboratory experiment was conducted using Synthesia AI. The participants were from the Sabah Branch of UiTM, and enrolled in a Basic Plant Science laboratory course under the Pre-Diploma Agrotechnology programme. The course was divided into two groups, an experimental group and a control group. The experimental group received laboratory instructions through Synthesia AI videos, while the control group received traditional laboratory instructions. The quantitative data were collected through pre and post-tests to assess the student's learning outcomes. The qualitative data were obtained through a survey containing open-ended questions to gather the students' feedback on their experience with Synthesia AI videos. The experimental group, which received laboratory instructions through Synthesia AI videos, was expected to perform better in the post-test than the control group. The findings of this research have provided valuable insights into the potential benefits and challenges of integrating Synthesi IO as an instructional tool,*

*thereby contributing to the enhancement of laboratory-based instruction. With its ability to create realistic virtual simulations, Synthesia AI could significantly enhance laboratory education, allowing for more cost-effective, innovative and accessible teaching methods, and ultimately empowering the next generation of scientists and innovators.*
*Keywords: Artificial intelligence, instructional experiment, laboratory, Synthesia IO*

## INTRODUCTION

Experiments in the laboratory are an essential component of scientific education. However, they can be time-consuming, costly, and occasionally hazardous. In recent years, technology has significantly contributed to the enhancement of the student learning experience. Synthesia AI is one such technology that can generate instructional videos by integrating text, images, and audio to simulate the experience of a real laboratory experiment. The purpose of this extended abstract is to investigate the use of Synthesia AI to improve laboratory experiment instruction. Leiker et al. (2023) report that Synthesia AI has been utilised in various disciplines, including education, to create instructional videos for science, mathematics, and languages. Nonetheless, its use in laboratory experiments remains restricted. Synthesia AI can provide a safe, cost-effective, and time-efficient laboratory simulation, which can enhance the learning experience for students ((Hwang et al., 2020).

The technology underlying Synthesia AI is founded on a number of essential components, including computer vision, deep learning, and natural language processing (NLP) (Lim et al., 2023). The purpose of computer vision algorithms is to extract key characteristics from videos of human actors, such as body position, facial expression, and gestures. Using this data, deep learning algorithms then synthesize the movements of the actors onto a virtual 3D model that can be animated and rendered against any background. In educational contexts, Synthesia AI has numerous applications, including the creation of instructional videos, virtual tours, and personalized feedback. For example, Synthesia AI can be used to create instructional videos that elucidate complex concepts or demonstrate practical skills. Synthesia AI can be used to construct virtual tours that provide learners with a virtual experience of a real-world location. However, in the context of traditional

instructor-led laboratory experiments, it can pose several challenges that can hinder student learning and engagement, such as;

i. Limited hands-on experience : using the traditional instructor led laboratory experiments often involve large groups of students, which can limit each student's hands on experience and access to the equipment.
ii. Lack of creativity and innovation amongst the students as traditional laboratory experiments often follow predetermined procedures and outcomes.
iii. Limited student engagement as students may feel disengaged and uninterested in the laboratory experiment if they are merely follow the instructions without any sense of ownership or control over the experiment.

To address this gap, Synthesia AI is deployed to assess the effectiveness of artificial intelligence or machine learning application as an instructor-led laboratory experiment.

## MATERIALS AND METHODS

The study was conducted using a mixed-method approach, consisting of both quantitative and qualitative data. The participants were from the Sabah Branch of UiTM, and enrolled in a Basic Plant Science laboratory course under the Pre-Diploma Agrotechnology programme. The course participants were put into two groups, an experimental group, and a control group. The experimental group received laboratory instructions through Synthesia AI videos (Fig. 2), while the control group received traditional laboratory instructions from the lecturer in-charge, Ts. Jacqueline Joseph.
The quantitative data were collected through pre and post-tests to assess the students' learning outcomes (Table 2). The qualitative data were collected through a survey to gather the students' feedback on their experience with Synthesia AI videos (Table 3). The survey included open-ended questions to allow the students to express their opinions on the usefulness of Synthesia AI in enhancing their learning experience (Table 4). Data analyses were performed by using the IBM SPSS Software ver26. There are THREE (3) 3learning outcomes developed for the purpose of integrating Synthesia AI in laboratory learning settings;

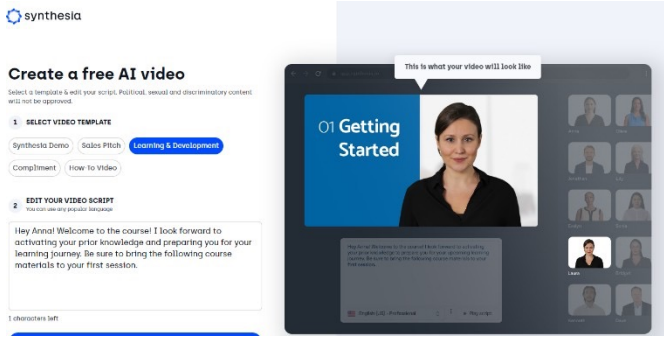
| |
|---|
| **CLO1** : To demonstrate laboratory techniques and procedures with accuracy and precision after completing the Synthesia AI instructional content for laboratory techniques and procedure. |
| **CLO2** : To design and implement experiments to test scientific hypotheses after completing the0<br>Synthesia AI instructional content. |
| **CLO3**: To analyze experimental data and draw conclusions based on scientific evidence by following the Synthesia AI instructional content. |

**Table 1. Learning Outcomes**

(a) (b) (c)

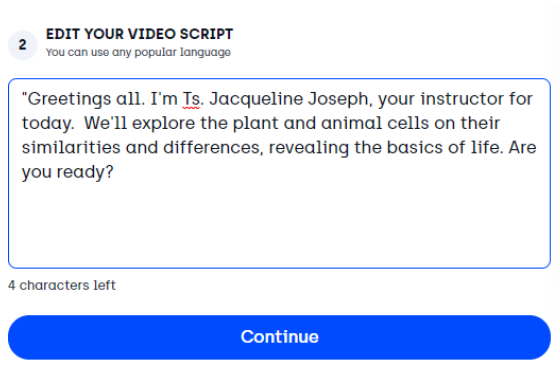
Fig. 1 (a), (b), (c); Students were listened to the experiment instructions delivered by Synthesia AI

**Step 1**



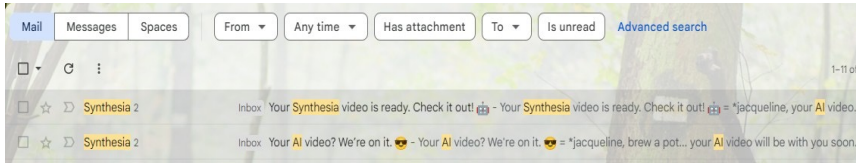

Visit Synthesia AI at http://www.synthesia.io

**Step 2**




AI video creation platfrom Synthesia was used to generate text-to-videos with photo-realistic synthetic actres

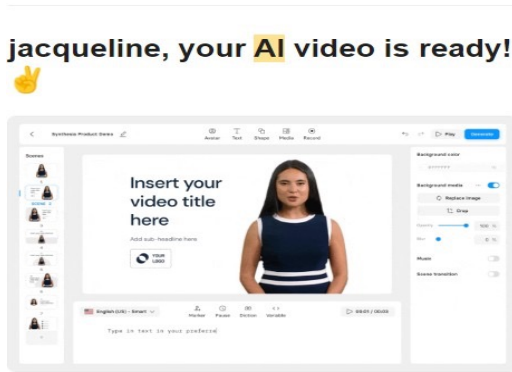
**Step 3**




An email is received notifying that the AI video is ready to be downloaded

synthesia

**Step 4**




AI video is available to be embedded in any platforms such as Padlet, Microsoft Power Point and others

**Fig. 2 A Step by Step to Generate an AI Video from Synthesia IO**

| Question Number | Pre-Questions | Post Questions |
|---|---|---|
| 1 | On a scale of 1 to 5, how familiar are you with Synthesia AI as an instructional tool? | On a scale of 1 to 5, how effectively did Synthesia AI help you understand the concepts demonstrated in the laboratory experiments? |
| 2 | On a scale of 1 to 5, how confident are you in your laboratory skills and knowledge? | How would you rate your confidence in performing laboratory experiments after using Synthesia AI? (Options: Very low, Low, Neutral, High, Very high) |
| 3 | How often do you currently use instructional tools during laboratory experiments? (Options: Never, Rarely, Sometimes, Often, Always) | On a scale of 1 to 5, how helpful was Synthesia AI in guiding you through the laboratory procedures? |
| 4 | How would you rate your understanding of the subject matter covered in the upcoming laboratory experiments? (Options: Very poor, Poor, Average, Good, Excellent) | How would you rate the overall effectiveness of Synthesia AI as an instructional tool in laboratory experiments? (Options: Very ineffective, Ineffective, Neutral, Effective, Very effective) |
| 5 | On a scale of 1 to 5, how prepared do you feel for the upcoming laboratory experiments? | On a scale of 1 to 5, how engaging was the use of Synthesia AI during the laboratory experiments? |
| 6 | How open are you to exploring new instructional tools to enhance your laboratory learning experience? (Options: Not open at all, Slightly open, Moderately open, Very open, Extremely open) | How effectively did Synthesia AI enhance your understanding of the concepts demonstrated in the laboratory experiments? (Options: Not at all effective, Slightly effective, Moderately effective, Very effective, Extremely effective) |
| 7 | On a scale of 1 to 5, rate your expectation of the impact of Synthesia AI on your laboratory learning experience. | On a scale of 1 to 5, rate the impact of Synthesia AI on your confidence in performing laboratory experiments. |

| | | |
|---|---|---|
| 8 | On a scale of 1 to 5, rate your perception of the potential benefits of using Synthesia AI in laboratory experiments. | On a scale of 1 to 10, rate the effectiveness of Synthesia AI as an instructional tool in laboratory experiments. |
| 9 | How likely are you to actively engage with instructional tools during laboratory experiments? (Options: Not likely at all, Slightly likely, Moderately likely, Very likely, Extremely likely). | How well did Synthesia AI guide you through the laboratory procedures? (Options: Not well at all, Slightly well, Moderately well, Very well, Extremely well). |
| 10 | How important do you consider the use of instructional tools in laboratory experiments for enhancing learning outcomes? (Options: Not important at all, Slightly important, Moderately important, Very important, Extremely important) | How willing are you to adapt to new instructional tools introduced in laboratory experiments? (Options: Not willing at all, Slightly willing, Moderately willing, Very willing, Extremely willing) |

**Table 2. Pre and Post Questions for the Quantitative Data**

## RESULTS AND DISCUSSION

The experimental group, which received laboratory instructions via Synthesia AI videos, outperformed the control group on the post-test (Figure 3). In addition, the survey results revealed that students discovered Synthesia AI videos beneficial for augmenting their understanding of laboratory experiments. As summarised in Table 3, students have agreed that Synthesia AI could be enhanced by adding more interaction and feedback opportunities to the videos. For instance, interactive exams or surveys could be incorporated to assist learners in gauging their comprehension of the material, and personalised feedback could be provided to assist learners in improving their performance. In addition, the use of more genuine human gestures and facial expressions could make the videos feel more authentic and engaging.

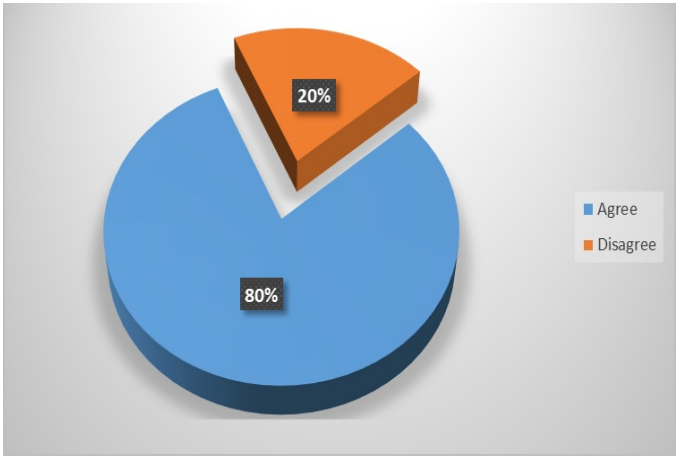



**Fig 3. Distribution of Responses to Survey Question on the Application of Synthesia AI in Laboratory Settings.**

| No. | Questions | Feedbacks |
|---|---|---|
| 1 | Do you agree that the personalized content of the videos addressed your individual needs and interests? | Yes |
| 2 | Do you agree Synthesia AI could be improved in order to enhance the instructional experience? | Yes |
| 3 | Do you agree that Synthesia AI has the potential to improve the quality of education? | Yes |
| 4 | Do you agree that the quality of the videos created using Synthesia AI is more engaging compared to other instructional videos you've seen? | Yes |

**Table 3 Sample of Survey Questions**

| Questions | Respondent Feedbacks |
|---|---|
| Based on your experience with Synthesia AI, how do you envision its potential for future applications? | It can facilitate collaborative learning experiences by encouraging teamwork, communication, and the exchange of ideas, fostering a more engaging and cooperative laboratory environment. |
| Please share any unexpected benefits or drawbacks you experienced when using Synthesia AI in the laboratory experiments. | Lack of tactile experience, which can limit students' hands-on learning and their ability to develop certain manual skills or techniques. |
| In what specific ways did Synthesia AI assist you in overcoming challenges or difficulties encountered during the laboratory experiments? | It provides visual demonstrations, step-by-step instructions, conceptual explanations and interactive simulations. |
| How did the integration of Synthesia AI as an instructional tool enhance your overall understanding of the laboratory experiments? | It promotes a deeper understanding by encouraging students to apply their knowledge, make decisions, and observe the outcomes in a controlled setting. |

**Table 4 Open-Ended Questions for Respondents**

| Step 1 | Dateset | M | SD | r | p |
|---|---|---|---|---|---|
| | Pre Feedbacks | .485 | .137 | .945 | >0.5 |
| | Post Feedbacks | .655 | .120 | | |

**Table 5 Pair t-test between the Two Datasets of Pre and Post Respondent Feedbacks**

Nevertheless, according to the respondents, the videos generated by Synthesia AI lacked some of the nuances of human speech and gesture. This rendered the videos less natural and engaging than they could have been otherwise. This scenario might greatly affect learner–instructor interaction, such as communication, support, and presence (Kang and Im, 2013).

In addition, there are significant differences between the two datasets ($p > .05$) that derived from the pre and post respondent feedbacks. It shows that the respondents highly favored the application of Synthesia AI as laboratory instructional tool based on the mean value (Table 5). Despite the disadvantages, the respondents agreed that Synthesia AI is well-known for producing engaging and interactive instructional videos that are frequently commended for their high production value and innovative use of technology (Table 4). The use of avatars powered by AI and personalized learning experiences can increase student engagement and motivation, making the learning experience more pleasurable and effective. Respondents also noted that Synthesia AI can reduce the resources required for conventional teaching methods, such as the hiring of instructors and the provision of tangible learning spaces. Synthesia AI could be an ideal solution for lecturers with demanding schedules or workload who still need to conduct onsite briefings and laboratory monitoring (Haseski, 2019). Lecturers can delegate the instructions to Synthesia AI and focus on other academic obligations, such as the writing of research papers. In addition, the use of AI in education can increase instruction and learning standardization and consistency. As a teaching instrument for laboratory experiments, Synthesia AI has demonstrated promising outcomes. It has the potential to increase student engagement, enhance learning outcomes, and decrease the time and resources required for conventional laboratory experiments (Roll and Wylie (2016). However, the use of Synthesia AI in laboratory experiments should supplement rather than replace conventional laboratory experiments. Certain laboratory skills, including the physical manipulation of apparatus and materials, may not be effectively taught by Synthesia AI. Concerns of theoretical and practical nature must be addressed regarding the use of AI in laboratory education, and ethical considerations should govern the development and implementation of such technologies.

## CONCLUSION

Further research is required to determine the most effective and efficient methods for integrating Synthesia AI into laboratory instruction and to evaluate its impact on student engagement and learning outcomes. With its ability to create realistic virtual simulations, Synthesia AI could significantly enhance laboratory education, allowing for more cost-effective, innovative and accessible teaching methods, and ultimately empowering the next generation of scientists and innovators.

## ACKNOWLEDGEMENT

None.

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# An Overview of Learning Methodology for Clinical Pharmacokinetics Course during the Covid-19 pandemic

**Hannani Mawarddah Muhammad Abdul Hafidz[1], Nur Wahida Zulkifli [1]*, Farhana Fakhira Ismail[1].**
*[1]Faculty of Pharmacy, Universiti Teknologi MARA,*
*Campus Puncak Alam, 42300 Puncak Alam, Selangor, Malaysia*
**wahidazulkifli@.uitm.edu.my*

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*Abstract: Due to the Covid-19 pandemic, the clinical pharmacokinetics course had to undergo a few modifications to its curriculum content. During the curriculum realignment, the Faculty of Pharmacy at UiTM Puncak Alam was obliged to adapting rapidly to these conditions by developing a few new strategies by implementing interesting learning methodologies that can suit students during the pandemic. In addition, despite being an interesting course, students are still afraid of clinical pharmacokinetics, thinking it difficult to understand. This study reviewed students' perceptions and satisfaction with the course and examples of learning methodologies which are suitable for pharmacokinetics course.*

*Keywords: clinical, COVID-19, learning, pandemic, pharmacokinetics*

## INTRODUCTION

The World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) as a pandemic in March 2020 which had given tremendous effect on people lives. More than 2.4 million Malaysians were infected with COVID-19 as of September 2022, about 36 245 fatalities were reported (1). This pandemic outbreak has caused many devastating effects in many aspects primarily on the healthcare and educational system, leading to adverse changes and shifts in education.

Consequently, this has also resulted in educational institutions' emergency responses during the pandemic, Emergency Remote Education (ERE) which refers to the shift in teaching and assessment was implemented. It involves adapting material for lessons which were once delivered face to face but now are partially distance-based or in a blended learning mode (2) To meet students' needs, many universities have previously implemented strategies to make their education delivery flexible and accessible.

Universities are facing various unprecedented difficulties, especially in the field of clinical education due to the COVID-19 outbreak. Despite this, hospitals had to stop accepting students for attachment because of safety concerns as some of them were designated as COVID-19 facilities which affect practical sessions and experiential learning (3). Clinical pharmacokinetic course is one of the courses that has undergone a few changes in its curriculum content due to the pandemic. To shape a competent future clinical pharmacist, pharmacy students must have a solid foundation in pharmacokinetics and its mathematical model to advocate effective therapeutic drug monitoring (TDM) in pharmaceutical care during real clinical settings (4). Hence, having good skills to perform pharmacokinetics calculations and strong command of the applications of the clinical skills are important, for the students to have a better understanding of its effects on evolving patient cases (5).

In response to that, various pedagogical methods and active-learning techniques are thought of as solutions to these problems (6). In UiTM, the Faculty of Pharmacy have been mandated to adapt quickly in overcoming these circumstances by implementing a few approaches during the

curriculum recalibration. Teaching teams have been generating some changes and appraising the curricular content for courses like clinical pharmacokinetics by inventing an in-house training module for third-year students. The reason to amend the in-house training is to reduce the student learning time from 3 credit hours to 2 credit hours.

This module consists of a laboratory activity that exposes students to the COBAS machine which requires students to interpret the result of drugs tested. Besides, students are exposed to an external lecture regarding TDM cases by a hospital pharmacists. Presentation, on the other hand, aims to enhance students' practical skills towards the recommendation of the dose where they are required to present three real case scenarios- meanwhile, case discussions expose them to calculation as well as dose recommendation.

Perception is the way you think about something, your conception of what it is like, or your natural capacity for comprehension or swift observation of things (7). Most students view mathematics as an exhausting and difficult subject that induces fear and worry as it is a dynamic process that requires planning and readiness (8). In the pharmacokinetics course, students face difficulties linking the fundamental concepts with clinical relevance due to its mathematical foundation (9). Furthermore, according on the students' perspective, a high-quality education provides superior learning possibilities, and their levels of contentment or discontent have a significant impact on their learning success or failure (10). Studies reveal that an effective instructional approach, plays a significant role in fostering student engagement and reinforcing difficult concepts taught in lectures to promote learning (11). Understanding current perceptions and measuring satisfaction held by future pharmacists regarding pharmacokinetics and its role in both research and clinical practice may be helpful in improving teaching of this subject and introducing appropriate changes into the curricula where and when necessary.

The pandemic situation has obligated the teaching teams to implement changes in the curriculum to ensure the continuity of exposure of clinical settings and practices among pharmacy students. Due to this complexity, students might face challenges to relate the fundamental knowledge of this course with its application in solving TDM cases.

## PEDAGOGY OF CLINICAL PHARMACOKINETICS COURSE DURING THE COVID-19 PANDEMIC

The outbreak of COVID-19 has harmed the health, economy, and social life of the global population. As a result, governments have employed extreme measures such as quarantines, lockdowns, social isolation, and movement restrictions. Most educational institutions throughout the world that have been affected have taken the initiative to stop in-school instruction to break the chain of virus transmission (13). Students' access to educational resources has been impacted by the closing of educational institutions. Evidently, higher education is still struggling with how the epidemic will impact its programs' educational outcomes as well as teaching, learning, research, and innovation. Following the WHO's announcement regarding the severity of the epidemic, rapid action was taken within a few days to switch to distance learning (14).

### 2.1 PEDAGOGICAL APPROACHES

Literally, pedagogy can be defined as the art or science of educating children. It is a synonym for teaching or education in contemporary usage, especially in scholarly literature (15). It implied that the learner's social and psychological needs drove the relationship between the teacher or facilitator and the student. To put it another way, pedagogy outlines how teaching and learning should be delivered based on how the learner learns and the understanding that person has, before beginning to prepare the lesson or the course.

Amidst of pandemic crisis, pedagogical shifts in the teaching-learning paradigm have become an unavoidable necessity. Due to the movement control order, higher education institutions have quickly adopted this strategy, shifting as many teachings, and learning activities online as they could. This led to the emergence of several new terms for the process, including "remote learning," "home-based learning," and "emergency remote education", in addition to terms for technology-enabled learning at a distance, like "online learning" and "distance learning"(16). Other than blended learning which comprises some elements of online course delivery, other strategies, like the hybrid model, which combines online and face-to-face sessions which necessitates students attending both modalities, is also practiced (17).

Significantly these learning alternatives can ensure the continuity of learning while protecting students against the risk of COVID-19 infection (18). Various strategies enable students to interact with learning resources, teachers, peers, employers, and other students as well as give opportunities for planned, active learning (19). Besides, the adoption of emerging technologies during the pandemic as well as in many other areas can enhance the efficiency in teaching and learning through connection with students and educators (20). As a conclusion, these methods are relatively recent and are fast becoming expanding strategies, especially in health profession education that provides a flexible learning environment (21).

## 2.2 FLIPPED CLASSROOM

Flipped learning approach was initially described as "the inverted classroom" (22). Till 2012, only The United States had been widely using the application of this new learning paradigm in pharmacy education. It creates a framework that may facilitate a more individualized education for students. The flipped classroom pedagogical method aims for students to commit to and actively participate in learning activities both before and during class, all with the assistance of IT (19). This broad approach allows for the flexibility in how activities are carried out both within and outside of the classroom. Pre-recorded lectures in the form of podcasts/ vodcasts, screencasts, annotated notes, and captured videos, as well as pre-readings and interactive videos from an online repository are all options for pre-class preparation in the flipped classroom. These tools allow students to learn reflectively and at their own pace (23).

In another way, the flipped classroom is used to create a pharmacokinetics course with a student-centered approach to learning using pre-recorded material and actively engage students in problem-solving, critical thinking, and the application of pharmacokinetics knowledge in a clinical setting while face-to-face class time is used for a deep learning through problem solving and discussions. Several pharmacy educators in Malaysia have embraced this active learning approach. For instance, Malaysian pharmacy students have received a complementary medicine module through the use of an audience response system in flipped classrooms (24). Later, a study in Universiti Sains Malaysia,

Penang, which utilized the active learning idea of the flipped classroom to drug delivery systems, revealed an improvement in the learning process and engagement of pharmacy students in Malaysia as well as positive outcomes from this approach (25). In conclusion, this pedagogy encourages students to take ownership of their learning and to start developing higher level learning skills for life-long learning in the future working environment (26).

## 2.3 TEAM-BASED LEARNING (TBL)

Team-Based Learning methodology promotes learner outcomes in a setting that fosters student involvement and development of their professional as well as interpersonal skills. TBL incorporates pre-class individual work and in-class team exercises with expert debriefs offered by the instructor, in contrast to standard lecture-based training (27). TBL is an active-learning pedagogy that adheres to a prescribed sequence and is utilized to actively stimulate student engagement where it produces additional essential outcomes for practising pharmacists, including improved communication, critical thinking, and preparation to confidently manage clinical situations in which students' engagement is a critical component to the success of TBL (28). It is shown to be successful for teaching applied pharmacokinetics in both face-to-face and online courses, according to a study conducted in the United States. Therefore, a clear, organized, and instructional learning format of TBL enables the learner to engage in various class situations, including online and face-to-face models, in addition to facilitating a high-quality online team experience at a distance (29).

## 2.4 CASE-BASED LEARNING (CBL)

Problem-based learning and inquiry-based education both contribute to construct-based learning (CBL) (30). CBL has been highly regarded as a teaching method for fundamental medical sciences. It has been demonstrated to enhance students' comprehension of the material, which has led to improved performance on assessments and in actual instruction (31). CBL is used to disseminate knowledge in a variety of medical and health-related sectors. According to the review's findings,

this approach has been used in pharmacology, occupational and physical therapy, nursing, allied health areas, and child development among other fields. In addition, higher education has seen a shift away from conventional, purely didactic forms of teaching in the pursuit of creating more socially and clinically oriented pharmacists (32). Pharmacy educators are utilizing CBL to supplement conventional pedagogical approaches to foster collaborative learning and higher order thinking (33). CBL allows a group of students to complete the given clinical cases and display their presentation followed by active interaction with the lecturers and constructive feedback. It exposes students to teaching and learning activities that are reflective of their future professional working roles, which in turn helps them develop problem-solving skills and clinical reasoning (34). As evidence, CBL gives students a platform for student-centered learning activities, which improves their capacity for critical thought and problem-solving in the early stages of their medical careers (35).

## 3. CLINICAL PHARMACY EDUCATION

Clinical education requires a different approach in the context of each discipline, which may lead to pedagogical uncertainty when attempting to define the term's meaning or goals. Clinical education in higher education institutions has long been recognized and successfully applied in health professional disciplines, but it has recently become a focus of legal education. To develop and implement opportunities for students to engage in experiential learning, clinical education has transformed into multifaceted educational models that have been embraced by many disciplines (36).
In other words, the delivery methods, strategies, and educational curricula are all changing significantly because of the rapid global evolution of pharmacy education (37). In addition, modules and programs for clinical training should be continuously improved to provide more engaging levels of education, and ensure clinical education is beneficial and relevant to healthcare professionals. In German clinical pharmacy academic education, new clinical competencies and skills must be taught using new teaching methods to enable the next generation of pharmacists to meet these new challenges and actively advance the profession (38). Additionally, other

clinical disciplines, like nursing and medicine, have demonstrated the value of clinical education (39). Ultimately, clinical pharmacy education provides a strong foundation in clinical knowledge which is designed to develop professional competencies among the students.

## 3.1 IMPORTANCE OF PHARMACOKINETICS COURSE

In just seven years, the overall number of instances tracked by TDM services for the entire nation climbed from 25,756 in 1998 to 61,907 in 2005, a 140.4% increase (40). With the knowledge and expertise in pharmacokinetics, healthcare professionals, especially pharmacists, are expected to make decisions or interventions to promote better outcomes for patients (41). For instance, therapeutic drug monitoring service is fundamentally based on pharmacokinetics concepts that requires the monitoring of narrow therapeutic medications, the concentrations within, and the ensuring that therapeutic optimum effect is achieved without unintended side effects (4). Therapeutic failure as a result of suboptimal routine vancomycin use, is an issue which frequently occurs in clinical practice and is linked to negative health outcomes such as nephrotoxicity. To increase the effectiveness, prevent failure, and lower significant toxicities related to vancomycin medication, adequate TDM practise is an important exercise (42). Evidently, a solid foundation of pharmacokinetics is not only important for future careers among students, but also play a vital role in predicting the effects of changes in dosing regimens, disease states, and medication interactions as well as important towards pharmaceutical industry and generic pharmaceuticals regulation as bioequivalence is one of regulatory considerations in creating generic medications (4).

## 3.2 FACTORS INFLUENCING THE PERCEPTION TOWARDS PHARMACOKINETICS COURSE

Perception is the way you think about something, your conception of what it is like, or your natural capacity for comprehension or swift observation of things (43). Students' opinions include a range of efficient teaching strategies for improving the instruction of foundational clinical sciences like pharmacology and pharmacokinetics in health education (44). While most of the students' clinical decision-making develops during their professional pharmacy experiences, the classroom can offer the first opportunities for students to start

enhancing their problem-solving, critical thinking, and communication skills in relation to pharmacokinetic principles (45).

To improve student learning, many games are employed in the pharmacokinetic courses at The University of North Carolina School of Pharmacy. This publication presents our initial experiences with these games. Incorporating problem-solving, critical thinking, cooperative learning, group work, and pharmacokinetic principles into these games was one of their main design goals. However, findings from the study had shown that students loved games as something different, the games were scored poorly in terms of the perception of learning. Students reported in response to a survey question addressing their preferred and favoured classroom activities - lecture paired with case studies and handouts (46).

According to a study on pharmacy students' attitudes towards a blended-learning pharmacokinetics course, 60% of the participants indicated that the face-to-face problem-solving tutorials were helpful. There was a positive association between time and students' enthusiasm for contact with online course modules, and at the end of the course, students are more enthusiastic about face-to-face interaction with the lecturers than at the beginning (47)

## 3.3 FACTORS CONTRIBUTING TO THE SATISFACTION TOWARDS PHARMACOKINETIC COURSE

The students' opinions on a range of efficient teaching strategies for numerous variables that have been noted may have an impact on a student's satisfaction with the various educational services provided by universities, including the expertise of the instructors, the courses offered, the learning environment, and the classroom facilities (48). Higher levels of learning, such as critical thinking, improved knowledge retention, and the analysis, synthesis, and evaluation of material, are made possible through student-centered learning. The

study revealed an effective instructional approach plays a significant role in fostering student engagement and reinforcing difficult concepts taught in lectures to promote learning (26).

A previous study had shown that a module that consists of tutorials and quizzes provides corrective feedback which improves student satisfaction and learning outcomes in clinical pharmacokinetic courses (49). A larger proportion of students in the third-year course who received quizzes during Cohort 2 of clinical pharmacokinetic course were satisfied with the feedback they received compared to Cohort 1, consisting of those who did not complete quizzes in their tutorials which were 68% and 60% respectively (49). Furthermore, another finding also shows that more than 75% of students strongly agreed or agreed with that learning pharmacokinetic principles was improved by the instructor's implementation of simulation modules in-class sessions (50). Also, a study on medical students' perception and received feedback on teaching and learning of pharmacology in a medical college shows about 50% of students believed that didactic lectures and small-group discussions were the best teaching methods for learning pharmacology (44). Therefore, it is important to understand the current perceptions and the satisfaction among the students by looking into the elements of the learning methodology and their effectiveness in a clinical pharmacokinetics course.

## CONCLUSION

The review can help lecturers use different learning methodologies for a clinical pharmacokinetics course. This can enhance students' knowledge and improve their understanding about this course. In addition, it can also increase students' satisfaction with the course as well as to make further improvements in the teaching and learning methodology of the module involving various array of tools, organizational arrangement, and pedagogical approaches.

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# Online teaching for cell culture techniques as a new paradigm : A review

**Noor Fahitah Abu Hanipah[1,2]*, Siti Norashikin Mohd Tambeh[1,2], Wan Nor I'zzah Wan Mohamad Zain[1,2]**

*2Institute of Medical Molecular Biotechnology, Faculty of Medicine, Universiti Teknologi MARA, UiTM Sungai Buloh Campus, Jalan Hospital, 47000, Sungai Buloh, Selangor, Malaysia*

**fahitah@uitm.edu.my*

*sitinorashikin@uitm.edu.my*

*wnizzah@uitm.edu.my*

**Corresponding Author*

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*Abstract: Due to its vast application in life sciences,mcell culture is one of the modes of choice for research and has been used extensively in antibody, vaccine and hormone production. Techniques in cell culturing are traditionally learnt hands-on in the laboratory setting. Instructors demonstrate the cell culturing techniques for students to emulate or re-perform. However, the lack of trained instructors, limited number of equipment and increased costs are major hindrances in hands-on learning of cell culture techniques. Online learning was initially necessitated for instructors by the unprecedented event of COVID-19 pandemic worldwide which led to the limitations in conducting practical and hands-on sessions. In this review, various teaching and learning methods which include blended learning, virtual laboratory, or massive online open course (MOOC), and assessment modalities related to online teaching of cell culture techniques are discussed. The benefits of these modalities to students and instructors such as increased motivation and more engaged learning are discussed. Even though the benefits of these modalities are substantial, we also discuss the limitations related to online learning such as less interpersonal communication and inability to nurture all the senses that usually happens in hands-on learning. Suggestions on the advancement and improvement of such modalities are also discussed in this review. The present review will aid educators and instructors in planning, designing modules and executing online teaching for cell culture techniques.*

*Keywords: Benefits, Cell culture, Online practical, Suggestions, Teaching modalities*

## INTRODUCTION

Traditionally, the methods of teaching and learning cellular function, molecular biology and cell cultures in science have always involved lecture series by the academic staff and the teaching session is followed by practical sessions in the laboratory settings. The presence of an instructor to facilitate the practical session with students has been the standard practice by all universities around the world. In the past, a practical session without the presence of instructors during face-to-face sessions was unimaginable. Specific teaching on practical skills such as using scientific equipment, technology, instrumentation, physical laboratory techniques are regarded as almost impossible to be taught outside traditional laboratory settings (Huang et al., 2015).

However, in the last decade, the recent advancement of technology has contributed to the innovation in practical session teaching at higher education level. The lecturers who are the content experts have embraced the technology in an innovative way by developing online distance learning materials or e-learning platform suitable for practical sessions. Online distance learning can be defined as conducting a learning session face-to-face, but the physical gap is bridged by the technology (Rahman et al., 2015). The use of e-learning or web-based learning has been seen as a solution to certain universities who have difficulties to conduct practical sessions effectively due to the large cohorts of students but limited numbers of academic staff and instructors (Peña-Fernández et al., 2020). The use of e-learning in medical sciences provides an interesting learning experience with flexibility of time and space. The e-learning resources have been seen as relevant platforms especially in medical related knowledge as they require constant updates and adaptation with the recent findings (Strube et al., 2018). Besides that, as suggested by the World Health Organization (WHO) and United Nations (UN), e-learning has high potential to be used as a learning method to address the shortage of health professionals in future (Al-Shorbaji et al., 2015).

The COVID-19 pandemic has caused a huge implication to the academic world, particularly critical courses involving practical sessions or hands-on sessions at tertiary level of education. The global pandemic has certainly raised concerns amongst the academicians, as the prolonged lock-downs in many countries have resulted in many universities and laboratories to be closed hence, compromising the exposure to practical skills and hands-on experience in the laboratory. The inadequate exposure to hands-on sessions may implicate lack of proficiency in laboratory techniques, procedures, and protocols which could jeopardize their performance and career later (Bhattacharjee et al., 2021). In light of the global pandemic that has affected the entire world, educators and academicians were compelled to adapt to the situation and rise to the challenge of finding alternative approaches as effective solutions for teaching and learning. Online distance learning has been adapted by many universities during the pandemic. The pandemic has made the teachers realize that their role is mainly as manager of various knowledge resources instead of the sole source of knowledge, hence expediting the growth of innovations in teaching and learning, as described in the literature since early 2020. Inter-faculty collaborations in producing a new way of online learning have been established in several universities around the world. Efforts such as collaboration with the faculty of computer science to develop virtual biomedical laboratory modules for medical students has been developed by one of the universities in the United Kingdom for effective parasitology learning (Fernandez et al., 2020). Academicians who are the content experts utilize the technology as a tool for the development of teaching and learning materials according to their learning objectives and creativity.

Teaching cell culture techniques at tertiary levels for undergraduate and postgraduate students during the COVID-19 pandemic era has imposed a great challenge to the academic staff who are supervising their students (Bhattacharjee et al., 2021). The global COVID-19 pandemic has certainly forced many instructors to venture into newer teaching modalities and at the same time, retain the student learning outcomes. As practical sessions are a core competency in science subjects, learning by doing is seen as an essential learning strategy to ensure competency (Pisano, 1996). The inappropriate learning strategies will impose a huge implication to the

research and development in biotechnology as well as manufacturing companies which contribute to the economic growth of the country (Pisano, 1996). The role of content experts is mainly constructing learning objectives, selecting the most appropriate mode of teaching, and utilizing all possible modalities to ensure that the learning session takes place, and the learning objectives are achieved. Based on this idea, many campuses have made the necessary transition of cell culture labs from campus to online, as their new approach (Peña-Fernández et al., 2019; Sabel et al., 2021). During the current pandemic, many companies and institutions have also taken their initiative in developing simulation labs or virtual labs, as this could be used as supplemental to online learning provided by educators.

This review was built from the conclusions of small and descriptive studies. In this review, various teaching and learning methods, assessment modalities, advantages and disadvantages of online distance learning related to online teaching of cell culture techniques are discussed in further detail in the next section.

## TEACHING AND ASSESSMENT MODALITIES

Online learning has been gaining momentum with the advancement of the internet as it is more accessible to all and considerably more affordable. A search in the relevant literature will give rise to a plethora of terms associated with online learning. The terms 'online learning', 'open learning' and 'blended learning' among others, are referring to the usage of a computer or electronic device which is connected to a network that offers the delivery of knowledge from anywhere and at any time (Dhawan, 2020). In online learning, students may not feel isolated from their peers or teachers as learning may be held synchronously. In synchronous learning, students and instructors need to follow a predetermined timetable; students listen to live lectures and are able to discuss the topics in real-time with their peers and instructors (Dhawan, 2020). Meanwhile in asynchronous learning, students are given pre-recorded lectures, quizzes, videos, and assignments online and the students need to retrieve this information and learn (Rehman & Fatima, 2021). Some online learning modalities are incorporating synchronous and asynchronous learning; and this is exemplified by blended learning or hybrid learning; which refers to the combination of face-to-face and online learning (Hrastinski, 2019).

The online platform has been used extensively in various levels of learning and institutes, from secondary school to undergraduate and postgraduate levels encompassing various topics and subjects. For this review, we are focusing on the various modalities of online teaching of cell culture techniques applied at a higher institutional level for our undergraduate and postgraduate students. The cell culture techniques here refer to the basic techniques such as aseptic technique, usage of biosafety cabinets, preparation of culture media, the changing of culture media and others.

In teaching cell culture techniques, various online learning modalities have been incorporated by different laboratories and institutes of higher learning such as blended learning and virtual laboratories. The way these modalities are delivered also changes during the pandemic. Some of the modules also include assessments to aid students in understanding the topics better.

Most of the institutes incorporate blended learning in online teaching of cell culture techniques in which there is a face-to-face teaching component and the retrieval of information from an online source. Huang et al. (2015) incorporated blended learning to undergraduate and graduate students of biochemical engineering courses. They produced videos on fundamental biological concepts, demonstrations of experiments and safety and basic skill training. The videos were accessed by students before the lecture or laboratory sessions to enhance their knowledge. During the actual session, students had more time to conduct the experiments and they were also able to refer to the videos for the proper protocols and techniques. Quizzes were incorporated at the end of the videos and students were given three attempts to answer all questions. A perfect score was needed by the students in making sure that they were allowed to start their research work in the laboratory. Once they started their research, students were given hands-on safety tours and demonstrations on protocols.

Similar blended learning was done by Peña-Fernández et al. (2020) with focus on teaching human cell culture in the field of parasitology. He created an online package which contained resources and materials such as videos, pictures of specimens and clinical case studies that can be assessed at any time and place. The contents of the online package were divided into sections, with one section dedicated to a virtual laboratory module which addressed cell culture techniques and quizzes for formative assessment.

This package was used as an adjunct in learning parasitology and students agreed that this module aided them in learning and understanding the subject. Blended learning was also undertaken by David et al. (2021) for the teaching of cell culture techniques to undergraduate students in bioengineering courses. This move towards blended learning was due to the effects of the COVID-19 pandemic which forced the closure of institutes of higher learning. The theoretical part of the programme was done face-to-face - however the practical aspect of the course which constituted the assessment of the course could not be conducted face-to-face. To overcome this, David et al. (2021) had designed a virtual laboratory practical to assess the hands-on cell culture techniques. The design of this assessment was to have students critique videos of improper cell culture techniques, analysis of data (images and calculations) and test their understanding by answering multiple-choice questions. Even though the design of this virtual laboratory practical did not test the students' hands-on practical skills, it required the students to think critically when appraising the techniques in the video.

The wave of pandemic that hit the world also changed the way blended learning in cell culture technique was carried out. Yap et al. (2021) reported the change in the usage of virtual laboratory simulation in undergraduate students in a biotechnology course. Prior to this, students utilized the Labster virtual simulation as a supplementary learning activity before entering the laboratory for practical sessions. The virtual simulation laboratory enabled them to perform animal cell culture experiments virtually with various multiple-choice questions to enhance their understanding. During the pandemic, the virtual simulation laboratory was the mainstay teaching modality for cell culture techniques. For the purpose of assessment, the virtual simulation laboratory was taken as the summative assessment of the practical segment from the fourth week of the semester.

The change in learning for cell culture techniques was also reported by Sabel et al. (2021). The authors reported the changes in three types of learning institutions; community college, liberal arts institutions, and regional state universities. Prior to the pandemic, the cell biology courses were conducted face-to-face; with the practical sessions taking place in the laboratory. The unprecedented wave of the pandemic forced the usage and application of online learning. As they had not had existing online learning materials before, various methods were employed to make sure that students met

the learning objectives of the course such as editing and finalizing videos of plant tissue culture techniques. Another institution utilized free online learning materials developed by other institutions and materials from the previous batch of students. Following this, the students were required to perform data analysis and partake in synchronous laboratory sessions where the materials were sent to the students earlier. Some students presented their data analysis as poster presentations in academic conferences. In terms of assessments, quizzes attempted by the students served as a formative assessment of the process of peer-reviewing of posters.

Bhattacharjee et al. (2021) also reported changes in delivery of cell culture techniques in second year bioengineering major students. To accommodate teaching and learning during the pandemic, their institution offered two options to students: face-to-face teaching or online. For online students, they were required to complete the online safety training prior, and an online course on laboratory introduction. Students also received at-home laboratory kits which consisted of micropipettes, consumables, and others which they would use during synchronous sessions with the instructor. In this sessions, students were able to observe videos on proper techniques with the demonstration and guidance from the instructors. Students were also required to produce their own videos demonstrating aseptic technique and completed virtual cell culture simulation, using commercially available online resources.

An interesting method of online teaching of cell culture techniques was reported by Furtney (2020). This method was utilized by the undergraduate students enrolled in Cellular Engineering Laboratory at the author's institution. This method incorporated the element of gamification in teaching the technical aspects in the form of First-Person Shooter (FPS). The instructor was the FPS and students were able to experience the laboratory techniques from the eyes of the instructor. The FPS would use a recording device equipped with a microphone during demonstration of cell culture techniques. The recording was streamed live to a group of students in the laboratory discussion area. The session was interactive; with students and instructors asking questions and discussing the techniques performed. The summary of the type of online learning is shown in Table 1.

| 1st author (year) | Academic course of students | Type of online learning | Description | Assessment of student (if any) |
|---|---|---|---|---|
| Bhattacharjee, (2021) | 2nd year bioengineering major students | Blended learning offered both face-to-face and online learning | - Online laboratory introduction (both face-to-face and online students)<br>- Cell culture kits are delivered to online students<br>- Online synchronous session (video with explanation) on protocols and usage of kits.<br>- Virtual cell culture simulation | - No assessment |
| Huang, Z. J. (2015) | Undergraduate and graduate students of biochemical engineering course | Blended learning<br>- online videos followed by hands-on session | - Online video on protocols and techniques (viewed before the practical session)<br>- Hands-on laboratory session | - Quiz after completion of video. Three attempts. |
| Peña-Fernández, A. (2020) | Undergraduate pharmacy students | Blended learning<br>- website for reference and addition to theoretical class | - Website is created containing theoretical knowledge, pictures, videos of various laboratory techniques (including cell culture), and quizzes | - Formative assessment (short quizzes, games, exercise).<br>- Unlimited attempt, instant feedback |
| Furtney, S. C. R. (2020) | Undergraduate students enrolled in 'Cellular Engineering Laboratory' | Gamification element, using First-person shooting/seeding (FPS) | - Instructor uses recording device to record cell culture techniques and live streams to a large screen<br>- Q&A session done in real time | - One-on-one assessment of protocol |

| | | | | |
|---|---|---|---|---|
| David, B. (2021) | Undergraduate students in bioengineering course | Blended learning<br>- In-person laboratory training followed by virtual laboratory practical | - Blended learning with three phases of assessment; using short video clips, randomly generated hypothetical image and a set of multiple-choice questions | - Creates learning management system-based assessment (Canvas), consists of critiquing instructor's technique, data analysis and multiple-choice questions |
| Sabel, J. L. (2021) | Students from different institutions; community college, liberal arts institutions, and regional state universities | Blended learning – in-person training followed by online practical or substitution of practical<br><br>Online – synchronous | - Students edit and finalize their video protocols of cell culture.<br>- Students assess free learning materials online, followed by data analysis and synchronous laboratory session with materials sent to students<br>- Perform data analysis and virtually present as poster | - Quizzes, peer review |
| Yap, W. H. (2021) | Undergraduate students in biotechnology course | Blended learning - Virtual laboratory simulation (Labster) as a supplement | - Students use the virtual laboratory prior to entering the lab<br>- Used as the main method of learning during pandemic | - Multiple-choice questions for formative assessment during the course<br>- As a summative assessment from fourth week of the semester |

**Table 1. Type of online cell culture learning**

## 3. IMPACT OF ONLINE LEARNING IN CELL CULTURE TRAINING

Cell culture users, especially the beginners, have been exposed for many years to online learning of cell culture techniques through websites of several well-known life sciences brands or manufacturers. Cell culture beginners can watch the YouTube videos provided by the manufacturers to get general information on cell culturing techniques.

Currently, cell culture training has also been part of several institutions' online course offerings. Rapid advancement in the internet, computer software and other technologies have made it feasible to incorporate the teaching materials into online teaching and learning platforms. Similar to other courses, cell culture training courses or module's learning resources are delivered via the institution's online learning environment or platform. The learning platform varies depending on the software used, but it usually consists of a central online platform that students can access from their personal desktop computer, mobile phone or tablet.

The degree to which students can properly use scientific equipment, technology, and instrumentation, follow technical and professional protocols, and/or demonstrate proficiency in physical laboratory techniques, procedures, and measurements are often regarded as challenging to teach outside a traditional laboratory setting. However, few studies have shown that students learn well through active learning that involves visual engagement. In this section, the impact of online learning in cell culture training is discussed based on the benefits of online learning on cell culture training as well as its limitations.

### 3.1 BENEFITS

In a virtual biomedical laboratory module constructed by Human Cell Culture e-Learning Unit (HCCU), 25 students in the second year of the Bachelor of Science (Biomedicine) programme have been exposed to the virtual laboratory module. The module covers how to work in the cell culture lab, consumables/equipment needed, video on steps and procedures in human cell culture as well as formative assessment and mini quiz to test student's understanding. Prior to practical training,

students were given a task to watch and complete the virtual module. At the end of the practical training, opinions from students were obtained from validated questionnaires with Likert scale and open questions. Fifty six percent agreed that the overall design was appropriate and interactive with 87% having enjoyed using, and being satisfied, with the module. The video on steps to do cell culture facilitated their learning, showing that application of blended learning is potentially an effective strategy to learn cell culture (Peña-Fernández et al., 2019).

In another cell culture module, which is known as Mammalian Cell Culture Module, students were able to practise cell culture techniques using lab kits provided by the instructors. Subsequently, the students were required to create a video demonstrating aseptic technique to assess their progress. Students who studied via an online platform were required to complete a virtual cell culture simulation. Although the practical activity was performed outside of a biosafety cabinet, the students were able to practise the aseptic technique and met the learning objective of this practical section, which was to become competent with aseptic technique and basic techniques in culturing mammalian cells (Huang et al., 2015).

The virtual laboratory environment is useful for the technicians and students across the world as it serves as a medium to experience the working environment in a biomedical laboratory as well as allowing for the performing of laboratory techniques virtually. As traditionally teaching cell culture technique using the biosafety cabinets require the students to sit or stand around the trainers, this is only feasible if the number of students is low. However, despite the low number of students, there is still intermittent visual obstruction and space limitation. Thus, some techniques may not be observed appropriately by the students. Having virtual teaching also has been seen as a means to solve teaching students in large crowds at a time. Not only that, virtual teaching has also been the solution to shortage of skilled personnel as instructors, teaching in limited resources and time constraint (Peña-Fernández et al., 2020). Besides promoting self-learning, overcoming barriers of time, space, equipment, and resources, virtual teaching has been seen to increase student engagement, facilitate essential work skills, and function as a useful source for academic teaching relevant to medical aspects.

In a separate study, a virtual cell culture lab was designed due to the COVID-19 pandemic to train students to practise cell culture independently. The virtual lab enabled the students to incorporate multisensory learning tools to recall information, while providing the opportunity for students to learn and make mistakes before using the equipment, as well as an enhancement to a hands-on lab. The online learning material allows students to pause and replay whenever they feel a need. Results showed that the virtual lab enhances students' understanding of the materials used in cell culture. The software used for designing the online learning materials also allows instructors or e-content developers to monitor the students' learning progress by acknowledging who had watched the video and to what degree they interacted with the materials (Gerstenhaber & Har-El, 2021).

Gamification was developed as one of the pedagogical tools (Furtney et al., 2020). Gamification motivates students into learning as some courses of action during the game offer reward. The application of game design elements in non-gaming environments increases motivation, engagement and attaining course outcome. Studies have shown that use of gamified laboratory simulations and active learning increase student interest, motivation, learning effectiveness, and self-efficacy. Furthermore, active learning decreases learning gaps, thus increasing student achievement (Theobald et al., 2020). Advantages to virtual laboratory simulations include cost-effectiveness, eliminates biosafety concerns, and increases engagement of digital aged students (Furtney et al., 2020).

In an Animal Biotechnology module for Biotechnology course in Taylor's University, Malaysia, Labster virtual simulations have been used as part of their blended learning activities. However, due to the COVID-19 pandemic, the role of virtual laboratory simulation has been transitioned from being a supplementary learning activity prior to entering physical labs, to primary learning tools. Instructors were able to monitor progress through assessments. Comparable to the traditional way; during assessment it is shown that a virtual simulation lab increases knowledge and understanding, facilitates active, inquiry-based learning, is low cost and enables students to learn at any time and pace. From their survey, students have responded that the virtual

simulation lab is extremely helpful. Increasing trend in students answering 'extremely confident' in their aseptic technique was also observed. Students like the quizzes in between, with theoretical explanations to help their understanding. The virtual simulation is a personalized learning experience to the students where they can repeat experiments until they can grasp the concepts. Students are also able to practise steps multiple times and perform at their own pace. Virtual simulation labs also increase study intensity and motivation. To apply virtual simulation laboratory in teaching, increased simulation realism and repeated simulations are needed. Structured lab simulations with realistic cases and animations, with theoretical explanation would be helpful (Yap et al., 2021).

There is equal or even increased learning outcome achievements when using virtual labs compared to traditional labs. However, in online teaching, it is not possible to test for the physical technique of the practical. But the students are tested on critical thinking such as thinking about the steps during practical and data interpretation. Multimedia examination is widely accepted by students if it mimics prior instruction. In the practical session for undergraduate biomedical engineering students during the COVID-19 pandemic, in-person lab training was conducted and then the assessment was done virtually. The assessments consist of students giving a critique on wrong techniques shown on videos, completing exercises on data analysis such as cell counting and answering multiple choice questions to assess their knowledge. Grades following assessment were analysed and the results were comparable between in-person and online cell culture laboratory. The findings may decrease the perceived subjectivity by instructors during live assessments (David, Masood & Jensen, 2021).

In another study where the cell culture courses had to be switched into online learning, which was also due to the pandemic, students were able to create their own experiments. Increased engagements and assessment scores among students were also observed. Online demonstrations, videos, quizzes, and mock data were used to improve students' techniques. While the online or virtual environment develops different types of skills than the traditional on-the-ground lab, these skills are equally important to student maturation into a scientist. (Sabel et al., 2021).

## 3.2 LIMITATION

The demand for online distance learning is increasingly spreading in education, especially in higher education levels. Online distance learning or e-learning is when the teacher and the student do not connect in the traditional way which is face-to-face during the educational process, and the physical gap between them is bridged by the technology (Rahman, Karim & Byramjee, 2015). The use of virtual worlds has irreversibly changed the traditional teaching and learning habits. They can provide appropriate conditions for a novice student while they have more advantages such as good quality, low costs, safety, and remote access - however, undoubtedly, it is a challenge to teach practical skills used in the lab such as using scientific equipment, technology and instrumentations outside of the laboratory setting.
There are concerns among instructors about online teaching of cell culture techniques whether the quality of teaching and learning materials have been peer-reviewed (Peña-Fernández et al., 2020). This is supported by Veselinovska, Gudeva & Djokic (2011) where content reviewers are crucial as an initial team consisting of medical researchers to provide overall insight, feedback, and accuracy check of the content disseminated in the modules.

There is also a decline in students who 'completely agree' for more simulations in teaching. Students also said it is not as interesting as normal methods and some students even preferred hands-on lab (Yap et al., 2021).

In another study that has been explained in the earlier section, although results showed that the virtual lab enhances students' understanding of the material used in cell culture, lack of social interaction, lack of student motivation as well as difficulties in conducting question and answer sessions were also observed. More importantly, students feel that the time for communication with lecturers for question-and-answer sessions was limited (Gerstenhaber & Har-El, 2021).

Online platform is not the ideal way to teach, but it can still engage students. Although students were comfortable with aseptic techniques and learned about culturing mammalian cells, some traditional aspects in hands-on teaching do not translate well in online platforms. Based on students' feedback, the live lectures that included technique demonstrations were helpful and students further suggested that additional sessions for online students to get instructor feedback on their techniques would be beneficial. The assessing of a student's ability to perform hands-on experiments is particularly challenging especially when the classes are conducted online, as the students are only assessed based on their conceptual knowledge. For future classes, it could be useful to compare the data between the written exams scores of online students and in-person students. The results of this work can be used to adopt similar at-home instructional lab models at other institutions as well as guide the implementation of future online lab course offerings or supplemental activities for in-person lab course offerings (Huang et al., 2015).

Another study also supported live lectures whereby the students mentioned that they preferred live lectures so they can ask questions immediately. Some comments include making instruction in a virtual lab to be clearer for students to understand (Gerstenhaber & Har-El, 2021).

Online labs do require different considerations in student engagement. A researcher pointed out that "getting the students to share data in a group is difficult remotely," and recommends "getting the students comfortable with speaking up and participating in an online system has to be the first priority." Another researcher also recommends being very purposeful in scaffolding the projects. "Meaningful data analysis projects can be accomplished in an online environment in which they just need to be planned that way" (Sabel et al., 2021).

## 4. SUGGESTION ON IMPROVING AN ONLINE TEACHING MATERIAL

The COVID-19 pandemic has certainly forced academicians and laboratory instructors to step out of their comfort zone and venture into new teaching and learning modalities. After more than a year in the pandemic era, we have transitioned into an endemic phase and it is remarkable to witness students showing their adaptation and improvement with the online distance learning provided by the instructors and academic staff who are the e-content developers. Continuous engagement between the academic staff and the students using online distance learning platforms has shown some benefits on both sides - the academic staff, and the learners. Students who have continuous engagement with the instructors are more likely to share their views and give suggestions and recommendations to the e-content developers. These inputs are considered valuable for the e-content developers for further improvement of the learning content. Designing the e-content module is the focus for academic staff who are the content experts. There are several aspects that the academic staff who are the e-content developers should be aware of when designing the learning module. The online course or the e-content and materials should be designed based on the learners' objective, basic knowledge attained by the learners, skills, and habits of learners. Having this information will help the e-content developers who are the content experts in their field to design modules suitable for learners better.

As teaching practical techniques such as cell culture techniques normally require the face-to-face mode, producing a good quality video is considered crucial. A good quality video for teaching and learning purposes contributes to the establishment of student engagement during the learning process. Addition of subtitles in the video can be an advantage to help the students stay focused when watching the video of practical steps. The use of high-quality equipment during video-shooting and good software are helpful in producing a good quality teaching video, apart from being time and energy saving for academic staff to do the editing. Using good software will not only help developers in creating high-quality photographs of specimens and video for teaching and learning purposes but also save time for the developers. Apart from the visual aspect, application of audio by using

different voice tones during video or voice recording may make video more interesting. Using all sensory information during learning has shown to be more effective for students (Goudsouzian et al., 2018).

With the current advancement in technology, incorporating impactful artworks, illustrations and graphic designs in learning materials is the new approach and thought to be essential to facilitate the understanding, enhancing of knowledge transfer and retention, enhancing of student engagement, application of visual model-based reasoning and simplifying a complex concept to a more understandable way. Based on this concept, some faculties such as from medical science, applied science and microbiology have commenced a network and collaboration with the faculty of arts apart from the faculty of computer science in developing a more impactful and high-quality e-learning module (Gomes & Bogosyan, 2009). Incorporating artists' art touch has shown to give an impact on society by producing visually high impact images and artwork (Peña-Fernández et al., 2020). The interesting design may enhance student engagement towards e-learning modules.

Teaching practical skills is thought to be challenging and almost impossible in a traditional learning method. The idea of developing a virtual lab for online learning is seen as beneficial for students. As some experts view the online learning module may not be the substitute for the whole course content, the use of online learning materials such as virtual lab can be used as a supplemental aid in learning. To create a more effective learning environment, the learning objective and instructions of online learning particularly the virtual lab for practical skill, must be clear for students to understand. The virtual interphase plays an important role as good quality and artistic interphase will be more likely to encourage active learning. To make the learning more realistic, the content of the simulation must be based on real life problems, for example identifying the source of contamination in cell culture (whether it is caused by fungus or bacteria) and the next steps to be taken by the operator. Steps in aseptic technique before starting cell culture can also be simulated to ensure student competency. By identifying the cause of the problem, students may be able to apply the knowledge learnt from videos or content provided by the instructors. This learning process can be an initial step to be learned before commencing real cell culture experiments later during real practical sessions.

As some learners thought that virtual lab learning lacks physical interaction and inhibits social interaction as most of the time students will have to perform the virtual lab session on their own, introducing game approaches which involve multiplayers could be a way to solve this matter. By creating games, other users from any country can use the platform. This platform can serve as a social network for communication with other students through text-based, voice-based, or other interactions. Apart from that, this platform can also be used for learners to interact with their peers and teachers. At the same time, the teachers have the direct medium to observe the students' progress while they are on online distance learning mode.

## CONCLUSION

Based on the review, it is concluded that teaching basic cell culture techniques via online distance learning platforms is possible in this current era. Determining the learning objectives and designing the e-learning content materials is crucial to ensure the suitability of the content to the learners. However, the online learning of cell culturing must also be accompanied by face-to-face sessions to ensure better understanding among students, and this can be done by blended or hybrid learning. In this case, collaborations between students, e-content developers or instructors, and the faculty or institution's involvement are deemed important in realising the plan to embark into blended learning for cell culture techniques for our undergraduates and postgraduate students.

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# Model of Conceptual Framework for Studio Based Open and Distance Learning (ODL): A Case Study on Students' Emotions in the Faculty of Art and Design, Universiti Teknologi MARA, Perak Branch, Campus Seri Iskandar

**Muhammad Asri Azuddin[1]*, Norhaslinda Shafie[2], Nur Akma Halili[3] , Didit Widiatmoko Soewardikoen[4] , Ardy Aprilian Anwar[5] , Arief Budiman[6]**

*[1,2,3]College of Creatives Arts, Digital and Imaging Arts, Department of Photography and Creative Imaging, Universiti Teknologi MARA, Campus Seri Iskandar, 32610 Seri Iskandar, Perak, Malaysia*

*masri101@uitm.edu.my, norha383@uitm.edu.my, nurakma8756@uitm.edu.my*

*[4,5,6]School of Creative Industries, Gedung Bangkit Telkom University, 40257 Bandung, Indonesia*

*diditwidiatmoko@telkomuniversity.ac.id, ardyaprilianawar@telkomuniversity.ac.id, ariefiink@telkomuniversity.ac.id*

**Corresponding Author*

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*Abstract: UiTM's Faculty of Art and Design uses "studio-based learning." Art and design students must participate in studio conversations about their work. Malaysia too went through the MCO due to COVID-19 and this had influenced the way the education industry was run – Open amd Distance Learning was applied to almost all courses. This study will examine the Technology Acceptance Model (TAM) and Pekrun Emotions and Learning Theory to assess how art and design students felt about COVID-19-related Open and Distance Learning (ODL) studio-based courses. This study will also identify students' emotions. The Technology Acceptance Model (TAM) was used to assess ODL studio-based students' tech attitudes. The Pekrun Emotion and Learning Theory was used to assess Art and Design students' technological attitudes. This study employed theoretical research to combine structured observation, questionnaires, and semi-structured interviews. The findings suggest that in studio based Open and Distance Learning (ODL)*

*classes, the Art and Design students' emotions should be considered prior, using technology acceptance, and after, using perceived usefulness and perceived ease of use when developing online studio learning. Technology adoption precedes technology utility and simplicity of use, according to the research. The research improves teaching and learning, especially studio learning. To better respond to students' feelings in the future, the online class should establish a healthier teaching and learning environment.*
*Keywords: Online Learning, Studio Based, Students Emotion*

## INTRODUCTION

Between the years 2020-2022, Malaysia was plagued with the COVID-19 virus, which had infected practically every country. The government was forced to enforce the Movement Control Order (MCO) limitation to slow the spread of the virus. The Movement Control Order (MCO) implementation in Malaysia had affected many sectors, especially the education system. Due to the virus' spreading ability, colleges and universities sent their students home, following The Ministry of Higher Education's guidelines to protect students. Therefore, online learning shifted to keep up with semester-long learning. Open and Distance Learning (ODL) replaced traditional classrooms and studio-based Art and Design programs. This innovative technique for learning was offered to students. The unanticipated break from the norm made catching up difficult for students. Each student had different constraints when using these methods. Slow internet, a lack of tangible instruments for the studio-based lesson, a lack of a suitable place to remain between sessions, and the need for students to share devices with siblings were some of the obstacles faced. The students could not concentrate in class and feared falling behind. Due to online distance learning's limited skill set, some pupils felt apprehensive. This research will immediately affect online course materials. If the curriculum is handled well, the online platform will become more reliable and be more than just a supplement to school.

Malaysia is one of the countries affected by the COVID-19 virus, which has now infected nearly every nation on earth. The government was obligated to apply the Movement Control Order (MCO) restriction to slow the spread of the COVID-19 virus due to the rapid growth in the number of

patients and the high death rate during the virus' initial waves. This action was taken to combat the outbreak. The implementation of the Movement Control Order (MCO) in Malaysia has had repercussions on a vast array of existing sectors. The education system in Malaysia is evidently one of the areas that has suffered the most. Due to the potential for the virus to spread, all colleges and universities were ordered to send their students home. Universiti Teknologi MARA (UiTM) adhered to the direction of the Ministry of Higher Education to ensure that each student on campus traveled home safely. However, during that period, it was vital to keep up with the learning during the semester, which shifted to online learning. Open and Distance Learning (ODL), a novel mode of education that replaces traditional face-to-face physical classrooms and studio-based programmes with teaching given via an online platform, is now available to Art and Design majors (Fleischmann, 2020; Gogu & Kumar, 2021). Students were introduced to this new manner of schooling as a new approach to learning. As a result of the unanticipated deviation from the usual, the catching-up procedure presented a few obstacles for pupils. This is since each student has their own unique restrictions when it comes to Open and Distance Learning (ODL). These constraints include a sluggish internet connection, a lack of physical tools for the studio-based lesson, a lack of a suitable place to stay during classes, and, in certain circumstances, the necessity for students to share gadgets with their siblings (Elfirdoussi et al., 2020). The pupils were unable to concentrate in class and believed they were slipping behind during the semester as a result of recent events. Due to the limited skill set they could master and acquire through online distance learning; students also felt uneasy. This research will have an immediate impact on the course content that is included in the syllabus for online platforms. Moreover, if the curriculum is treated appropriately, the online platform will become more dependable, and it will become more than a supplementary mode of education in the future. Considering this, all the challenges the students encountered while using the Open and Distance Learning (ODL) technique will be rectified, and a more conducive learning atmosphere will be created during online class sessions to better accommodate the students' emotions. The objective of this study is to determine how art and design students felt about the Open and Distance Learning (ODL) approach in studio subjects during the Movement Control Order (MCO).

## OPEN AND DISTANCE LEARNING (ODL)

Open and Distance Learning (ODL) is an acronym that was derived from the Universiti Teknologi MARA, UiTM Guidelines. ODL refers to open teaching and learning sessions that take place at a distance. The teaching and learning process conducted by the lecturer takes place in its own space and time, separate from that of the students. This aligns with the beliefs of YB Tan Sri Amar Dr. Sulaiman Bin Hj. Daud, who served as the Minister of Education in Malaysia in 1993. Dr. Sulaiman Bin Hj. Daud maintains that access to education should not be contingent on factors such as age, gender, social status, or race. A reform in terms of teaching and learning cannot be achieved if the teaching and learning process is still maintained face-to-face and in the traditional manner at the university level. As a consequence of this, the implementation of Open and Distance Learning (ODL) was appropriate when the government implemented the Movement Control Order (MCO) during the spread of the COVID-19 epidemic. As a result of this, Universiti Teknologi MARA implemented preventative measures in order to ensure that its students continued to receive instruction and participate in educational activities despite the COVID-19 epidemic. The Open and Distance Learning Program is provided by the Academic Affairs Division of MARA University of Technology (ODL). Students are afforded the opportunity to acquire knowledge in a variety of ways and through a variety of access points thanks to this. The term "flexible" refers to the ability to carry out the process of teaching and learning in a variety of settings; "access" refers to the freedom of students to make use of space and time; and "various modes" refers to the integration of technological tools into the teaching and learning process (Norazrina Ag-Ahmad, 2020). The method and process of teaching and learning in Open and Distance Learning (ODL) do not target or emphasise the issue of students' attendance to class; rather, they emphasise the involvement and emotions of the students when the teaching process is taking place. This is in contrast to the method and process of teaching and learning in traditional classrooms, which target or emphasise the issue of students' attendance to class. As a consequence of this, the lecturer's observation of the students' involvement and emotions is extremely important and needs to be documented in order to achieve the quality of Open and Distance Learning (ODL) when the teaching and learning process between lecturers and students is put into practice.

## STUDENTS' ATTITUDES TOWARDS ONLINE LEARNING SESSIONS

Students are affected by internet-based education and learning. It can also have an effect on one's mental, physical, emotional, and social wellbeing. There are studies that suggest it is related to screen exposure - exposure to the screen for four or five hours will indirectly make it difficult for us to sleep and will subsequently experience emotional disturbances, according to psychologists (Blume et al., 2019). Students must be engaged to gain maximum learning because online learning involves intense concentration. Environmental elements are also crucial in dealing with students' emotions while they are learning online. During class, students are exposed to various external variables that interfere with focus, such as parents who are unconcerned about the ambiance of their students' online classes and frequently ask students to help with household chores while the class is in session. Students are unable to fully concentrate in class since they must move from one location to another while doing their assignments. As they feel embarrassed towards the other classmates, the students' emotions will be volatile in this situation. As a result, when students are in class, they will have lower self-esteem than they did before, and also worry about their academic achievement and future employment possibilities (Sundarasen et al., 2020).

## METHODOLOGY

When it comes to ensuring that the goal of the research can be attained, the method that is chosen to conduct the research is of the utmost importance. The current study employed a theoretical research approach because it gave the researchers the opportunity to investigate the Technology Acceptance Model (TAM) (Silva, 2015) and the Pekrun Emotions and Learning Theory (Ramlie et al., 2020; Ali & Ramlie 2021) in studio-based Open and Distance Learning (ODL) in order to recognise Art and Design students' emotions during Covid-19. Structured observation, questionnaires, and semi-structured interviews were the three methods of data collection incorporated into the research in order to gain an understanding of the feelings experienced by the Art and Design students. In order to ensure that this research was successful

in accomplishing its goals, a total of 362 students from the faculty of art and design participated in it. This investigation was carried out within the photography and creative imaging, fashion, the graphic design, the ceramics, and the fine art departments.

## STRUCTURE OBSERVATION

The purpose of conducting structure observation in this study was to capture the natural surroundings of Open and Distance Learning (ODL) studio-based art and design students as well as their feelings while they were participating in the online studio during the Covid-19 pandemic. As a consequence of this, the researcher assumed the role of an observer in the online studio class in order to collect primary data on levels of satisfaction, attitudes, and behaviours. The most essential aspect of this endeavour was to compile a list of both positive and negative feelings regarding art and design while participating in open and distance learning (ODL) studio-based learning. Following the completion of the observation, the researcher entered the data into Table 1.

| Department (Diploma) | Student Percentage | Satisfaction Percentage | Attitude Percentage | Behaviour Percentage | Positive Emotion Percentage | Negative Emotion Percentage |
|---|---|---|---|---|---|---|
| Fashion | 39.8% | 39.8% | 39.8% | 39.8% | 10.2% | 29.6% |
| Ceramic | 4% | 4% | 4% | 4% | 0.5% | 3.5% |
| Fine Art | 7.5% | 7.5% | 7.5% | 7.5% | 1.3% | 6.2% |
| Graphic and Media Digital | 23.8% | 23.8% | 23.8% | 23.8% | 15.7% | 8.1% |
| Photography andCreative Imaging | 24.9% | 24.9% | 24.9% | 24.9% | 7.2% | 17.7% |

**Table 1. The percentage of 362 students enrolled in Art and Design courses who took part in structured observation as part of studio-based Open and Distance Learning (ODL) classes.**

The results are presented in Table 1 as follows: During Open and Distance Learning (ODL) studio-based classes, structured observation was completed on 39.8% of students enrolled in fashion, 4% of students enrolled in ceramics, 7.5% of students enrolled in fine art, 23.8% of students enrolled in graphic and media digital, and 24.9% of students enrolled in photography

and creative imaging. During the Open and Distance Learning (ODL) studio-based class, researchers used a method called "structured observation" to focus on the positive and negative emotions that Art and Design students experience. Table 2 displays the findings of the researchers regarding both positive and negative feelings.

| **Department (Diploma)** | **Positive Emotion Percentage** | **Negative Emotion Percentage** |
|---|---|---|
| Fashion | 10.2% | 29.6% |
| Ceramic | 0.5% | 3.5% |
| Fine Art | 1.3% | 6.2% |
| Graphic and Media Digital | 15.7% | 8.1% |
| Photography and Creative Imaging | 7.2% | 17.7% |

**Table 2. The structured observation result of positive and negative emotion of Art and Design students during Open and Distance Learning (ODL) studio-based classes.**

According to the findings presented in Table 2, 29.6% of fashion students experienced unfavourable feelings because they were unable to participate in hands-on learning experiences or use workshop and studio facilities like sewing and embroidery machines. On the other hand, 10.2% of fashion students had favourable feelings while taking Open and Distance Learning (ODL) classes. Only 0.5% of ceramic students experiencrd positive emotions during Open and Distance Learning (ODL) classes, whereas 3.5% of ceramic students had negative emotions as a result of the constraints in using the facilities that are available in the studio. These facilities include ceramic firing facilities, glaze studios, and raw material facilities such as clay. Fine art students faced challenges in completing existing works that require facilities such as wood workshops, iron workshops, and printmaking facilities. In addition, 6.2% of fine art students experienced negative emotions, and 1.3% experienced positive emotions during Open and Distance Learning (ODL) classes. 17.7% of students studying photography and creative imaging experienced difficult feelings as a result of the constraints imposed by photography equipment, such as the absence of studio lighting. As a consequence of that, there is an absence of creativity in the work that the students produced, and only 7.2% of them had positive emotions while they

were participating in Open and Distance Learning (ODL) classes. However, during Open and Distance Learning (ODL) classes, 15.7% of graphic and media digital students had positive emotions because they did not depend on the facilities of the workshop and studio to complete the work, while only 8.1% had negative emotions.

## QUESTIONNAIRE

As can be seen in Table 3, there were 362 people who responded to the preliminary questionnaire that was distributed. Students in Art and Design were given the questionnaire to fill out in order to collect preliminary feedback from them regarding their attitudes toward Open and Distance Learning (ODL) studio-based courses. While participating in open and distance learning (ODL), only 15.8% of students experienced positive emotions, while 84.2% experienced negative emotions because the limitation of the use of studio and workshop facilities in completing the work. During the studio-based portion of the Open and Distance Learning (ODL), 216 out of 362 respondents experienced negative emotions, while 40.3% experienced positive emotions. As a result, 67.2% of people think that Open and Distance Learning (ODL) Studio Based should be improved in the future, whereas 32.8% of people think that this shouldn't happen. It has been established, on the basis of the results of the questionnaire, that Art and Design students' emotions during Open and Distance Learning (ODL) in a studio environment ought to be improved in the near future.

| Questionnaire | Positive | Negative |
|---|---|---|
| How do you feel during the Studio Based Open and Distance learning (ODL) classes? | 15.8% | 84.2% |
| Were you satisfied with your emotions during Studio Based Open and Distance Learning (ODL) classes? | 40.3% | 59.7% |
| Do you think that Studio Based Open and Distance learning (ODL) classes forArt and Design students should be enhanced in future? | 67.2% | 32.8% |

**Table 3. The percentage of 362 Art and Design students who answered a questionnaire about their feelings while participating in Open and Distance Learning (ODL) studio-based learning.**

## SEMI-STRUCTURED INTERVIEWS

Interviews are a very important method, as stated by Sulaiman Shamsuri (2006), for gaining an understanding of the perspective that an individual has on a given circumstance. For the purpose of this research, semi-structured interviews were used, and a total of 20 questions were posed to a select group of art and design students hailing from five distinct academic disciplines: fashion, ceramics, fine art, graphic and media arts, and photography and creative imaging. This method is used to identify the students' feelings during the Open and Distance Learning (ODL) studio-based class that they were taking. The semi-structured interviews lasted anywhere from fifteen to thirty minutes for each student. Structured and unstructured interviews are both a part of the semi-structured interview process. Both types of interviews are conducted. The researcher compiled a list of questions that will be asked of each and every student in the Art and Design programme. Additional questions were asked by the researcher during the interview session in order to elicit additional information regarding the feelings experienced by the student while participating in the Studio-Based Open and Distance Learning (ODL) classes.

## RESULTS AND DISCUSSION: TECHNOLOGY ACCEPTENCE MODEL (TAM) AND PEKRUN EMOTIONS AND LEARNING THEORY

This research aims to investigate the Technology Acceptance Model (TAM) and the Pekrun Emotions and Learning Theory in order to determine the feelings that art and design students have towards studio-based Open and Distance Learning (ODL) courses that were offered during COVID-19. Additionally, the findings of this investigation will be used to identify the emotions that these students had. Within the Open and Distance Learning (ODL) Studio, the Technology Acceptance Model (TAM) serves as the foundation for determining how students feel about their use of various technological tools. Pekrun's Emotion and Learning Theories were consulted in order to determine the students of Art and Design's emotional states. The Technology Acceptance Model entails the following: (TAM),it is a description of the factors that influence user behaviour with regard to the utilization of technology and the technology acceptance model hypothesis. In other words, it describes the variables that drive user behaviour, or is a

description of the factors that drive user behaviour. A person's conviction that they will profit in some manner from using a particular piece of technology is one of the factors that can encourage them to utilize it. The second issue that must be taken into account is the user's ability to benefit from the technology. Before deciding whether or not to use this kind of technology, the user should carefully think about the two points above (Silva, 2015).

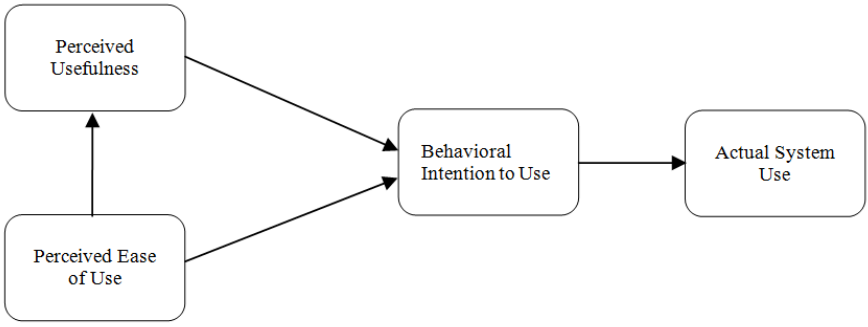


**Table 3. The percentage of 362 Art and Design students who answered a questionnaire about their feelings while participating in Open and Distance Learning (ODL) studio-based learning.**

Pekrun's theory of the relationship between acceptance and learning predicts that the different emotional states that a person goes through before and after learning are directly related to one another. However, the findings of the study suggest that these relationships do not hold true. Pekrun's theory of emotions and learning, which postulates a link between the two ideas, lends credence to this assumption and provides support for it. Pekrun was kind enough to provide his feedback on the investigation's findings, which we are very grateful for.

| | Positive | | Negative | |
|---|---|---|---|---|
| **Object Focus** | *Activating* | *Deactivating* | *Activating* | *Deactivating* |
| **Activity Focus** | - Enjoyment | - Relaxation | - Anger<br>- Frustration | - Boredom |
| **Outcome Focus** | - Joy<br>- Hope<br>- Pride<br>- Gratitude | - Contentment<br>- Relief | - Anxiety<br>- Shame<br>- Anger | - Sadness<br>- Disappointment<br>- Hopelessness |

**Fig. 2 The Theory of Pekrun Emotions and Learning**

When a person deliberately activates their positive emotions prior to beginning a learning session, those positive emotions are indirectly triggered throughout the learning process, which results in the emergence of additional happy emotions after the learning session has come to a close. If, on the other hand, individuals are miserable before they learn something, they will continue to be miserable after having acquired that knowledge. This has been demonstrated by education-related research that was conducted in the past (Ramlie et al, 2020; Ali & Ramlie, 2021).

## MODEL OF THE CONCEPTUAL FRAMEWORK

According to William (2008), a conceptual framework or conceptual model is a visual, written product that depicts graphically or narratively and relates to each other's information. Combining theoretical understanding with practical application enables the development of a conceptual framework that is informed by the goals of the researcher's research. The best way to describe a conceptual framework is graphically, using arrows to show how different aspects are related to one another. Because of this, the researcher proposes this conceptual framework as a guideline for more positive reactions and feelings among Art and Design students during studio-based Open and Distance Learning (ODL) learning in the hopes of enhancing future online studio learning.The Technology Acceptance Model will be used throughout the construction of the conceptual framework for this research project. This will allow for a greater understanding of the way the implementation of technology, notably the online platform, affects

pupils. This is because the online platform employed has an indirect effect on students' perceptions of the platform's usability and usefulness prior to enrolling in an online class. Students who can take online studio classes and have completed online exams prior to the start of a virtual session should feel good about themselves. In the context of this study, the researcher will analyse the feelings of students both before and after their participation in online classes involving studio subjects using an online platform used in lecture sessions during the movement control command period. This rating will be based on a variety of enjoyment-related factors.

The cognitive load level assessment instrument can be subdivided into two distinct groups. The mood and motivation measuring instruments can be administered by either self-questionnaires or specialised hardware, according to how the cognitive load level assessment instrument can be subdivided. In order to determine how students feel about their education, the researcher resorted to the use of a questionnaire in the course of this investigation. The Achievement Emotions Questionnaire (AEQ), which corresponds to Pekrun's Control Value Theory, served as the basis for the development of this questionnaire. The levels of students' happiness, optimism, pride, anger, anxiety, humiliation, hopelessness, and boredom will be measured using this value control theory before and after they sign up for online programmes. This will be done so that the theory can be validated. Acceptance of the online platform itself is one of the criteria that influences whether students' positive or negative emotions are triggered prior to the start of class. This is determined by the theoretical Technology Acceptance Model. In spite of this, negative feelings will be recorded if platform or internet access problems cause students to feel something other than happy or sad while the online class is in session, or if the opposite is true.

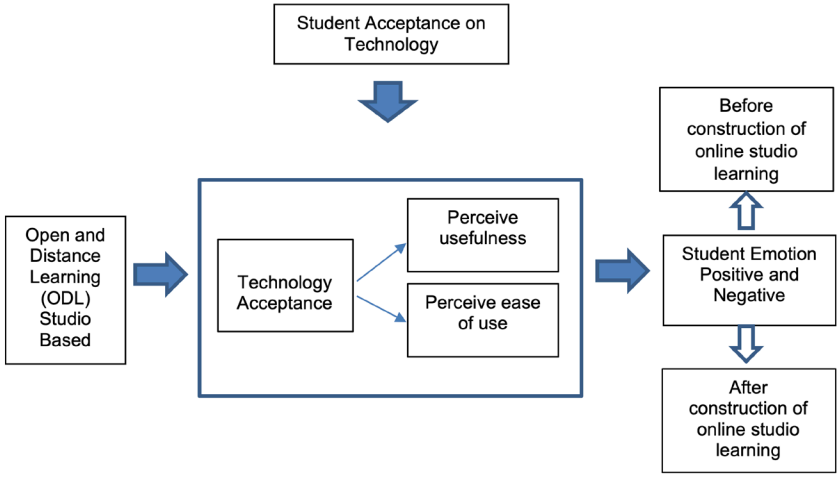


**Fig. 3 Open and Distance Learning (ODL) Studio Based Conceptual Framework proposed**

## CONTRIBUTIONS, LIMITATIONS AND RECOMMENDATION OF THE STUDY

The research makes a significant contribution to the process of teaching and learning, particularly for students who are engaged in studio-based learning or who are studying Art and Design programs. In spite of the fact that open and distance learning (ODL) is of paramount significance in the modern, interconnected world, the teaching and learning procedures associated with the studio subject are severely constrained. This is due to the fact that students participating in Open and Distance Learning (ODL) are restricted in their ability to use the Art and Design workshop and studio equipment to its full capacity. This includes the iron workshop, wood workshop, ceramic workshop, sewing workshop, and lighting studio. Students have a difficult time managing the various pieces of equipment in the studio and the workshop because of this. In addition to this, classroom activities such as workshops and equipment demonstrations that take place online have a smaller impact on students. During the course of studio-based open and distance learning (ODL), this circumstance contributes in a roundabout way to the feelings experienced by the art and design students. This research

has made an effort to address the issue by putting forward a model that is centred on the conceptual framework for Open and Distance Learning (ODL) and has a studio-based setting.

## CONCLUSION

In a broad sense, the primary objectives of this study are to investigate the feelings that art and design students have towards studio online learning while participating in COVID-19. The happiness that students of art and design experience as a result of participating in studio-based online learning can be interpreted as a positive step towards the improvement of studio-based subjects. As a result, the following stage of development, which will take place in the not-too-distant future, will consist of conducting an investigation into the practicability of teaching a studio-based subject in an online setting. In order to achieve the objectives of this investigation, the conceptual framework that has been developed will be utilised. The researcher will then move on to the next stage of the process, which entails determining the mental responses that the students had to the online learning session. The findings of this study will hopefully lead to enhancements being made to online studio classes in the near or distant future.

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# Improving the Use of Lecture Videos to Increase Student Engagement in ESL Blended Learning Classrooms

**Nurul Amilin Razawi[1], Nuruladilah Mohamed[2]*, Mia Emily Abd Rahim[3], Emma Marini Abd Rahim[4]**

*[1,2,3,4]Akademi Pengajian Bahasa, Universiti Teknologi MARA (UiTM), Terengganu, Malaysia*
*nurulamilin@uitm.edu.my,*
**nuruladilah@uitm.edu.my,*
*miaemily@uitm.edu.my,*
*emmamarini@uitm.edu.my,*

**Corresponding Author*

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*Abstract: Online lecture videos in classrooms have been shown to aid learning by delivering information in a variety of formats. However, problems with learning have been discovered when lecture videos were used inappropriately and were of poor quality, potentially reducing student engagement. This study aims to investigate the students' perceptions of using lecture videos in ESL blended learning classrooms and to examine their suggestions for the lecturers to improve the use of lecture videos. The study employed mixed methods research design in which the data collection procedure and data analysis were done following two phases; quantitative and qualitative. A total of (n=146) respondents were involved in answering the questionnaire and written interview. The data gathered from the questionnaire were analysed statistically using SPSS version 28 while the data obtained from the written interview were thematically analysed using Atlas.ti. The quantitative finding showed the respondents' agreement to all items indicating their agreement that lecture videos play significant roles in ESL blended learning classrooms. The qualitative finding revealed four major enhancements suggested by the students. The suggestions were grouped and coded as social media integration, quality*

*and accessibility, content creativity, and feedback assessment. This paper proposes implications for lecturers to improve the use of lecture videos for better student engagement in ESL blended learning classrooms.*

*Keywords: blended learning, educational technology, ESL, lecture videos, student engagement*

## INTRODUCTION

A physical teaching and learning environment is conceivably the better and most effective setting that is still being vastly adopted throughout the institutions of higher learning all around the world. Nonetheless, over the last 30 years, higher education, particularly traditional lectures, have been heavily criticized. To date, blended learning is seen as a good initiative to be incorporated into the existing physical teaching and learning. Blended learning in the ESL context is a combination of traditional face-to-face instruction and online learning. It allows students to learn English in a more flexible and personalized way, as they can access online resources and activities at their own pace and convenience. Blended learning also allows teachers to use a variety of teaching methods and materials to meet the needs of their students.

More specifically, it is the integration of traditional classroom-based instruction with online learning. Video lectures offer a variety of learner/system interactional features that are intended to supplement content delivered in various forms of both auditory and visual media (Alraimi, Zo, & Ciganek, 2015; Breslow et al., 2013). This approach combines the best of both worlds, allowing students to benefit from the convenience and flexibility of online learning while still having access to the support and guidance of a teacher. This approach has been particularly beneficial for ESL students, as it allows them to learn at their own pace and in their own environment, while still having access to the support and guidance of a teacher. Additionally, this approach has allowed for more personalized instruction, as teachers can tailor their lessons to the individual needs of each student.

In ESL blended learning classrooms, a variety of learning tools are used to help students learn English. These tools include online learning platforms, interactive whiteboards, video conferencing, virtual reality, and augmented

reality. Online learning platforms provide students with access to online resources such as videos, audio recordings, and interactive activities. Interactive whiteboards allow teachers to present material in an engaging way and provide students with an interactive learning experience. Video conferencing allows teachers and students to communicate in real-time, while virtual and augmented reality provide immersive learning experiences. All of these tools help to create an engaging and effective learning environment for ESL students.

The incorporation of media into video lectures enables students to process information received via channels of audio-visual communication. Illustrations, images, graphs, maps, animations, videos, slides, and texts are examples of visual media used to increase student attention and engagement with video lectures (Kizilcec, Bailenson, & Gomez, 2015). Meanwhile, auditory media, which includes music, sound effects, spoken text, the instructor's voice, and narration, is intended to increase student engagement (Kizilcec et al., 2015; Mayer, 2014). Hence, lecture videos can be a great tool for ESL blended learning classrooms. They can be used to introduce new topics, provide visual examples of language in use, and help students practise their listening and comprehension skills. Lecture videos can also be used to supplement traditional teaching methods, such as providing additional information on a topic or providing a different perspective on a subject. Additionally, lecture videos can be used to provide a break from traditional classroom activities, allowing students to engage with the material in a more relaxed and enjoyable way. The integration of informative as well as engaging nature of both visual and auditory in a learning environment is beneficial to the enhancement of efficiency necessary in assisting the students' language learning. It is accomplished by organizing information in working memory and transferring it to long term memory. This should ideally result in more schema construction and, as a result, a better understanding of the content (Mayer, 2014).

Even so, it is argued that lecture videos made by lecturers are more effective than those found on YouTube in ESL blended learning classrooms. (Loan, 2021). Lecture videos made by lecturers have several advantages over instructional videos on YouTube. Firstly, lecture videos are typically created by experienced lecturers who have a deep understanding of the subject matter (Alksne, 2016). This means that the content is more likely to be accurate and up-to-date. Secondly, lecture videos are often tailored to the

specific course or topic, making them more relevant and useful for students (Ou et al., 2019). Finally, lecture videos are often accompanied by additional resources such as slides, notes, and other materials, which can help students better understand the material (Kurzweil et al., 2020).

## 1.1 PROBLEM STATEMENT

Online lecture videos in classrooms have been shown to aid learning by delivering information in a variety of formats. However, problems with learning have been discovered when lecture videos were used inappropriately and were of poor quality, potentially reducing student engagement. This can lead to students not understanding the material, not being able to retain the information, and not being able to apply the knowledge to real-world situations. Recent research has shown that students face difficulties in understanding the materials covered in video lectures (Wilton, 2019; Hegarty, 2011). Although video lectures can be a versatile and convenient medium for delivering learning materials, they can also be a challenging option for students due to the lack of face-to-face interaction. As a result, students may struggle to accurately understand and retain the information being presented, resulting in lowered performance on tests and assignments.

Additionally, the lack of interaction between the lecturer and the students can lead to a lack of motivation and engagement in the learning process. This issue was also raised in a study conducted by Loan (2021), in which some participants stated that using lecture videos in flipped learning resulted in a lack of interaction between teacher and student. When there was no face-to-face classroom and they had to watch lecture videos at home, they became lazy, unmotivated, and disoriented. The lack of interaction, motivation, and engagement between lecturers and students when using video lectures is an emerging concern in higher education (Ash, Boozer, Pai & Best, 2017). In such learning contexts, students often lack instructor feedback and meaningful dialogue with peers or instructors

(Koay, Nazzeer & Foong, 2017). Furthermore, video lectures can be passive and can be perceived by students as "dull and unmotivating" (Shabbir & Musavi, 2013). This can lead to a loss of student interest and motivation (Ash et al., 2017).

## 1.2 RESEARCH GAPS

Similarly, through the researchers' role as ESL lecturers, this issue can also be observed among the students who used lecture videos in the ESL blended learning classrooms at a Malaysian public university, in which some students reported that they struggled to understand and retain the lesson being presented, resulting in demotivation to learn and disengagement with the lectures. Therefore, in the dual role of ESL lecturers and researchers, the main purposes of this study were to understand and investigate the use of lecture videos in the ESL blended learning classrooms as well as to propose suggestions for better usage of lecture videos.

Other than that, this study was also conducted because many of the previous studies researched the use of YouTube videos in the ESL context (e.g., Zaidi et al., 2018; Hasan et al., 2018; Bakar et al., 2019; Dinh, 2018; Kabooha & Elyas, 2018, etc.) instead of lecture videos made by lecturers. This area of study is still under-explored and therefore needed to be investigated in this study.

## 1.3 RESEARCH QUESTIONS

This study aimed to seek answers from the following research questions;

1. How do the students perceive the use of lecture videos made by the lecturers in the ESL blended learning classrooms?
2. How should the lecturers improve the use of lecture videos in ESL blended learning classrooms?

## 2. LITERATURE REVIEW

### 2.1 ADVANTAGES OF USING LECTURE VIDEOS IN ESL CLASSROOMS

The use of lecture videos in ESL classrooms has become increasingly popular in recent years. It has been revealed that lecture videos can be used to provide a more engaging and interactive learning experience for ESL students. Studies have shown that lecture videos can be an effective way to engage students and improve their language skills (Deng, 2016; Li, 2016). Integrating lecture videos into classroom lesson plans is a great option for lecturers.

Lecture videos can also be used to supplement traditional classroom instruction, allowing students to review material at their own pace and to review material that was not covered in class. According to Robertson and Flowers (2020), video lectures are valuable and worth the time, but only when they are accompanied by other conventional materials like PowerPoint presentations, handouts, and lecture notes.

Additionally, lecture videos can be used to provide a more personalized learning experience, as students can watch the videos multiple times and pause and rewind as needed. The videos can be particularly helpful for ESL students who are struggling with listening comprehension. Also, lecture videos can provide visual cues that may help ESL students to understand the content of the lecture (Deng, 2016). Similarly, Li (2016) found that using videos in English as a foreign language classroom can improve student learning outcomes.

Among other advantages, it also enables the students to go over material again for a better understanding and improved recall (Copley 2007; Gorissen et al. 2012; Gosper et al. 2010; Traphagan et al. 2010; Zhang et al. 2006). It also enables the students to review for an exam. Furthermore, the availability of lecture videos enables students in both types of classroom settings to generate more comprehensive notes. Students from the in-person class who felt that their notes were incomplete or that they had missed a class might watch a lecture video in their own time and make more thorough notes for study. The

instructor's in-video explanations and demonstrations of various ideas can be used by online students to create notes (Brotherton and Abowd 2004; Luna and Cullen 2011).

## 2.2 CHALLENGES OF USING LECTURE VIDEOS MADE BY THE LECTURERS IN ESL CLASSROOMS

However, there are some drawbacks to using lecture videos made by the lecturers in ESL classrooms. One of the main challenges is that they can be difficult for students to understand. Lecture videos often contain complex language and concepts that can be difficult for ESL students to comprehend.

As stated in Pisarenko (2017), because foreign language is perceived as a complex phenomenon, working with videos is a more complex activity. The simultaneous perception of phonetic, grammatical, lexical, cultural, and other types of materials is what is being considered. It is quite difficult and may present additional difficulties to students and even more so, removing these constraints will take more time. She also added that in some cases, allocated contact hours are insufficient to help students learn a language. Unfortunately, the students' abilities to work independently when learning a foreign language are not fully developed. Students in Malaysian universities spend around 4 hours per week in a formal ESL classroom. Considering the small amount of hours spent to learn all aspects of the language, it is not enough to help them achieve a robust comprehension and fluency. This is especially so when these students are second language learners and already many of them do not possess the proficiency to be regarded as good speakers of the English Language. They lack the skills required to be independent language learners whereas the environment in our learning institutions is not often encouraging and to add to that, only limited time is allocated for most English Language subjects.

Another huge challenge that is faced by the students is technical issues. Such technical issues can arise especially when using videos for educational purposes. Some of the technical issues faced by students or teachers when using videos in learning, involve internet access, technological equipment, issues with copyrights, storage capacity,

compatibility issue, and also the most common; technical glitches. Slow internet connection can result in buffering and can affect the video's quality, making it difficult to follow. This can lead to frustration and a lack of engagement in the learning process. Students would no longer be eager and interested in watching or listening when the video play is constantly interrupted. Another issue is involving the copyrights. Videos used for educational purposes may be subject to copyright laws, which can limit their use. Teachers must first obtain permission for copyrighted material or use public domain images should they want to incorporate them in their lecture videos. This can be tedious, although many are still unaware of the ethical guidelines of using copyrighted materials.

Some widely used platforms such as Zoom and Google Meet are subjected to its allocated storage size, thus limiting the flexibility for sharing across platforms or through different medium. Videos can take up a lot of storage space and may be difficult to share with others (Zhao, 2020). Compatibility issue with learning management systems (LMS) is resulted from having an unstandardized method in addressing different types of LMS individually created by developers, in which some are not user-friendly to other LMS or video applications. Videos created by the lecturers may not be compatible with the institution's learning management system, resulting in difficulties uploading and sharing the videos. Lastly, technical glitches which , despite the technological advances, still frequently occurs. Technical glitches such as video freezing or audio-video synchronization issues can disrupt the learning process (Ke, et al., 2020). Cunningham et al. (2010), also addressed the same concern that when audio is unintelligible, studies have found that it can interrupt the learning process, causing students to go back and replay the audio. Teachers are required to test videos for technical issues before sharing them and provide backup options in case of technical problems. Although this is a common practice, it is still not an excuse for the lack of stability and dependability of any video-making applications or video players.

Apart from that, quality and reliability are some of the constraints in using video lectures. It is essential to ensure that the quality of visual media supports student engagement and, ultimately, learning.

According to Leacock and Nesbi (2007), the learning process is influenced by aesthetics, production values, and overall design. When the students are exposed to poor quality of the visual materials, their comprehension of the material may suffer (Molnar, 2017), of which lecture videos can be difficult to follow for ESL students who are not used to the lecturer's accent or speaking style. Additionally, a decline in concentration brought on by poor video lectures reflects a general decline in interest and focus caused by poor visual media (Molnar et al., 2013).

A specific limitation to using the lecture videos for learning noted by many students was lack of immediate feedback or interaction with the instructor such as there is no one to ask (immediate and non-immediate) questions to, and clarification from. This can lead to a loss of student interest and motivation (Ash et al., 2017). To put it another way, there is a lack of direct, human interaction, which restricts teachers' capacity for nonverbal communication. Combs (2020) cites discussion boards, surveys, and multimedia formats as effective tools for boosting student engagement. Therefore, video lectures must be used in combination with other active learning activities to effectively facilitate meaningful interaction, motivation, and engagement for students (Shabbir & Musavi, 2013).

## 2.3 STRATEGIES TO IMPROVE THE USE OF LECTURE VIDEOS IN ESL CLASSROOMS.

In order to improve the use of lecture videos in ESL classrooms, there are several strategies that can be employed. Brame (2015) mooted that in order for videos to become meaningful educational tools, there are three elements that teachers need to consider when designing and implementing videos; (i) student's cognitive load, (ii) student engagement and (iii) features of active learning.

Since working memory has limited capacity, teachers should try to minimize excessive cognitive load and focus only on the utmost important information (Ibrahim et al., 2012). Mayer (2008) highlighted that lecturers should ensure the language used in the video is appropriate for the level of the students, as part of the non-cognitive elements to improve student engagement. He also mentioned that

lecturers should provide students with a summary of the material covered in the video prior to viewing it, as this can help students to better understand the material. According to Hansch et al. (2015); Hollands & Tirthali (2014); Poquet et al. (2018) as cited in Ou et al., (2019), video lessons frequently include in-video tests or self-evaluation questions to engage students and support their study. Lange & Costley (2020) supported that illustrations, photos, graphs, maps, animations, films, slides, and text are just a few examples of the visual materials used to increase students' interest and engagement in video lectures. Students should also be provided with guiding questions, as proposed by Lawson et al. (2006), that are integrated into the videos to promote active learning, "to help them process the information and to monitor their own understanding" (Brame, 2015).

## 3. RESEARCH METHODOLOGY

### 3.1 RESEARCH SETTING, SAMPLE AND SAMPLING TECHNIQUE

A mixed methods of quantitative and qualitative research design employing a questionnaire to examine the students' perceptions on the use of lecture videos in ESL blended learning classrooms and a written interview to inquire the students' suggestions for the lecturers to improve the use of lecture videos were used in this study. Both methods were conducted between March 2022 to February 2023 over the course of two semesters at a public university in Malaysia. Research participants (n=146) were the students who took English courses which integrated blended learning in the classrooms. They were selected through purposive sampling for this study as they were using lecture videos made by the lecturers during the English blended learning classrooms.

### 3.2 STRATEGIES RESEARCH INSTRUMENTS

#### 3.2.1 QUESTIONNAIRE

For the purpose of this study, an online questionnaire was created with Google forms and distributed to the participants through

WhatsApp and Telegram. The Google forms containing the adapted questionnaire from Galatsopoulou (2022) featured items asking for students' acceptance of using lecture videos in the ESL blended learning classrooms. These items were to answer research question 1 in this study. The incorporated questions were tailored to the needs of the current study. Most of the questions were structured on a five-point Likert scale in terms of agreement or disagreement (1-Totally disagree to 5 -Totally agree). The data from the questionnaire was analyzed using the latest SPSS software version 28.

### 3.2.2 ITEMS RELIABILITY

Reliability statistics was run using SPSS and Cronbach's Alpha was established at $\alpha = 0.974$, i.e., the reliability of the questionnaire was ensured highly reliable.

| Cronbach's Alpha | N of items |
|---|---|
| .974 | 16 |

**Table 1. Reliability Statistics**

### 3.2.3 WRITTEN INTERVIEW SHEET

In order to complement the data, an open-ended question about the students' suggestions for the lecturers to improve the use of lecture videos in the ESL blended learning classrooms was provided in an interview sheet to answer research question 2 in this study. The students' responses were collected through the same Google forms as the questionnaire and analyzed through thematic analysis using Atlas-ti where the responses were group-coded according to the themes to see trends and patterns in the data.

## RESULTS AND DISCUSSION

The data analysis followed two phases; quantitative and qualitative. In the quantitative phase, data collected from the Likert-scale questions were analysed in SPSS using descriptive statistics. The descriptive statistics

revealed students' acceptance of using lecture videos made by lecturers in ESL blended learning classrooms. The results gathered from the questionnaire answered the formulated research questions in the study as follows;

*Research question 1: How do the students perceive the use of lecture videos made by the lecturers in the ESL blended learning classrooms?*

| | N | Minimum | Maximum | Mean | Std. |
|---|---|---|---|---|---|
| Deviation | | | | | |
| 1. Lecture videos are easy to use during the English educational process | 146 | 1 | 5 | 4.30 | .858 |
| 2. Learning how to use lecture videos for English lessons is easy (playback/save/study with texts) | 146 | 1 | 5 | 4.34 | .765 |
| 3. Using lecture videos for English lessons provides flexibility in interaction (i.e., in conversations with lecturers or students) | 146 | 1 | 5 | 4.02 | .958 |
| 4. The use of lecture videos in the English course material gives me more control and flexibility in the study (i.e., I can watch the videos anytime I choose) | 146 | 1 | 5 | 4.39 | .791 |
| 5. I have fun watching lecture videos in English class | 146 | 1 | 5 | 4.28 | .828 |
| 6. Using lecture videos for English lessons is a pleasant experience | 146 | 1 | 5 | 4.19 | .873 |
| 7. Watching lecture videos in English class makes me look for creativity | 146 | 1 | 5 | 4.08 | .898 |
| 8. Watching lecture videos in English class makes me feel imaginative, sparks my imagination, and gives me ideas | 146 | 1 | 5 | 4.15 | .912 |
| 9. The use of lecture videos for English lessons is effective in achieving learning goals | 146 | 1 | 5 | 4.18 | .871 |

| | N | Minimum | Maximum | Mean | Std. |
|---|---|---|---|---|---|
| 10. The use of lecture videos for English lessons contributed significantly to the acquisition of relevant knowledge in the speaking, listening, reading and writing skills | 146 | 1 | 5 | 4.24 | .833 |
| 11. Watching lecture videos in English class helps me complete my assignment faster | 146 | 1 | 5 | 4.22 | .913 |
| 12. Watching lecture videos for English lessons improves the quality of my understanding of English subject | 146 | 1 | 5 | 4.21 | .846 |
| 13. If I need help watching lecture videos in English class, there are sources available to help | 146 | 1 | 5 | 4.25 | .827 |
| 14. I have the necessary technical tools (computer, mobile phone, internet access) to watch lecture videos in English class | 146 | 1 | 5 | 4.37 | .847 |
| 15. In the future, I will continue to use lecture videos during my English study | 146 | 1 | 5 | 4.22 | .867 |
| 16. In the future, I will continue to participate in discussions about the lecture videos shown in the English class | 146 | 1 | 5 | 4.23 | .822 |

**Table 2. Frequency distribution on the student's acceptance of using lecture videos made by the lecturers in the ESL blended learning classrooms**

Table 2 shows the frequency distribution on the students' acceptance of using lecture videos made by the lecturers in the ESL blended learning classrooms. 16 items show minimum values of 1 indicating that there was a respondent who totally disagreed with the items of acceptance of using lecture videos made by the lecturers in the ESL blended learning classrooms. In total, the maximum value shows respondents' agreement to all items indicating their agreement that lecture videos play significant roles in the English blended learning classrooms.

The finding confirms what was found from a bigger scale study by Ou et al. (2019), in which the students' perceptions of video effectiveness significantly predicted their perceptions of the course's overall effectiveness, indicating that lecture videos are critical to the success of an online course. The results indicated that students liked the lecture videos because they are interactive, easy to understand, interesting, and relevant.

A similar finding was found in a study that was conducted by Loan (2021), in which it was also discovered that all interviewees in the study agreed that instructional videos play an important role in their online learning. In this study, the students' responses were coded into 10 advantages of lecture videos which include learning autonomy, motivation and engagement in online learning, learning at one's own pace, self-directed learning, the flexibility of learning and accessing lecture videos, etc.

Therefore, it is inevitable that lecture videos are critical to the success of online/blended learning because they provide students with a visual representation of the material being taught. They also allow students to review the material at their own pace and can be used as a reference for future learning. Lecture videos can also help to engage students in the learning process and provide a more interactive learning experience.

| | **Questionnaire item** | **Mean score** |
|---|---|---|
| Item 4 | The use of lecture videos in the English course material gives me more control and flexibility in the study (i.e., I can watch the videos anytime I choose) | 4.39 |
| Item 14 | I have the necessary technical tools (computer, mobile phone, internet access) to watch lecture videos in English class | 4.37 |
| Item 2 | Learning how to use lecture videos for English lessons is easy (playback/save/study with texts) | 4.34 |
| Item 1 | Lecture videos are easy to use during the English educational process | 4.30 |

**Table 3. Questionnaire items with the highest mean scores**

From the 16 items of acceptance of using lecture videos made by the lecturers in the ESL blended learning classrooms listed in the questionnaire, some of the items are regarded highly acceptable by the respondents, as most of the mean scores are over 4.00. The items with the highest mean scores were found in item 4, 14, 2 and 1.

As depicted in Table 3, the students mostly agreed that the learning is more flexible where they can watch the lecture videos anytime that they prefer. The analysis of item 4 validates the finding that was discovered by Ishak et al. (2020), in which it was found that the asynchronous online video lectures allow students to access the lesson at any time, any place, and as many times as they want. Students are empowered to choose what they will focus on and how much time they will spend learning the contents or watching video lectures both inside and outside the classroom. Furthermore, the analysis of item 14 supports the discovery made by Galatsopoulou et al. (2022) that technical parameters (computer, mobile phone, internet access, headphones) are not impediments to the process of video-based and video-assisted active learning, particularly lecture videos. Moreover, the analysis of items 1 and 2 corroborates the finding made by Nouri (2016), who discovered that when examining the students' experiences with lecture video as a learning tool, a number of reasons for appreciating video emerged. The students strongly agreed that being able to pause, rewind, and fast-forward the video was useful for their learning.

The use of lecture videos was a phenomenon especially in online learning during the Covid 19 pandemic. However, it is still applicable in the current situation where lecture videos are still being used in the ESL blended learning classrooms. Lecture videos can be a flexible learning tool for students because they can be accessed at any time and from any location. This allows students to watch the videos at their own pace and on their own schedule. Lecture videos can also be paused, rewound, and replayed as needed, allowing students to review material as often as they need to. In terms of technical tools to use with the lecture videos, it could be observed that ever since the pandemic, the majority of students have better internet access. This could be attributed to modern improved connections, whether via landlines or Wi-Fi. Similarly, to watch lecture videos with video quality, modern productions include high-quality audio, even in the form of surround-sound techniques, which can be played back using classroom

equipment or inexpensive headphones. As a result of the findings, using lecture videos during ESL blended learning sessions is not hampered by technical tools.

In the qualitative phase, the results gathered from the written interview answered the formulated research questions in the study as follows;

*Research question 2: How should the lecturers improve the use of lecture videos in ESL blended learning classrooms?*

A total of 146 students responded to the open-ended question about suggestions for the lecturers to improve the lecture videos. 80 students (54.8%) responded that the lecture videos were excellent and that no changes were required. The remaining 66 responses were thus coded. Thematic data analysis method was employed using Atlas.ti software to identify, analyse, and document themes and codes from the open-ended question in the questionnaire. The data coded is as illustrated in Table 4;

| Code | Frequency | Explanation | Illustrative Note |
|---|---|---|---|
| Social Media Integration | 6 | Lecture videos are linked to variety of social media platforms | S10: Use easier platforms such as Youtube<br><br>S91: Use Microsoft Teams for better experience<br><br>S102: Using Tiktok |
| Quality & Accessibility | 27 | Ease-of-use, duration/ length, video features | S123: in my opinion, should improve video quality and have good sound<br><br>S107: Insert subtitle, interesting media and clear audio |

| | | | |
|---|---|---|---|
| Content & Creativity | 19 | Interactive, fun, engaging and interesting content | S61: In my personal opinion, lecturers should include more graphics in the video/slides to make it more interesting and fun.<br><br>S98: By using visuals colours, images and animations. |
| Feedback & Assessment | 14 | Rooms for students to ask questions and test their knowledge & understanding of the videos | S12: Test knowledge with quizzes and self-assessment<br><br>S76: In my opinion, lecturers can make a activity like quiz |

**Table 4. Students' suggestions for the lecturers to improve the lecture videos: Code, frequency, explanation and illustrative note**

Students expressed the points that needed to be taken into consideration during the use of lecture videos in the future as can be found in the following themes;

**i) Social media integration**

Students emphasized this theme based on the suggestions of how they could benefit from the lecture videos and receive meaningful language learning experiences. Social media integration of lecture videos such as YoutTbe and TikTok can be a beneficial component of ESL blended learning classrooms, as it allows lecturers to extend learning to the online environment and create a meaningful language learning experience for the students. Some student statements in this regard are as follows.

*S10: "Use easier platforms such as Youtube"*

*S102: "Using Tiktok"*

It can be seen that the availability of social media sites has had a major impact on the ESL blended learning experience, allowing lecturers to provide students with instructional videos that are easily accessible. This type of benefit can enhance the learning experience by offering helpful cues and additional practice for language learners (Plonsky, 2020). The suggestions by the students also validate the study of Hall & Nguyen (2018) stating that through social media, the lecture videos can provide students with the opportunity to review and revisit lesson material and activities in an engaging format outside of the classrooms. By making lecture videos available through social media, students can interact with the material and course content at their own pace and in their own time, allowing lecturers to manage long-term learning objectives, explore more in-depth concepts, and increase overall comprehension (Vilar and Kostagiolas, 2019).

*S91: "Use Microsoft Teams for better experience"*

Additionally, lecturers can create groups through social media channels such as Microsoft Teams as suggested by S91 to manage interaction and communication between the lecturer and the students, allowing them to provide feedback on the lecture videos and keep discussion threads alive during and after lecture sessions (Vilar and Kostagiolas, 2019). As cited in Combs (2020), multimedia formats can also become effective tools for boosting student engagement along with the lecture videos. Therefore, the video must be used in combination with other active learning activities and platforms to effectively facilitate meaningful interaction, motivation, and engagement for students (Shabbir & Musavi, 2013).

**ii) Quality & accessibility**

This theme is one that received the majority of the suggestions. Students believed that videos used in the learning process enriched by quality and accessibility helped to improve the lecture videos in the classrooms. This is especially important in ESL classrooms as the quality of the material can influence the quality of learning outcomes (Wang & Liu, 2018). The theme of quality and accessibility is composed of the following explanations: "ease-of-use, "duration/

length", and "video features". Students stated that lecture videos should be improved in terms of their quality and audio clarity since they aroused interest and prevented boredom. A student's explanation in this regard is as follows.

*S123: "in my opinion, should improve video quality and have good sound"*

This suggestion above represents the belief that videos should be of good quality as it associates with the students' learning experience. Studies have found that high quality video is essential to learning success (Kim et al., 2017). Recent research has shown that utilizing lecture videos in ESL classrooms can have a significant impact on the education of students by promoting engagement, increasing collaboration, and improving the overall quality of learning (Fang & Chiang, 2017). With the increased use of video lectures in ESL classrooms, it is important to consider the video and audio quality of the lectures. In order to ensure that the lecture videos being utilized in ESL classrooms provide the best learning experience possible, it is important to ensure the videos are of the highest quality. This means using the best quality equipment and software available to ensure the video is clear and the sound is at an appropriate level. In addition to high quality video, having clear and crisp audio is essential for students to fully understand and benefit from video lectures (Kim et al., 2017). It might be challenging for students to fully understand what is being said if the sound is distorted or muffled, which makes learning more challenging for them. To reduce the risk of this issue, it is important to use good sound equipment and to carry out regular sound checks throughout each video to ensure the audio is clear and is at an appropriate volume which will help to ensure that students get the most out of their educational experience.

*S107: "Insert subtitle, interesting media and clear audio"*

Additionally, students also emphasized on the interesting media and subtitles to improve on their comprehension of the subject as suggested by S107. To achieve their full potential, it is essential that lecture videos be of the highest quality and be easily accessible. It is therefore

important for lecturers to ensure that their lecture videos meet these criteria to enable improved learning outcomes for their students. This is similar to the previous study conducted by Umsetzung (2018) in which the asynchronous nature of video lectures reduces the sense of pressure that may accompany in-class discussions and allows learners to view and review instructional videos at their own pace. By providing learners with the option to take a pause and rewatch the lecture of the video, lecturers can ensure the easy access of the videos and help the students to gain a better understanding of the material. Additionally, videos can be used to supplement, rather than replace, the in-class work by allowing instructors to cover material more efficiently and without sacrificing quality (Kuhle, 2020). Additionally, the quality and easy accessibility of the lecture videos help in sustaining students' interest and engagement of the subject.

**iii) Content & creativity**

In general, including graphics in videos and slides when teaching in the classroom can provide numerous advantages in different perspectives. By doing this, it provides context, increases accessibility, increases creativity, appeals to younger generations, enhances learning retention, increases engagement, facilitates understanding, and appeals to different learning styles. Students highlighted the inclusion of more graphics, colors, and animations in the video to make it more engaging. Several statements from the students can be quoted as follows.

*S61: "In my personal opinion, lecturers should include more graphics in the video/slides to make it more interesting and fun"*

S98: "By using visuals colors, images and animations"
In general, using these elements in lecture videos will make it more appealing to the younger generations. Younger generations have grown up with technology and are often more visually oriented in their learning preferences. Including graphics in videos can cater to this preference and make learning more relatable and relevant to students (Bates, 2015). Using colors, images, and animations enhances learning retention. According to the dual-coding theory, learners

process information better when it is presented in both visual and verbal formats. Incorporating graphics in videos can aid to visual learning and improve the retention of information.

Moreover, as pointed out by Mayer (2014), incorporating graphics in videos can make the learning experience more engaging and enjoyable for students. It can break the monotony of just listening to a teacher speak, which can lead to student disengagement. Graphics can provide context to the information being presented in the video. This makes sense because visual images aid in helping the information to be received more effectively. For instance, when explaining about a theory, learners would understand better if it is accompanied with visual imagery to represent the said theory. It can help students understand how different pieces of information relate to each other and can create a more cohesive learning experience (Mayer, 2014).

**iv) Feedback & assessment**

Lecture videos can provide rooms for students to ask questions and to test their knowledge and understanding of the videos. Overall, these strategies can provide multiple opportunities for students to ask questions and test their understanding of the material. By incorporating interactive features, discussion forums, and assignment feedback, instructors can create a more engaging and interactive learning experience for their students. Referring to the interview responses from the students, some excerpts mentioned the details as seen below.

*S12: "Test knowledge with quizzes and self-assessment"*

*S76: "In my opinion, lecturers can make an activity like quiz"*

Some lecture video platforms let teachers incorporate interactive elements like tests or polls right into the presentation (Hsin & Cigas, 2013). Lecture video platforms often have interactive features such as quizzes, polls, or other activities that can be embedded within the video. These features can be used to test students' understanding of the material and provide immediate feedback. For example, instructors can pause the video and ask students to answer a multiple-choice question

related to the material. The students' responses can be immediately graded and displayed on the screen. This allows students to see how well they understand the material and identify areas where they need to review.

Discussion forums are online spaces where students can post questions or comments about the material and engage in dialogue with their peers and instructors. Discussion forums can be utilized as a virtual forum for students to ask questions or make comments on the course material and interact with other students and teachers (Hew & Cheung, 2014). Instructors can post questions related to the lecture video and ask students to respond. This can help to clarify students' understanding of the material and encourage them to engage with the course content. In addition, students can post their own questions or comments and receive feedback from their peers and instructors. This can create a sense of community among students and help them to feel more connected to the course.

Lecture videos should also be used to provide a platform for assignment feedback. Assignments connected to the lecture video material can be utilized to assess students' comprehension of the subject and offer tailored criticism on their performance (Brame, 2016). Assignments related to the lecture video material can be used to test students' understanding of the material and provide personalized feedback on their performance. For example, instructors can assign a quiz or essay related to the lecture video and provide feedback on the students' performance. This can help to identify areas where students may be struggling and provide suggestions for improvement. In addition, instructors can use the assignment feedback to guide their instruction and identify areas where they may need to provide additional support.

## CONCLUSION

In conclusion, using lecture videos made by the lecturers in the ESL blended learning classrooms was found to be effective. The quantitative finding from this study points out the students' agreement that lecture videos play significant roles in blended learning. In addition, the qualitative finding identifies four major suggestions by the students. The suggestions were

grouped and coded as social media integration, quality and accessibility, content creativity, and feedback assessment. However, this study has some limitations. The sample size is small, so the findings cannot be generalized due to the small sample size and the population, which is limited to the students at that specific Malaysian public university. A larger sample size could have resulted in more accurate quantitative results. Furthermore, more open-ended questions in the written interview could be added to elicit more responses and supplement data. Aside from that, the research design used to achieve the objectives of the study is a combination of quantitative and qualitative methods, with only questionnaire and written interview question serving as instruments. In this study, no quasi-experimental research design was used to investigate the use of lecture videos among students. Future research on the acceptance and perceptions of students' use of lecture videos in ESL blended learning classrooms should address these limitations.

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# Career Awareness, Skills and Acceptance of Multimedia in Teaching and Learning, Malaysia: An Expansion of the UTAUT Model

**Siew King Ting[1]* and Tze Wee Lai[2]**
*[1]Faculty of Business and Management, Universiti Teknologi MARA, Cawangan Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*
*tings036@uitm.edu.my*
*[2]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Cawangan Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*
*laitzewee@uitm.edu.my*
**Corresponding Author*

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*Abstract: Various information communication and technology (ICT) are used in teaching, learning and research collaborations in the higher learning institutions for the human capital development. Using the extended Unified Theory of Acceptance and Use of Technology (UTAUT) model, this paper aims to examine the determinants of the acceptance on the use of multimedia in learning among graduates who took economics related subjects in UiTM Cawangan Sarawak. The data was analysed using Partial Least Square (PLS) and Structural Equation Modelling (SEM). Our results show that out of five constructs, the new variable, namely career awareness, had the largest effect on the behavioural intention of using multimedia in learning among students. The moderating variables such as gender and age did not have any influence, while hard skills and soft skills had influence on the behavior of students. Several policies are recommended to further improve the determinants of the acceptance on the use of multimedia in the higher learning institutions.*

*Keywords: Career awareness, UTAUT model, PLS-SEM, hard skills, soft skills*

## INTRODUCTION

The information communication and technology (ICT) are used extensively in teaching, learning and research collaborations in the higher learning institutions worldwide. In particular, instructors and university students use ICT on a daily basis to engage in innovative teaching and learning methods, which are essential in nurturing and developing human capital (Ting et al., 2021, 2020). Among others, these include virtual classroom, mobile learning application, Moodle learning management system, blogs, social networks, WhatsApp, webinar system, online learning, and digital technologies (Sari et al, 2022; Yeboah and Nyagorme, 2022).

The empirical findings on the acceptance of the use of ICT in teaching and learning are very positive, where ICT has become common practice in higher learning institutions. However, there are several challenges of teaching and learning faced by the various stakeholders of universities in Malaysia. Firstly, there is skill requirement mismatch between employers and university students in the labour market especially after the evolution of the Industrial Revolution 4.0 (Rodzalan et al., 2022). Employers often discover insufficient soft skills among university graduates (Sujova et al., 2021). In recent decades, employers seek after university graduates that demonstrate both hard skills and soft skills at the workplace.

Secondly, the use of ICT has become every part of the academic assessment in the higher learning institutions worldwide. The government and university have invested heavily on the ICT for the human capital development. The ICT are used in online teaching and learning activities such as conducting lectures and meetings, doing academic assessments such as examination and grading, and conducting research and attending online conferences. Nonetheless, there are various report of issues and challenges on the use of ICT in universities such as lack of management, dilapidated infrastructures, and limited fundings (Sirat and Wan, 2022; Yeap et al., 2021).

Thirdly, career awareness motives and drives undergraduates to explore various innovations and creativity in their studies. Scholars discover

that undergraduates could re-orient or change their career choices if undergraduates have better command of ICT (Bennett et al., 2021; Tsakissiris and Grant-Smith, 2021). In addition, many undergraduates are reported as not having good career awareness especially in developing countries, due to various factors such as low students' abilities and career aspirations, limited use of ICT, restricted cultural values, poor career guidance, limited parental support and other environmental factors (Bennett et al., 2021; Qiu et al., 2017). These factors restrain career awareness and motivation toward career choice after graduation by university students.

There is burgeoning literature of the use of ICT on teaching and learning in higher learning institutions in Malaysia. Among others, these empirical studies focus on the Google classroom (Sari et al., 2022), online learning (Yunus et al. (2021)) and augmented reality (Nizar et al., 2019). These empirical studies are conducted for various academic subjects and generated mixed findings. Ting et al. (2022, 2021, 2020) conducted a serial of empirical studies in Malaysia on the innovative teaching and learning methods in economics related subjects. However, the above existing empirical studies in Malaysia do not incorporate career awareness, hard skills and soft skills-all of which are important elements that motivate students in their learning activities.

Thus, this study further expands the existing literature by focusing on the determinants of the acceptance of ICT on the learning experience in a specific subject, namely economics. In particular, the objective of this paper is to examine the factors that influence the acceptance of use of multimedia in learning economic concepts by undergraduates in UiTM Cawangan Sarawak, Malaysia by using the UTAUT model.

The rest of the paper is divided into four main components. Section 2 provides a synoptic review of the scholarly literature by focusing on theoretical background and hypotheses development. Section 3 outlines the methodology used in the study. Section 4 discusses the empirical results. The paper ends with concluding remarks in Section 5.

## 2. LITERATURE REVIEW

### 2.1 THEORETICAL BACKGROUND

The original UTAUT model was introduced by Venkatesh et al. (2003). Venkatesh et al. (2003) reviewed eight existing theories in order to develop a unified model. The original UTAUT model consists of four main constructs namely: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC) and four moderating variables: age, gender, experience and voluntariness of use.

In this paper, the extension of the UTAUT model is Career Awareness (CA) as the independent variable. Career awareness plays an important role in influencing student's preference of using ICT for academic assessment. In addition, we replaced the moderating variables of experience and voluntariness of use by hard skills (HS) and soft skills (SS), due to the requirement and suitability of HS and SS to complete the project by the students.

### 2.2 HYPOTHESIS DEVELOPMENT

The original four constructs and four moderating variables, as mentioned above, will not be elaborated in detail in this paper. The empirical findings of these studies are mixed. (See excellent literature review by Alshref et al. (2021), Mohebi (2021) and Nizar et al. (2019) on the use of ICT in teaching and learning using UTAUT model for additional insight). The new construct, namely Career Awareness (CA) and two new moderating variables which are hard skills (HS) and soft skills (SS) will be explained in detail in this paper.

Following Venkatesh et al. (2003), we briefly summarise the extended UTAUT model. PE refers to the extent of an individual's perception regarding the usefulness of the system in performing the tasks. EE refers to the extent of an individual's perception concerning the ease of using a system. SI refers to the reflection of peers, instructors, important people, and friends' perception regarding technology on the user's BI. FC refers to the availability of adequate support and resources such as organizational and technical infrastructure for the

proper use of technology. BI refers to the degree of intention to use IT. In general, these constructs positively influence the BI and UB of ICT in teaching and learning. Thus, the following hypotheses are proposed by the authors based on the review of the above literature:

H1: Performance Expectancy (PE) positively influences Behavioural Intention (BI).
H2: Effort Expectancy (EE) positively influences Behavioural Intention (BI).
H3: Social Influence (SI) positively influences Behavioural Intention (BI).
H4: Facilitating Conditions (FC) positively influences Use Behaviour (UB).
H5: Behavioural Intention (BI) positively influences Use Behaviour (UB).

We included a new construct namely Career Awareness (CA) to seek it influences the use of ICT in learning economic concepts. CA refers to the process of developing a comprehensive understanding of possible career opportunities which are influenced by various elements such as interest, skills and talents, job outlook, personal preferences, and relevant academic qualification (Bennett et al., 2021; Tsakissiris and Grant-Smith, 2021). The career awareness motivates and drives students to explore innovations and creativity which are largely driven by ICT. Thus, students tend to learn and improve their ICT skills for their academic performance and career readiness. Scholars have discovered that students could re-orient their careers if they know more about ICT and are able to integrate them in multiple disciplines. Thus, the following hypothesis is proposed by the authors based on the review of the literature:

H6: Career Awareness (CA) positively influences the Behavioural Intention (BI).

The standard moderating variables as reported in the UTAUT literature include age and gender. (See Sari (2022), Maican (2021) and Khechine (2014) for details of the empirical analyses of the age and gender on the BI and UB in the teaching and learning experience).
As for the moderating variables, the proposed hypotheses are:

H7: Age moderates the relationship between Performance Expectancy (PE) and Behavioural Intention (BI).
H8: Age moderates the relationship between Effort Expectancy (EE) and Behavioural Intention (BI).
H9: Age moderates the relationship between Social Influence (SI) and Behavioural Intention (BI).
H10: Age moderates the relationship between Career Awareness (CA) and Behavioural Intention (BI).
H11: Age moderates the relationship between Facilitating Conditions (FC) and Use Behaviour (UB).
H12: Gender moderates the relationship between Performance Expectancy (PE) and Behavioural Intention (BI).
H13: Gender moderates the relationship between Effort Expectancy (EE) and Behavioural Intention (BI).
H14: Gender moderates the relationship between Social Influence (SI) and Behavioural Intention (BI).
H15: Gender moderates the relationship between Career Awareness (CA) and Behavioural Intention (BI).
H16: Gender moderates the relationship between Facilitating Conditions (FC) and Use Behaviour (UB).

There are two new moderating variables that are included in this paper, namely: (a) hard skills and soft skills. The following sub-section explains the importance of these moderating variables in the online learning experience in higher learning institutions.

Hard Skills (HS) refer to discipline related or technical skills associated with a specific program of study or career field (Sunismi et al., 2022). For example, these skills include teaching skills, architecture skills, graphic design skills, and programming skills. Hard skills are learnable and typically measured by academic or professional examination results. The command of hard skills enables undergraduate students to use ICT either online or offline easily in performing their academic assessments. Alagu and Thanuskodi (2018) and Sayaf et al. (2022) discovered that hard skills such as ICT skills and knowledge were important to their academic performance in India and Saudi Arabia respectively.
Thus, the following hypothesis is proposed by the authors based on the review of the literature:

H17: Hard Skills (HS) moderates the relationship between Performance Expectancy (PE) and Behavioural Intention (BI).
H18: Hard Skills (HS) moderates the relationship between Effort Expectancy (EE) and Behavioural Intention (BI).
H19: Hard Skills (HS) moderates the relationship between Social Influence (SI) and Behavioural Intention (BI).
H20: Hard Skills (HS) moderates the relationship between Career Awareness (CA) and Behavioural Intention (BI).
H21: Hard Skills (HS) moderates the relationship between Facilitating Conditions (FC) and Use Behaviour (UB).

Soft Skills (SS) are transferable and non-technical skills which are applicable to all careers. Soft skills are typically associated with behaviors and personality traits of a person. For example, soft skills include critical thinking skills, problem solving skills, time management skills, and interpersonal skills. University students with excellent soft skills are highly sought by employers in the labour market. Most higher learning institutions incorporate soft skills elements in the academic curriculum and co-curriculum to improve the employability of students (Martin el. Al., 2023; Jainah et al., 2022). Students with good soft skills are reported to be more co-operative, employable, and productive (Attri and Kushwaha, 2018; Rodzalan and Jasman, 2022). However, Betti et al. (2022) discovered that innovative flipped classroom did not improve or worsen students' performance in terms of hard and soft skills.

Thus, the following hypothesis is proposed by the authors based on the review of the literature:
H22: Soft Skills (SS) moderates the relationship between Performance Expectancy (PE) and Behavioural Intention (BI).
H23: Soft Skills (SS) moderates the relationship between Effort Expectancy (EE) and Behavioural Intention (BI).
H24: Soft Skills (SS) moderates the relationship between Social Influence (SI) and Behavioural Intention (BI).
H25: Soft Skills (SS) moderates the relationship between Career Awareness (CA) and Behavioural Intention (BI).
H26: Soft Skills (SS) moderates the relationship between Facilitating Conditions (FC) and Use Behaviour (UB).

## 3. METHODOLOGY

### 3.1 RESEARCH MODEL

The unified theory acceptance and use of technology (UTAUT) model was extended and modified to explore the factors that influenced the BI and UB of students on using multimedia to explain economic concepts. The UTAUT model is able to predict 69 percent of the variance in the BI (Venkatesh et al., 2003). Thus, the UTAUT model is more preferable to study the acceptance of students on using multimedia to explain the economic concepts. The original UTAUT model consists of four main constructs namely: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC) and four moderating variables: age, gender, experience and voluntariness of use. In this paper, the extension of the UTAUT model was Career Awareness (CA) as the independent variable. In addition, we replaced the moderating variables of experience and voluntariness of use by hard skills (HS) and soft skills (SS), due to the requirement and suitability of HS and SS to complete the project by the students.

### 3.2 DATA COLLECTION AND INSTRUMENTATION

The sample used in this study included the students who took economics related subjects, namely economics (ECO415) and Macroeconomics (ECO211) in Universiti Teknologi MARA Cawangan Sarawak (UiTMCS). The students were required to complete a project which was to self-produce a short video clip to explain the economic concepts as part of their academic assessment for the semester of October 2019-Jan 2020. The economic lecturers explained to the students about the requirement and processes of conducting the project beginning of the semester.

The students answered a set of questionnaire at the end of the semester about the acceptance of using multimedia to explain the economic concepts. A total of 89 respondents participated the questionnaire, where 66 respondents were female and 23 students were male.

The scale for measuring the constructs was based on a set of 5-points Likert Scale. The responses for analysis were collected from 89 respondents via the manual questionnaire. The scale of "1 = Least Agree", "2 = Slightly Agree", "3 = Neutral", "4 = Agree", and "5 = Fully Agree" were used to indicate the level of agreement based on the items in the questionnaire. There was a total of 34 items included in the questionnaire, as listed in Table 1.

| Constructs | Indicators | Items |
|---|---|---|
| Performance Expectancy (PE) | PE1 | The project enhances my understanding of economic concepts. |
| | PE2 | The project improves my application of economic concepts in my daily activities. |
| | PE3 | The project helps me to improve my academic performance. |
| | PE4 | The project helps me to achieve the learning outcome of my course. |
| Effort Expectancy (EE) | EE1 | I understood the concepts easily through the short video clip production. |
| | EE2 | I am more able to retain the economic concepts easily through the short video clip production. |
| | EE3 | I can apply economic concepts with real-life examples easily through the short video clip production. |
| | EE4 | I find that it is easy to complete the project. |
| Social Influence (SI) | SI1 | My peers have been supporting me to produce a short video clip. |
| | SI2 | My lecturers have been supporting me to produce a short video clip. |
| | SI3 | My local community have been supporting me to produce a short video clip. |
| Facilitating Conditions (FC) | FC1 | I have the hardware to produce a short video clip. |
| | FC2 | I have the software to produce a short video clip. |
| | FC3 | I can access the venue of the video shooting easily. |
| | FC4 | I have hardware and software support from the university to produce a short video clip. |
| | FC5 | I have enough time to complete the short video clip production. |

| | | |
|---|---|---|
| Career Awareness (CA) | CA1 | I am aware of career options in the film and creative industries. |
| | CA2 | I am aware of the importance of creativity and intellectual property. |
| | CA3 | I am aware and appreciate film as an art form. |
| | CA4 | I would like to work in the film industry in the future instead of economic-related industries such as finance, banking, retailing and management. |
| Behavioural Intention (BI) | BI1 | I prefer acting to face-to-face lectures when learning economic concepts after the project. |
| | BI2 | I prefer acting to watching movies/films/videos when learning economic concepts. |
| | BI3 | I prefer acting to reading textbooks/tests/quizzes when learning economic concepts. |
| | BI4 | I prefer acting to writing assignments/term papers when learning economic concepts. |
| | BI5 | I would like the same project to be continued for the next semester. |
| Use Behaviour (UB) | UB1 | The project is useful. |
| | UB2 | I became more interested in the course after completing the project. |
| | UB3 | I participated actively in the classroom discussion after completing the project. |
| Hard Skills (HS) | HS1 | I know how to use technology to complete the project. |
| | HS2 | I know how to use financial knowledge to complete the project. |
| | HS3 | I know the local socio-culture to complete the project. |
| Soft Skills (SS) | SS1 | I can reflect on various aspects to complete the project. |
| | SS2 | I am capable to use creativity to complete the project. |
| | SS3 | I can manage emotional intelligence to complete the project. |

**Table 1 Items of Questionnaire**

## 3.3 RESEARCH METHOD

The partial least squares structural equation modeling (PLS-SEM) is applied to explore the interrelation among the exogenous and endogenous latent variables, as shown in Figure 1. PLS-SEM is a second-generation technique in multivariate analysis which enables researchers to develop theories in exploratory research (Hair et al. 2016). The use of PLS-SEM is not required for the normality assumption on the data but this method could perform a high level of

statistical power with a small sample size (Hair et al., 2016). The PLS-SEM could handle complex models with several integrated relations and moderating effects, which were the goals of this study. The PLS-SEM was performed in two stages: namely the measurement model and followed by the structural model. All the analyses were carried out by using a software named SmartPLS version 3.3.3.

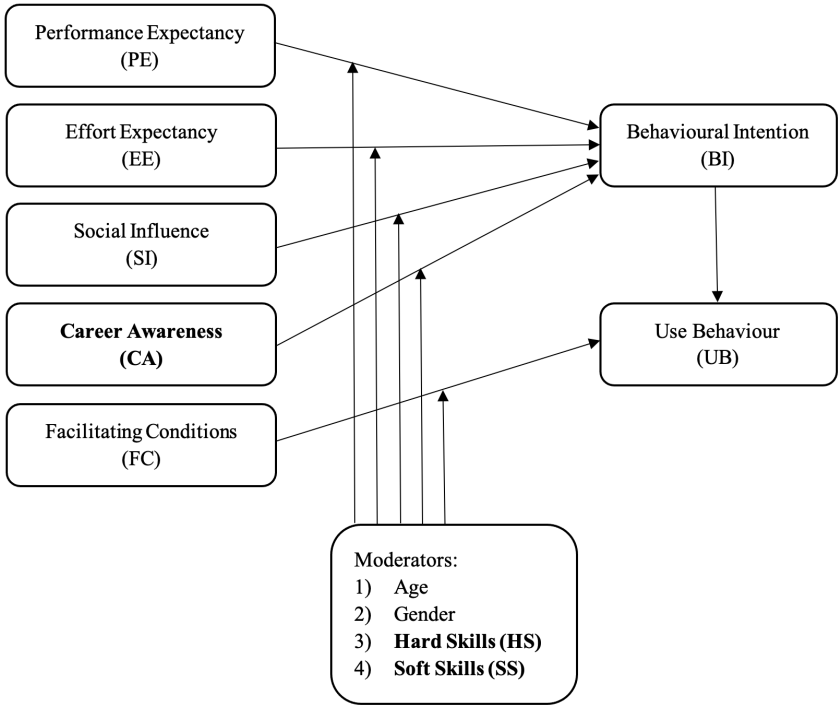


**Fig 1: The Conceptual Model**

*Note: Career awareness, hard skills and soft skills are new variables.*

## 4. RESULTS AND DISCUSSIONS

### 4.1 MEASUREMENT MODEL

The first stage of data analysis was to assess the measurement model which was also called the outer models. In this study, all the exogenous latent variables and endogenous latent variables were reflective measurement models. The relationship between all the constructs and their reflective indicators were determined through outer loadings (individual indicator reliability), internal consistency (Cronbach's alpha and composite reliability), convergent validity (average variance extracted), and discriminant validity.

The acceptable reliability of the indicators could be determined initially through the outer loadings which was preferably more than 0.708 (Hair et al., 2019). Meanwhile, the weaker outer loadings ranged between 0.4 to 0.7. The indicators could be retained if the exclusion did not elevate the value of composite reliability (CR) and to avoid the reduction in validity. Therefore, the indicators of EE4 (0.621), FC4 (0.633) and BI5 (0.588), as depicted in Table 2, were maintained as the deletion of these indicators did not exhibit a sharp rise in the value of CR and also retained the validity of the data.

For internal consistency, the interpretation for both Cronbach's alpha and composite reliability (CR) was the same. If the value was more than 0.7, the Cronbach's alpha and CR of the indicators were considered acceptable and satisfactory (Taber, 2017; Hair et al., 2019). Meanwhile, the CR value of more than 0.95 was not advisable, as it reflected the redundancy of all the reflective indicators. The results of all the constructs were reliable because the scale of Cronbach's Alpha was between 0.737 and 0.878, as demonstrated in Table 2. The CR also showed that the value varied from 0.834 to 0.914, which denoted that all the constructs were reliable.

The average variance extracted (AVE) could be used to measure the convergent validity for all the latent variables (Benitez et al., 2020). Any constructs with an AVE greater than 0.5 was acceptable, as it denoted that more than 50% of the variance for all the indicators could be explained by the respective construct (Hair et al., 2019). Table 2 reported that all the constructs' AVE was more than 0.5, which have fulfilled the rule of thumb for the convergent validity.

| Indicatorts | | Outer Loadings | Mean | SD | Cronbach's Alpha | CR | AVE |
|---|---|---|---|---|---|---|---|
| PE | PE1 | 0.826 | 3.888 | 0.785 | 0.865 | 0.907 | 0.710 |
| | PE2 | 0.842 | 3.730 | 0.871 | | | |
| | PE3 | 0.867 | 3.753 | 0.838 | | | |
| | PE4 | 0.835 | 3.764 | 0.874 | | | |
| EE | EE1 | 0.812 | 3.843 | 0.777 | 0.737 | 0.834 | 0.559 |
| | EE2 | 0.731 | 3.618 | 0.800 | | | |
| | EE3 | 0.811 | 3.618 | 0.742 | | | |
| | EE4 | 0.621 | 3.596 | 0.980 | | | |
| SI | SI1 | 0.842 | 4.067 | 0.804 | 0.805 | 0.885 | 0.719 |
| | SI2 | 0.881 | 3.933 | 0.845 | | | |
| | SI3 | 0.820 | 3.742 | 0.906 | | | |
| FC | FC1 | 0.802 | 3.719 | 1.028 | 0.803 | 0.861 | 0.555 |
| | FC2 | 0.746 | 3.989 | 0.930 | | | |
| | FC3 | 0.703 | 3.551 | 1.060 | | | |
| | FC4 | 0.633 | 3.011 | 1.185 | | | |
| | FC5 | 0.826 | 3.281 | 1.101 | | | |
| CA | CA1 | 0.905 | 3.472 | 0.937 | 0.845 | 0.892 | 0.675 |
| | CA2 | 0.850 | 3.843 | 0.833 | | | |
| | CA3 | 0.727 | 3.910 | 0.843 | | | |
| | CA4 | 0.794 | 3.135 | 1.192 | | | |
| BI | BI1 | 0.823 | 3.360 | 1.164 | 0.878 | 0.915 | 0.687 |
| | BI2 | 0.876 | 3.169 | 1.114 | | | |
| | BI3 | 0.927 | 3.225 | 1.057 | | | |
| | BI4 | 0.883 | 3.191 | 1.090 | | | |
| | BI5 | 0.588 | 3.921 | 1.775 | | | |
| UB | UB1 | 0.839 | 3.674 | 1.036 | 0.823 | 0.895 | 0.740 |
| | UB2 | 0.917 | 3.461 | 0.849 | | | |
| | UB3 | 0.821 | 3.551 | 0.793 | | | |
| HS | HS1 | 0.806 | 4.056 | 0.740 | 0.797 | 0.877 | 0.705 |
| | HS2 | 0.799 | 3.618 | 1.022 | | | |
| | HS3 | 0.910 | 3.865 | 0.737 | | | |
| SS | SS1 | 0.843 | 3.944 | 0.725 | 0.788 | 0.874 | 0.698 |
| | SS2 | 0.851 | 4.180 | 0.743 | | | |
| | SS3 | 0.812 | 3.933 | 0.614 | | | |

Note: PE = Performance Expectancy, EE = Effort Expectancy, SI = Social Influence, FC = Facilitating Conditions (FC), CA = Career Awareness, HS = Hard Skills, SS = Soft Skills, SD = Standard Deviation, CR = Composite Reliability, and AVE = average variance extracted

| | PE | EE | SI | FC | CA | BI | UB | HS | SS |
|---|---|---|---|---|---|---|---|---|---|
| PE | | | | | | | | | |
| EE | 0.800 | | | | | | | | |
| SI | 0.846 | 0.844 | | | | | | | |
| FC | 0.527 | 0.833 | 0.546 | | | | | | |
| CA | 0.673 | 0.669 | 0.533 | 0.414 | | | | | |
| BI | 0.580 | 0.583 | 0.468 | 0.548 | 0.761 | | | | |
| UB | 0.825 | 0.736 | 0.593 | 0.642 | 0.630 | 0.595 | | | |
| HS | 0.421 | 0.443 | 0.376 | 0.404 | 0.351 | 0.371 | 0.300 | | |
| SS | 0.283 | 0.312 | 0.237 | 0.247 | 0.297 | 0.171 | 0.255 | 0.842 | |

Note: PE = Performance Expectancy, EE = Effort Expectancy, SI = Social Influence, FC = Facilitating Conditions (FC), CA = Career Awareness, BI = Behaviour Intention, UB = Use Behaviour, frgHS = Hard Skills, SS = Soft Skills

The last step of reflective measurement model analysis was the evaluation of the discriminant validity. Discriminant validity was used to investigate how much a construct differed from other constructs (Hair et al., 2016). There were three methods to measure the discriminant validity which included: Fornell-Larcker Criterion, Cross Loadings and Heterotrait-Monotrait Ratio (HTMT). Fornell-Larcker criterion and cross loadings were the conventional approaches to test the discriminant validity but unfortunately, both approaches were underperformed when there was only a minor difference among the outer loadings that belonged to the same construct (Henseler et al., 2015; Hair et al., 2019).

Therefore, Henseler et al. (2015) proposed the HTMT approach to overcome the limitation of the Fornell-Larcker criterion and cross loadings. The threshold value for the HTMT was 0.90 if there were conceptual similarities among the structural constructs and 0.85 if the structural constructs were conceptually distinctive (Henseler et al., 2015). Thus, there was a lack of discriminant validity if the HTMT was exceeding 0.85 or 0.90. Table 3 showed that the value of HTMT for all the constructs were less than the threshold value of 0.85, which reflected that the discriminant validity was present.

The internal consistency, convergent validity and discriminant validity had been tested and fulfilled, which were the key criteria for reflective constructs to meet the requirement of using PLS-SEM analysis. Thus, we could proceed to the next stage of analysis, which was the structural model.

## 4.3 STRUCTURAL MODEL

In this stage, the efficiency of the proposed structural model (also called the inner model) on prediction and the correlation between constructs was analysed. In this model, the collinearity test was examined first and then followed by significance and relevance of path coefficients, coefficient of determination (R2), effect size (f 2) and predictive relevance (Q2) (Benitez et al., 2020). The results of path coefficients, R2, f2 and Q2 were tabulated in Table 4.

Investigation on the collinearity of structural models was necessary to avoid the bias in regression results, as the path coefficients were estimated from a series of ordinary least squares (OLS) regressions (Hair et al., 2019). The collinearity problems could be traced through variance inflation factor (VIF) values with a threshold value of five. VIF value of more than 5 indicated that the presence of collinearity issue between endogenous and exogenous latent variables. Based on Table 4, there were no collinearity problems, as all the VIF values were lower than 5.

The hypotheses H4, H5 and H6 were not rejected, as the p-value were less than 0.01. Thus, there was a significant influence of CA on the BI of UiTM students for explaining economic concepts via multimedia. Meanwhile, the FC and BI had significant influence on the UB of the students. The path coefficients for H4 ($\beta = 0.395$), H5 ($\beta = 0.329$) and H6 ($\beta = 0.580$) also revealed that there was a positive relationship between these proposed constructs.

On the other hand, the hypotheses of H1, H2, and H3 were rejected. Thus, there was no effect of PE, EE and SI on UiTM students' BI for using multimedia to explain economic concepts. The explanatory capabilities of endogenous constructs was determined by the coefficient

of determination (R2). In this model, the R2 value of students' BI and UB of using multimedia to explain concepts in economics was 0.518 and 0.385 respectively. Thus, 51.8% of students' BI could be explained by the four main exogenous constructs (PE, EE, SI, CA) and 38.5% of students' UB could be explained by the BI and FC. According Hair et al. (2017), the level of R2 values for both BI and UB were considered moderate.

The effect size, f2 was used to examine the impact of excluding a particular exogenous construct in the proposed model on the endogenous construct. Cohen (1992) had categorised the effect size as small (0.02), medium (0.15) and large (0.35) for multiple and multiple partial correlation tests. In Table 4, there was a small effect of BI on UB, a medium effect of FC on UB and a large effect of CA on BI. There was no effect of PE, EE and SI on BI as all the values are less than 0.02.

The predictive relevance or Stone-Geisser indicator, Q2 was the last stage of structural model analysis. The value of Q2 was used to examine the significance of predictive power of the exogenous latent variables (PE, EE, SI, CA and FC) on the endogenous latent variables (BI and UB). If the Q2 value was larger than zero, the predictive relevance between the exogenous and endogenous latent variables was present. Thus, the exogenous latent variables had predictive relevance with both BI and UB, as shown in Table 5.

Overall, the PE, EE and SI had weak effect on BI, while CA had strong effect on BI of students on using multimedia to explain economic concepts. Thus, PE, EE and SI could not influence BI, and only CA could influence BI. On the other hand, both FC and BI could influence UB.

| Hypotheses | Path | VIF | Direct Effect | Significant | f 2 effect size | Remark |
|---|---|---|---|---|---|---|
| H1 | PE → BI | 2.499 | 0.116 | No *(p > 0.10)* | 0.011 | Reject |
| H2 | EE → BI | 2.206 | 0.111 | No *(p > 0.10)* | 0.012 | Reject |
| H3 | SI → BI | 2.344 | -0.009 | No *(p > 0.10)* | < 0.001 | Reject |
| H6 | CA → BI | 1.611 | 0.580 | Yes *(p < 0.01)* | 0.433 | Do not reject |
| H4 | FC → UB | 1.274 | 0.395 | Yes *(p < 0.01)* | 0.199 | Do not reject |
| H5 | BI → UB | 1.274 | 0.329 | Yes *(p < 0.01)* | 0.139 | Do not reject |

Note: Note: PE = Performance Expectancy, EE = Effort Expectancy, SI = Social Influence, FC = Facilitating Conditions (FC), CA = Career Awareness, BI = Behaviour Intention, UB = Use Behaviour, VIF = variance inflation factor. H6 is placed before H4 in order to test the BI first and then UB

| | $R^2$ | $R^2$ *Adjusted* | $Q^2$ *(= 1 – SSE/SSO)* |
|---|---|---|---|
| *BI* | *0.518* | *0.495* | *0.329* |
| *UB* | *0.385* | *0.371* | *0.263* |

**Table 5 The Level of R2 and Q2 of Endogeneous Constructs**

## 4.4 MODERATOR ANALYSIS

In this paper, there were four moderating variables which include: age, gender, hard skills (HS) and soft skills (SS). The measurement model assessments for HS and SS were reported in Table 2 and Table 3, but age and gender were not included. The age and gender were categorical data, thus, multigroup analysis (MGA) was used to examine the measurement model for them (Cheah et al., 2019) and the results were shown in Table 6 and 7.

The age moderator was divided into two categories namely: (a) low age (20 years old) and high age (21-24 years old) to assess the outer loadings (individual indicator reliability), internal consistency (Cronbach's alpha and composite reliability), convergent validity (average variance extracted), and discriminant validity. Based on Table 6, CA (Cronbach's alpha), CR (composite reliability) and AVE (average variance extracted) of all the constructs exceeded the threshold values under low age category. However, the Cronbach's alpha of EE was less than 0.7 and AVE was less than 0.5 for the high age category. SI reported similar situation with EE whereby the CR was less than 0.7 and AVE was less than 0.5. Therefore, the EE and SI were not reliable and not valid for the moderation analysis. The HTMT values in Table 7 revealed that the discriminant validity was not established for both low and high age categories because the values exceeded the threshold value of 0.85. Thus, both low and high age categories did not satisfy the measurement model assessment.

The gender moderator was divided into female and male categories for assessing the measurement model. For the female category, all the constructs exceeded the threshold value of CA, CR and AVE. Nonetheless, the FC construct under the male category did not fit the criteria of CR and AVE. Therefore, the FC was not reliable and not valid to be assessed in the next stage. Based on Table 8, the HTMT values presented the discriminant validity was not established for both female and male group because some values were beyond the threshold value of 0.85. Thus, the measurement model assessment failed for both the female and male groups.

Therefore, the hypotheses from H7 to H16 were rejected. As for HS and SS moderators, Table 2 and 3 have shown that the measurement model assessment was successful for both moderators. As shown in Table 8, only two hypotheses were significant, namely: H21 and H26, while the remaining hypotheses were not significant.

Hard skills refer to the specific technical knowledge and trainings which are teachable and measurable. Based on Table 4, the relationship between FC and UB was significant. After adding the moderator of hard skills variable, the relationship between FC and UB was still

significant, as demonstrated in Table 8. The direct effect between FC and UB in Table 4 had positive effect, and with the presence of moderator of hard skills variable, the indirect effect between FC and UB was still positive and became stronger. Thus, hard skills strengthened the relationship between FC and UB. This implied that the students must know the how-to-do in order to make the use of the facilities in teaching and learning.

Soft skills are personality traits and personal qualities which are self-developed or self-taught. Based on Table 4, the relationship between FC and UB is significant. After adding the moderator of soft skills variable, the relationship between FC and UB is still significant, as demonstrated in Table 8. The direct effect between FC and UB in Table 4 had positive effect. However, with the presence of moderator of soft skills variable, the indirect effect between FC and UB became negative. Thus, the more soft skills the students possess, the less the facilitating conditions is required on use behavior of students. This result indicated that the more creative the students, less technology was required in using multimedia as a learning tool.

| Construct | AGE | | | | | |
|---|---|---|---|---|---|---|
| | **Low Age** | | | **High Age** | | |
| | CA > 0.7 | CR > 0.7 | AVE > 0.5 | CA > 0.7 | CR > 0.7 | AVE > 0.5 |
| **PE** | 0.875 | 0.915 | 0.728 | 0.816 | 0.844 | 0.577 |
| **EE** | 0.728 | 0.824 | 0.551 | 0.628 | 0.755 | 0.444 |
| **SI** | 0.813 | 0.890 | 0.730 | 0.753 | 0.661 | 0.452 |
| **CA** | 0.847 | 0.893 | 0.679 | 0.794 | 0.857 | 0.601 |
| **FC** | 0.781 | 0.850 | 0.533 | 0.798 | 0.833 | 0.517 |
| **BI** | 0.867 | 0.906 | 0.665 | 0.839 | 0.898 | 0.659 |
| **UB** | 0.767 | 0.863 | 0.679 | 0.874 | 0.923 | 0.799 |

| Construct | GENDER | | | | | |
|---|---|---|---|---|---|---|
| | Female | | | Male | | |
| | CA > 0.7 | CR > 0.7 | AVE > 0.5 | CA > 0.7 | CR > 0.7 | AVE > 0.5 |
| **PE** | 0.876 | 0.915 | 0.729 | 0.813 | 0.832 | 0.565 |
| **EE** | 0.739 | 0.831 | 0.554 | 0.754 | 0.848 | 0.604 |
| **SI** | 0.827 | 0.896 | 0.742 | 0.760 | 0.848 | 0.661 |
| **CA** | 0.862 | 0.905 | 0.706 | 0.791 | 0.847 | 0.586 |
| **FC** | 0.802 | 0.863 | 0.560 | 0.781 | 0.529 | 0.308 |
| **BI** | 0.878 | 0.913 | 0.681 | 0.881 | 0.919 | 0.702 |
| **UB** | 0.793 | 0.879 | 0.708 | 0.917 | 0.947 | 0.856 |

**Table 6 The Measurement Model Assessment for the Age and Gender Moderators**

| LOW AGE (20 years old) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PE** | **EE** | **SI** | **CA** | **FC** | **BI** | **UB** |
| **PE** | | | | | | | |
| **EE** | 0.759 | | | | | | |
| **SI** | 0.878 | 0.827 | | | | | |
| **CA** | 0.703 | 0.647 | 0.564 | | | | |
| **FC** | 0.521 | 0.814 | 0.544 | 0.409 | | | |
| **BI** | 0.617 | 0.454 | 0.570 | 0.803 | 0.439 | | |
| **UB** | 0.743 | 0.668 | 0.596 | 0.580 | 0.596 | 0.549 | |
| HIGH AGE (21-24 years old) | | | | | | | |
| | **PE** | **EE** | **SI** | **CA** | **FC** | **BI** | **UB** |
| **PE** | | | | | | | |
| **EE** | 0.928 | | | | | | |
| **SI** | 0.754 | 0.895 | | | | | |
| **CA** | 0.466 | 0.654 | 0.455 | | | | |
| **FC** | 0.414 | 0.755 | 0.433 | 0.279 | | | |
| **BI** | 0.321 | 0.724 | 0.180 | 0.529 | 0.724 | | |
| **UB** | 0.887 | 0.829 | 0.488 | 0.590 | 0.531 | 0.490 | |

| FEMALE | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PE** | **EE** | **SI** | **CA** | **FC** | **BI** | **UB** |
| **PE** | | | | | | | |
| **EE** | 0.804 | | | | | | |
| **SI** | 0.863 | 0.770 | | | | | |
| **CA** | 0.631 | 0.676 | 0.533 | | | | |
| **FC** | 0.599 | 0.863 | 0.507 | 0.493 | | | |
| **BI** | 0.654 | 0.624 | 0.562 | 0.776 | 0.693 | | |
| **UB** | 0.833 | 0.843 | 0.699 | 0.545 | 0.895 | 0.656 | |
| MALE | | | | | | | |
| | **PE** | **EE** | **SI** | **CA** | **FC** | **BI** | **UB** |
| **PE** | | | | | | | |
| **EE** | 0.803 | | | | | | |
| **SI** | 0.768 | 1.031 | | | | | |
| **CA** | 0.880 | 0.637 | 0.500 | | | | |
| **FC** | 0.417 | 0.780 | 0.682 | 0.321 | | | |
| **BI** | 0.461 | 0.457 | 0.247 | 0.740 | 0.499 | | |
| **UB** | 0.831 | 0.449 | 0.289 | 0.903 | 0.204 | 0.457 | |

**Table 7 HTMT for the Age and Gender Moderators**

| Moderating Variables | Hypotheses | Path | Indirect Effect | Significant | Remark |
|---|---|---|---|---|---|
| Hard Skills (HS) | H17 | PE → BI | -0.254 | No *(p > 0.10)* | Reject |
| | H18 | EE → BI | -0.032 | No *(p > 0.10)* | Reject |
| | H19 | SI → BI | 0.059 | No *(p > 0.10)* | Reject |
| | H20 | CA → BI | 0.163 | No *(p > 0.10)* | Reject |
| | H21 | FC → UB | 0.986 | Yes *(p < 0.01)* | Do not reject |
| Soft Skills (SS) | H22 | PE → BI | 0.149 | No *(p > 0.10)* | Reject |
| | H23 | EE → BI | 0.287 | No *(p > 0.10)* | Reject |
| | H24 | SI → BI | -0.242 | No *(p > 0.10)* | Reject |
| | H25 | CA → BI | 0.097 | No *(p > 0.10)* | Reject |
| | H26 | FC → UB | -0.240 | Yes *(p < 0.10)* | Do not reject |

**Table 8 Moderation Analysis**

## CONCLUSION

This paper aimed to examine the determinants of the acceptance on the use of multimedia in learning economic concepts among graduates who took economics related subjects in UiTM Cawangan Sarawak, Malaysia. The original four constructs from the UTAUT models were employed, namely PE, EE, SI and FC. The model was extended by including a new construct, that was career awareness (CA) and two new moderating variables which were hard skills (HS) and soft skills (SS).

Overall, the PE, EE and SI had weak effect on BI, while CA had strong effect on BI of students on using multimedia to explain economic concepts. Thus, PE, EE and SI could not influence BI, and only CA could influence BI. On the other hand, both FC and BI could influence UB. The moderating variables such as gender and age did not have any influence, while hard skills

and soft skills had influence on the use behavior (UB) of students. Both hard skills and soft skills moderated the relationship between facilitating conditions (FC) and Use Behaviour (UB).

Based on the above results, several policies could be suggested for the further improvement of learning experience by the university students. Firstly, students should be given more exposure to career awareness that is related to technologies (Tang et al., 2023). This would enable students to be equipped with better technological knowledge in order to be more employable in the labour market. Secondly, the university should improve the FC in order to encourage students to continue to use technologies in their academic projects. The facilitating infrastructures such as technologies, equipment, and technologies-related trainings could be implemented as some of the academic subjects or workshops for the students. Thirdly, various skills program could be further improved in order to develop the skills among students. The suggested skills programs include soft skills programs, entrepreneurship programs, career exhibitions, volunteering programs, and community services. These programs are important to create career awareness and opportunities, development of hard skills and soft skills to nurture and prepare university students to be more employable and competent at both local and international level (Hamzah et al., 2022; Mohamad et al., 2017).

This study has several limitations. Among others, these include small sample size where the sample consists of students who took economics related subjects and limited moderating variables. Future researchers could enlarge the sample size, explore new constructs and moderating variables and apply them in other academic subjects in both lower and higher learning institutions to achieve more generalized results.

Although the study has its limitations, our findings nonetheless suggest that career awareness influenced the behavioural intention of students, and both hard skills and soft skills moderated the facilitating condition and use behaviour of students on the acceptance of using multimedia in their learning.

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