THE MERLIN PROJECT: MALAYSIAN STUDENTS' ACCEPTANCE OF AN AI CHATBOT IN THEIR LEARNING PROCESS

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ABSTRACT

The COVID-19 pandemic has accelerated the educational landscape of institutions of higher education, which were predominantly face-to-face. In Malaysia, many universities converted their courses into online courses to keep up with the challenges of working from home during the pandemic, using web technologies and blended learning approaches. However, there are challenges in ensuring students' attention and retention rates are maintained and enough support and scaffolding are provided to them when they are learning online. As such, the MERLIN Project was undertaken to develop a virtual learning assistant that would provide online support to students outside of their online classes. The project used Artificial Intelligence (AI) technology with Natural Language Processing (NLP) features to develop a chatbot that simulated human-like conversation between chatbot and students. Content in the learning environment was media-rich and mapped to Mayer's 12 Multimedia Learning Principles. Data from 102 students was collected to gauge their perceptions and feedback. Results showed that students found the chatbot to be helpful in their learning process and improved their understanding of the course material. A conceptual learning framework for the use of AI chatbots as learning assistants is proposed to improve students' online learning experiences in the new normal.

Keywords: Artificial intelligence, Malaysian students, e-learning, scaffolding.

INTRODUCTION

Today's education landscape now sees more technologies being used in the classrooms, making it a necessary enabler to cultivate creativity, innovation, communication and critical thinking among students. In addition, today's learners, the Gen Zs, are highly visual learners and demand more visually appealing content in order to stay engaged in their classes. With the recent COVID 19 pandemic, the shift to online classes has brought its share of challenges to educators around the world (Li & Lalani, 2020; Bentley, 2020; Butnaru, Nita, Anichiti, and Brinza, 2021). When the pandemic hit Malaysia in 2019, the Government issued a total lockdown and the closing of all educational institutions, and many universities were taken by surprise and had to switch to online teaching almost immediately, and many were not prepared for such a drastic change (Azlan, Hamzah, Sern, Ayub, and Mohamad 2020).

Although many universities had technological support in the form of LMS systems and web technologies, there was still an issue of lack of interaction with students (Keshavarz, 2020), which stemmed from poorly designed online learning environments, and the suggestion that Malaysian teaching methodologies were becoming outdated (Mahathir 2018) and needed to be redesigned to accommodate these new learning requirements. In other words, shifting to online learning should not only deliver course materials online, but to also provide proper support and interaction opportunities during times when they are not online with the

lecturer. There is growing evidence that chatbots are being utilised in the classrooms to support the student learning process (Winkler and Sollner, 2018; Sandu and Gide, 2020; Gaglo, Degboe, Kossingou, and Ouya, 2021) and would be conducive to scaffolding students when learning online without the lecturer present (Armstrong, 2017; Yang and Evans, 2019). As such, this paper seeks to investigate the impact of using an AI chatbot with Natural Language Processing (NLP) features integrated into a course that was taught online. In doing so, the study was guided by the research question, "*What are the students' perceptions of using an AI chatbot in their learning process?*". Specifically, data was collected to gauge students' readiness to use an AI chatbot in their learning, as well as their perceptions about using an AI chatbot as an instructional tool that supports and scaffolds them when learning online outside of the class time. The chatbot was theoretically underpinned by Mayer's (2001) 12 Principles of Multimedia, and Davis' (1989) Technology Acceptance Model (TAM) was adapted as the data collection research instrument.

OVERVIEW

The COVID 19 pandemic had a serious global impact on education with regards to the instructional designs and the teaching and learning methodologies (Hodges, Moore, Lockee and Trust, 2020; Mailizar, Almanthari, Maulina and Bruce 2020), and forced many instructors to turn to online learning to deliver their course in the face of the pandemic (Bentley, 2020; Li and Lalani, 2020). Although online learning has become more prevalent in higher education (Bali and Liu, 2018; Butnaru et. al, 2021), the abilities of educators to effectively teach online is likely to differ depending on the design of the learning environment created (Liguori and Winkler 2020; Doyumgac, Tanhan, A. and Kiymaz, 2021). The unexpected shift to online learning has posed many challenges to both students and instructors. Research has shown that many institutions of higher education have reacted to this sudden change by simply transferring educational content to digital repositories and not necessarily focussing on the methods and delivery of these online materials (Adnan and Anwar 2020; Vu, Hoang, Than, Nguyen, Dinh, Le, Le, Pham and Nyugen, 2020). Butnaru et. al (2021) posited that going online for students have resulted in different outcomes, and these are dependent on how well they are able to use online learning tools and access online materials, and how well the teaching staff manages the online learning environment. The rapid and accelerated move to online learning has resulted in mixed outcomes. According to Li and Lalani (2020), while some who transitioned to online education were unable to maintain and yielded poor student learning experiences, especially in the interactions between students and teacher (Kebritchi, Lipschuetz and Santiague, 2017), some others were able to harness the potential of online learning and developed new models for online education and hybrid learning (Platt, Raile and Yu, 2014; Bentley, 2020; Zavyalova, 2020).

Many would argue that online education in the face of the pandemic has tremendous potential to innovate current education systems (Dede and Richards, 2020). There is increased flexibility in the delivery of course materials; lecturers able to create more authentic learning experiences by being able to access experts online to join their courses, thus saving on time and cost of travel, and students are presented with a wide range of online courses from Coursera, Khan Academy, EdX, to name a few, to join in order to supplement their online courses. Research has also shown that students retain 25-60% of the course content when learning online compared to the 8-10% average when in a physical learning environment, and learn more efficiently, at about 60% less time to learn than when in a physical classroom (Li and Lalani, 2020).

However, most of these happen when students are in class with their peers and lecturer. When these online classes are over, students are then provided with learning activities and materials to go over on their own. As such, during these times, students experience less communication and interactions as the teacher is not around to provide enough online support to them (Adnan and Anwar, 2020; Keshavarz, 2020), especially after class times. Girik (2020) argued that online education differs from traditional classroom learning in that learning activities need to provide a higher level of active participation in the absence of the lecturer, noting that effective online learning environments must provide the support for students to learn materials before and after the online class. Wang, Hall and Wang (2018) and Doyumgac, Tanhan, and Kiymaz (2021) further noted that to rely on students to manage and self-regulate their learning and engagement, without proper guidance, is unrealistic, and measures need to be in place to assist them during online out-of-class learning times.

As such, scaffolding measures in online learning environments can be a possible solution to assist students in their learning process outside of the online classroom. Scaffolding has been recognised in research as a very integral part of the learning process and an effective instructional strategy as it enables students to better engage with their learning process and achieve their learning outcomes (Belland, Walker, Kim and Lefler; 2017). Vygotsky (1978) posited that learning is enhanced when learners are actively engaged in interactions and when tasks are supported by more experienced tutors or peers. Vygotsky's (1978) Zone of Proximal Development theory posits that learning takes place when tasks are supported with assistance from more experienced peers or tutors. Armstrong (2017) further states that scaffolding is an integral part of the learning process and can contribute significantly to improved engagement in the content. In such occasions, the use of technologies can be of significant benefit and advantage, especially when available 24/7 to students.

According to the Horizon Reports 2019 (Alexander, Ashford-Rowe, Barajas-Murph, Dobbin, Knott, McCormack, Pomerantz, Seilhamer and Weber, 2019) and 2020 (Brown, McCormack, Reeves, Brook, Grajek, Alexander, Bali, Bulger, Dark, Engelbert and Gannon, 2020), mixed reality, adaptive learning, and AI (Artificial Intelligence) machine learning, are some of the technologies posited to emerge to enhance the learning processes. Research in AI has shown there is good potential in the use of chatbots as teaching and learning agents (Winkler and Sollner, 2018; Tsidylo, Samborskiy, Mazur and Zamoroz 2020; Gaglo, Degboe, Kossingou, and Ouya, 2021). Using Artificial Intelligent (AI) chatbots when students are studying online, without the presence of the teacher, will increase the support they will receive during those times. This can be especially true when Natural Language Processing (NLP) features are incorporated into the chatbots to simulate intelligent conversations between humans and chatbots. Such AI Conversational chatbots can do the following: 1. Simulate intelligent human language interaction through text or speech. 2. Promote more interaction between students and chatbots, and consequently, in engaging in their learning materials, and 3. Establish a more engaging virtual teaching-learning environment. Sandu and Gide (2020) and Yang and Evans (2019) have suggested that the education industry can benefit tremendously from the use of chatbot as it can provide efficient teaching assistance (Nurshatayeva, White and Gehlbach, 2020), reduce the confusion during interactions, and perform functions similar to a human tutor (Georgescu 2018; Perez, Daradoumis, and Puig, 2020). Some universities such as Northwestern University (USA), Griffith University (Australia), and the University of Oklahoma (USA) have started to incorporate chatbot services to their students (Brown, McCormack, Reeves, Brook, Grajek, Alexander, Bali, Bulger, Dark, Engelbert , Gannon, Gauthier, Gibson, Gibson, Lundin, Veletsianos and Weber, 2020). In Malaysia, the use of chatbots has been limited to customer service carelines (Lee, Kee, Chan, Liow, Chin and Alkandri (2020), customer satisfaction (Johari, Zaman, Nohuddin, 2019), for reviewing medical applications (Safi, Abd-Alrazaq, Khalifa and Househ, 2020) and for digitalising Malaysian industries (Seah, Loh, Lew, Keong, Chin, Lio, Lee, Lim and Wong, 2021), but very few, if any, as an educational facilitator of learning materials (Yang and Evans, 2019). This is a gap that needs to be addressed especially in online learning environments.

Therefore, this research investigates the use of AI chatbots as scaffolds and virtual learning agents to support student learning outside of the classroom. In particular, it investigates how ready are students to accept chatbots in their learning process, and whether these AI chatbots can function as the scaffold and learning assistant, when the teacher is not present.

DESIGNING THE LEARNING ENVIRONMENT: MERLIN THE AI CHATBOT

The MERLIN chatbot was part of a research project funded by Telekom Malaysia's Research & Development agency to develop virtual classrooms for 21st century learning using mixed reality technologies. The project was undertaken at the Faculty of Creative Multimedia, Multimedia University, and looked at using Artificial Intelligence (AI) and Natural Language Processing (NLP) features in a virtual learning assistant to support online student learning. For this research project, the content used in MERLIN was mapped to topics taught in the faculty's Diploma of Creative Multimedia curriculum. These topics were provided by the course lecturer and were designed to support the teaching content by the lecturer when students are learning online on their own. These topics were then re-designed to be presented in a media-rich form, allowing MERLIN to return more visually appealing and interactive content to the questions asked by the students. As part of the innovation to develop 21st century classrooms, learning was presented in 3 ways:

1. Students would learn these topics while they were online with the lecturer.
2. Students can also take part in an Augmented Reality (AR) game, a Virtual Reality (VR) game, or a Hologram application, that would provide them with experiential learning of the topics, and
3. Depending on the scores achieved in each game, students would be advised to interact with the MERLIN chatbot to learn more advanced content about the topic, or to refresh their knowledge of the topic so that they can go back to the game and score better.

During the design stage, brainstorming sessions were centred around the dialogue flow of the chatbot and how it would be teaching learners, thus developing the structure and flow of the chatbot before any production would take place, as shown in Figure 1.

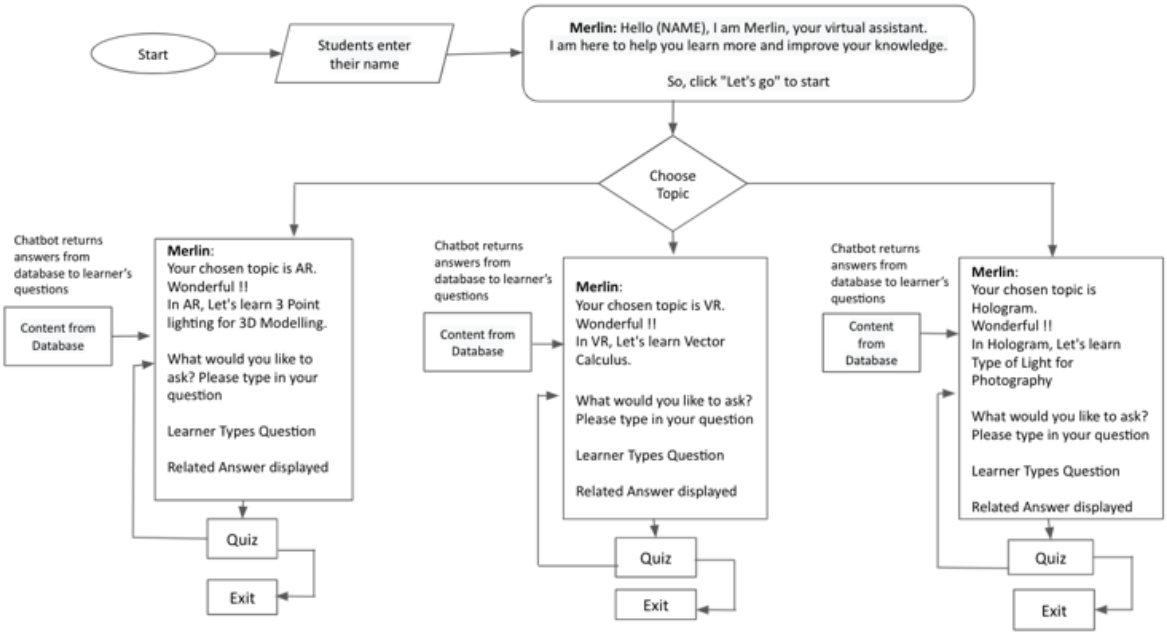

Figure 1. The dialogue flow of the chatbot

METHOD

In order to create a chatbot that was pedagogically sound, Mayer's (2001) Cognitive Theory of Multimedia Learning was used as its theoretical framework and underpinned its development. Mayer's (2001) cognitive theory of multimedia learning suggests that when incorporating multimedia elements into an application, its impact on the interactivity and feedback on student learning must be considered. According to Mayer and Moreno (1998) and Mayer (2014), this theory operates on the assumption that information is processed using two separate channels, visual and auditory (also known as the Dual-Coding theory). They also state that people have limited capacity for processing information, and that learning is an active process where learners filter, select, organise and integrate the information based on their prior experiences.

Mapping MERLIN Content to Mayer's Principles of Multimedia Learning

As such, based on this theory, using multimedia elements in the learning content will positively impact and contribute effectively to their learning process, and put the locus of control with the learner, Therefore, the MERLIN chatbot was underpinned by Mayer's (2001) 12 Principles of Multimedia Learning and designed with the following characteristics:

1. Content was presented in both text and graphics that were placed next to each other at the same time,
2. Wherever there were images that explained a certain concept, narration was provided in the form of a human voice,

3. The narration was presented in a conversational and casual style, to simulate the way a lecturer would be presenting a lecture in class, and animations and videos were used to illustrate these concepts, instead of talking heads,
4. The chatbot would welcome the students by asking them to type their name and using their name to address them throughout the presentation,
5. The chatbot would ask learners about how they performed in the game, and would answer accordingly, making the interaction more personal and conversational
6. Content presented was categorised into small chunks of information and, wherever necessary, "NEXT" buttons were added for learners to click to go to the other information segments,
7. A self-efficacy quiz was available for learners to test themselves on the content they learned to provide them with a benchmark on how they performed on the topic. By doing the quiz and seeing their scores, learners can then choose to go back to the game and try to score better.

In addition, MERLIN was also developed with Natural Language Processing (NLP) features that would allow for the chatbot to return the most relevant answers to their questions, and to do the following:

1. **Menu items** for learners to choose from different options to explore, such as a) Topics, b) Quiz and c) Edpuzzle. EdPuzzle modules were incorporated into the chatbot's learning environment to provide blended learning opportunities to students and to curate relevant interactive information for them while learning online. This will reduce their own search time and allow them to focus on the topics at hand.
2. If the learner chooses "**Topics**", a menu will appear with a list of topics contained in the chatbot. This will give the learner an overview of the topic modules they can learn in the chatbot and make their choices then. The learner can do so by typing their question about what they would like to learn, and MERLIN will return the most relevant content to them. Learners can either type whole sentences or simply key in the topic number (eg: 1,2,3,i,ii,a,b,c) from the menu.
3. If the learner wants to learn about a **specific topic** that may not be listed in the menu, but are part of the chatbot's content database, such as *"Point light"* or *"Spot light"*, they can just type in these keywords and the MERLIN will display this specific content for them. This is designed for learners who may have scored better in the AR game QUEST, and simply wanted to find out more about a specific topic.
4. **Text to Speech** features, where text is transformed into audio and can be played within the chatbot's learning environment. However, this feature uses a computer voice and therefore it is presented only at the beginning of the chatbot module, to welcome the learner by name, and at the end of the module, when the learner clicks the "EXIT" button, to say goodbye to the learner. The rest of the audio in the MERLIN's learning environment uses human voice, as per Mayer's Voice Principle.
5. **Robust** keyword recognition using NLP to capture **general terms** like "light", "lighting", "render", "rendering". In this instance, MERLIN will return a menu that would contain items with all these general terms listed, and the learner can make a more specific choice from it.
6. An **error** message will be displayed when the learner types in something that is not related to the content of the modules.

Figure 2 shows examples of chatting with MERLIN.

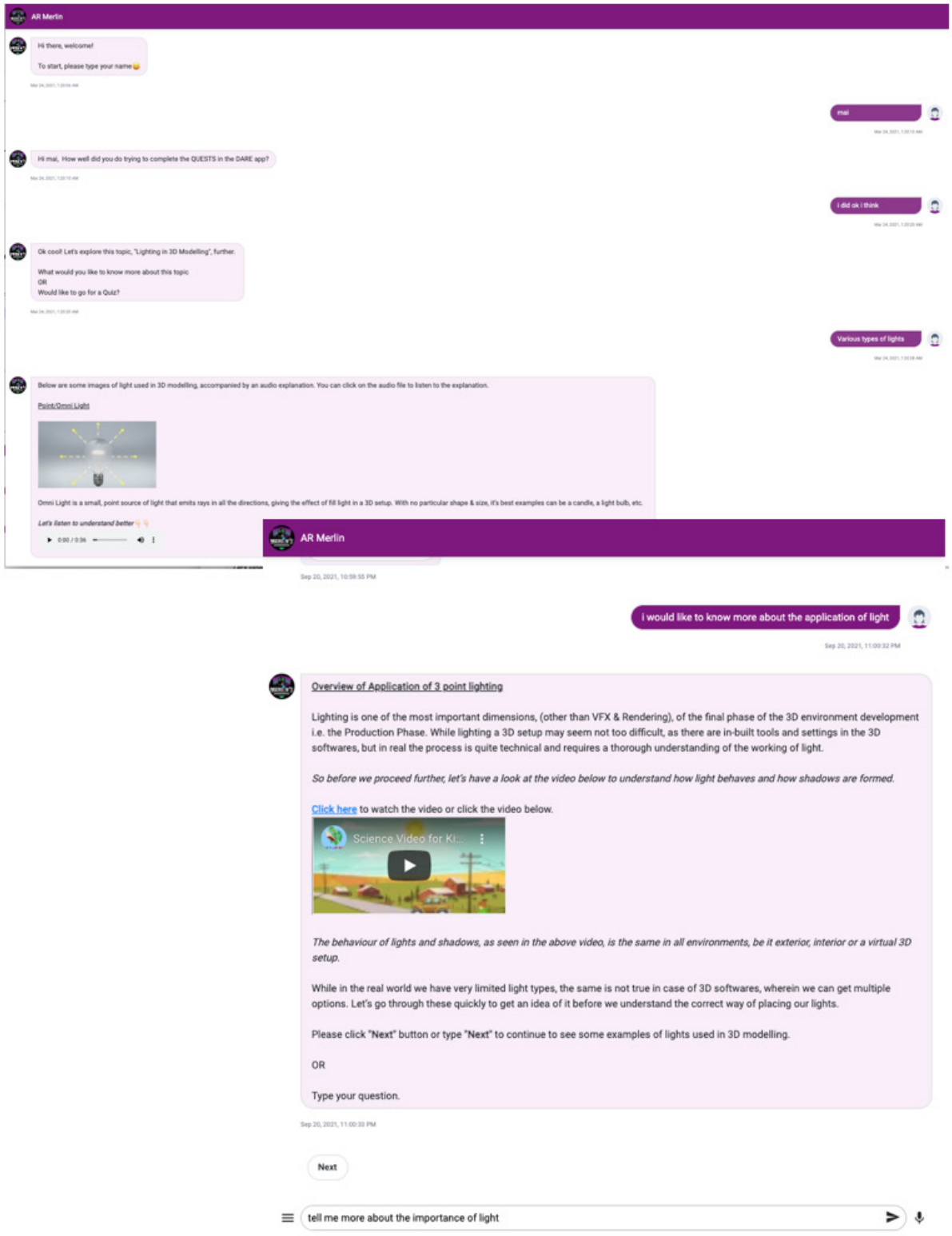

Figure 2. Chatting with Merlin

Participants

The questionnaire was administered to first year Diploma students from Faculty of Creative Multimedia, Multimedia University, taking their Diploma in Creative Multimedia, and the topic covered in the chatbot was one of the topics in their class, which was "*3-Point Lighting in 3D modelling*", and was provided by the lecturer of the class. Students were informed that participation in the survey was voluntary and would in no

way influence their grades for their course. Additionally, their consent was solicited in the form and students who did not want to participate could opt out of the exercise. A total of 102 students agreed to participate, with 5 students choosing not to participate. The participating students were given the link to the chatbot and a quick overview of the navigation around the chatbot. They were then given 30 minutes to explore the chatbot on their own and complete the questionnaire.

Data Collection and Analysis

The research design used in this study was a convergent mixed method design, using both quantitative and qualitative data collection methods. According to Creswell and Creswell (2018), a convergent mixed method design is where both quantitative and qualitative data are collected and analysed in one phase. The data from both methods are then analysed and compared to see if the data support or contradict each other. In this study, quantitative data was collected from a 5-point Likert scale questionnaire administered to the participants, while qualitative data was collected from the open-ended questions in the survey.

The questionnaire used in this study adapted Davis's (1989) Technology Acceptance Model (TAM) to gauge learners' Intention to Use (IU), which was based on their Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of the MERLIN chatbot. These two perceptions would then impact their Attitudes Towards Usage of the chatbot) (ATU), and subsequently, their Behavioral Intentions to Use (BIU). In other words, how user-friendly and how useful the chatbot was would impact the learners' attitudes towards it and consequently influence their intentions to use the chatbot in their learning process and provide insight to their readiness to use a chatbot in their learning process. Items adapted for the 22-item questionnaire consisted of 3 constructs which can be mapped to measure learners' Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and 1 construct that would measure learners' Intention to Use (IU). The Motivation and Understanding construct would provide results for learners' Perceived Usefulness (PU) and the Content and Navigation construct would yield results for the learners' Perceived Ease Of Use (PEOU) construct. In addition to that, 6 items on the questionnaire would yield results for learners' Intentions to Use construct of the model, which were:

1. Perceived Usefulness (PU) which consisted of Motivation and Understanding items:
2. Perceived Ease Of Use (PEOU) which consisted of Content and Navigation items
3. Intention to Use (IU) items

The questionnaire that was administered to the participating students consisted of 22 items on a 5-point Likert scale, ranging from Strongly Agree (5) to Strongly Disagree (1). Table 1 shows the results of the questionnaire (means, standard deviation, and percentage responses for Agree and Strongly Agree on the scale). The results show that qualitative data strongly supported the quantitative data and are combined and presented in Tables 1-4 below. To collect qualitative data, the students were asked open-ended questions to solicit their feedback and comments on the chatbot. These questions were asked to gauge their perceptions of MERLIN as an instructional tool and to investigate the critical factors that would make MERLIN a successful virtual learning assistant.

FINDINGS AND DISCUSSION

In this research, the research question investigated was, "*What are the students' perceptions of using an AI chatbot in their learning process?*". A questionnaire was administered to 102 students and yielded a Cronbach Alpha of 0.961, making it a reliable scale. Analysis was performed on the questionnaire, using SPSS v27, and the findings were presented in the following manner:

1. Triangulation of findings of the TAM questionnaire on student readiness, supported by student comments,
2. Discussion the use of MERLIN as an instructional tool

Student Readiness in Using an AI chatbot

Perceived Usefulness (PU): The Motivation Construct

As shown in Table 1 below, the Motivation construct consisted of 6 items in the questionnaire. Results showed that 81.4% of students reported an overall satisfaction towards using MERLIN in the learning of the topic (Item #6, X = 4.14), making it the highest mean score in that category. This is followed by 87.3% of the students reporting that they enjoyed learning with MERLIN (Item #1, X = 3.91). 67.7% of the students reported that they had fun learning with MERLIN (Item #2, X = 3.89), and 67.6% of the students felt more engaged with the topic with the chatbot's assistance (Item #5, X = 3.88). In addition, 64.4% of the students reported that they felt more motivated to learn more about the topic (Item #3, X = 3.80), and 61.4% of the students felt more confident with the knowledge that they gained through the interaction with the MERLIN chatbot (Item #4, X = 3.76).

Table 1. The Merlin Chatbot Questionnaire Results for Motivation

Motivation (Perceived Usefulness)				
	Item Name	**Mean (X)**	**Std. Dev (SD)**	**p (%)**
1.	I enjoyed learning with the MERLIN Virtual Assistant module.	3.91	0.76	87.3
2.	I had fun learning with MERLIN.	3.89	0.87	67.7
3.	Thanks to MERLIN, I feel more motivated to learn further about this topic.	3.8	0.85	64.4
4.	I am more confident now with the knowledge that I have gained from the MERLIN Virtual Assistant	3.76	0.84	61.4
5.	With MERLIN's help, I feel more engaged with this topic.	3.88	0.84	67.6
6.	Overall I am satisfied in using the MERLIN Virtual Assistant for my learning of this topic.	4.14	0.83	81.4
Student comments on Innovativeness and Fun (Personalization Principle)				
(Comments mapped to Mayer's (2001) Personalization Principle)				
1.	*It teaching me in interesting way*			
2.	*It's user friendly and a cool way to learn something*			
3.	*Very fun to use and it is able to get my attention*			
4.	*I feel like this will really help students, especially the shy ones, because sometimes it is scary to go up to a lecturer and ask a question, so a chatbot like Merlin would really help us in studying.*			
5.	*I like the implementation of the concept of conversational language and how the bot is designed to comprehend it.*			
6.	*I can save time to get info*			
7.	*It would be good because of the current situation in which students have to do online learning and most of them prefer to work at night. Maybe the virtual assistants can help them.*			
8.	*Can help me to solve my problem ASAP without always disturbing my friends and others.*			
9.	*It's fun having a conversation with VA without the feeling of thinking too much on what to say.*			
10.	*I enjoyed learning along with Merlin and find the Virtual Learning assistant very helpful.*			

Table 1 also shows student comments that were found to support the results of the questionnaire. Here, students commented on their enjoyment and the innovativeness of learning with MERLIN. These comments also show evidence of Mayer's (2001) Personalization Principle in the chatbot. Research by Girik (2020) stated that activities for the online learning environment should not be similar to that of the traditional, conventional classrooms, and this is further noted by Brown, McCormack, Reeves, Brook, Grajek, Alexander, Bali, Bulger, Dark, Engelbert and Gannon (2020) that 21st century education should take advantage of new and emerging technologies to support learning. Findings from this study support these research studies. In addition, students in the study commented that MERLIN was an innovative and fun virtual learning

assistant to interact with as it was *"....user friendly and a cool way to learn something."* They also commented that "*It's fun having a conversation with VA without the feeling of thinking too much on what to say",* that it was "*Very fun and it is able to get my attention*". The results also support Dede and Richards (2020) position that online learning can be innovative to allow students a more interesting and authentic way to learn.

Perceived Usefulness (PU): The Understanding Construct

The findings also yielded results for the Understanding construct, which consisted of 6 items in the questionnaire, as shown in Table 2 below. In terms of their understanding of the content presented in the chatbot, 79.4% of the students reported that the additional information that was available to them in the chatbot was very helpful (Item #2, X = 4.14), making it the highest mean score in that category. 79.2% of them further reported that they found the MERLIN chatbot to be informative and engaging (Item #6, X = 4.03). 70.3% of them found the inclusion of the quiz further enabled them to assess the authenticity of their understanding (Item #3, X = 3.93), and 70.6% of the students reported that MERLIN helped to strengthen their retention of the information of the topic (Item #5, X = 3.91). In addition, 67.7% of the students found MERLIN helped to clear their doubts for certain questions posed (Item #1, X = 3.90), and 71.8% of them reported that the MERLIN chatbot enhanced their understanding in an interesting and engaging way (Item #4, X = 3.88).

Table 2. The Merlin Chatbot Questionnaire Results for Understanding

	Understanding (Perceived Usefulness)			
	Item Name	**Mean (X)**	**Std. Dev (SD)**	**p (%)**
1.	The Merlin Assistant helped in clearing my doubts for certain questions.	3.90	0.83	67.7
2.	The additional info available through the virtual module was quite helpful.	4.14	0.80	79.4
3.	The inclusion of quiz in the MERLIN Virtual Assistant further helped in assessing the authenticity of my understanding of the topic.	3.93	0.80	70.3
4.	The MERLIN virtual assistant tool enhanced my understanding of this topic in an interesting & engaging manner.	3.88	0.86	71.8
5.	The MERLIN Virtual Assistant helped me strengthen my retention of the topic.	3.91	0.73	70.6
6.	I found Merlin Virtual Learning Assistant informative and engaging.	4.03	0.77	79.2
	Student comments on empowering their learning process (mapped to Mayer's (2001) Coherence, Signaling, Image and Segmenting Principles)			
1.	*More detailed and depth of the subject*			
2.	*Clear and concise. The minimization of information shown at one time allows information to be digested easier.*			
3.	*Good application to help with my learning. Lots of knowledge.*			
4.	*It provides a lot of extra knowledge.*			
5.	*It is very straight to the point and gives detailed explanations on the topics. (Signaling)*			
6.	*It uses video to explain the concept to the user.*			
7.	*I got to learn new things that I don't know.*			
8.	*Makes it easier to understand without the needing to do much research*			
9.	*It helps me with things that I don't understand*			
10.	*I got to see most of the topics that I've learn in class so that I can refresh my memory*			
11.	*It explains topics I have known and read again in a clear manner, with addition to audio and visual information.*			

Similarly, in Table 2 above, the questionnaire results were also well-supported by the comments from the students. Students commented that their learning process was improved as they were able to acquire a deeper understanding and knowledge of the topics, showing the presence of Mayer's (2001) Coherence, Signaling, Image and Segmenting Principles in their comments. This meant that information that was presented to the students upon their query were relevant and appropriate, with appropriate cues and visuals, and presented in an easy manner to understand. Findings from the questionnaire and comments also showed that chatbots helped to empower the student's learning process and increased their understanding of the content. This can be seen in the comments from students, such as, "*It is very straight to the point and gives detailed explanations on the topics", "It helps me with things that I don't understand",* and "*It explains topics I have known and read again in a clear manner, with addition to audio and visual information".* This shows that students were able to understand and comprehend their course topic better after they interacted with MERLIN. The incorporation of audio and video materials, as suggested by Mayer (2001), resulted in a better understanding of the topic, as the juxtaposition of text and images together increased the comprehension of the material, and the inclusion of human voice in the audio resulted in an improved learning process. Furthermore, Li and Lalani (2020) have suggested that online learning improves the retention rate. The results of this project supported their research as students commented that they were able to retain and understand the course content better. Here, students were able to reflect on the content, by being able to re-read the materials presented by the chatbot, proceed to the quiz for a self efficacy test, or view EDPuzzle videos specifically chosen for them by the chatbot, increasing their efficiency in learning, supporting the suggestion by Yang and Evans (2019).

Perceived Ease of Use (PEOU): The Content and Navigation Construct

To gauge the ease-of-use of MERLIN, Table 3 below shows the results of the Content and Navigation construct, which consisted of 4 items in the questionnaire. 82.3% of the students reported that they found the language and content of the chatbot easy to understand (Item #3, X = 4.24), making it the highest mean score for this construct. This was followed by 78.4% of students who reported that the inclusion of web links and visual aids (eg., videos and images) had provided more clarity to the topic (Item #4, X = 4.24). In addition, 81% of the students reported that the content in the chatbot was well-organised and followed a suitable sequence that helped in the understanding of the topic (Item #2, X = 4.10). And 69.6% of the students reported that they were able to navigate easily through the chatbot from beginning to end (Item #1, X = 3.92).

Table 3. The Merlin Chatbot Questionnaire Results for Content and Navigation

	Content & Navigation (Ease of Use)			
1.	I was able to navigate through MERLIN easily from start to finish.	3.92	0.87	69.6
2.	The content in the MERLIN Virtual Assistant was well-organized and followed a suitable sequence for understanding a topic.	4.10	0.82	81.0
3.	The language and the content of the MERLIN Virtual Assistant was easily understandable.	4.24	0.80	82.3
4.	The inclusion of web links and visual aids, such as videos & images, in the MERLIN Virtual Assistant further helped in the clarity of the topic.	4.24	0.84	78.4
5.	I had no problem going through MERLIN on my own.	4.02	0.86	68.3
6.	It was easy for me to become skillful at using the Merlin Virtual Assistant.	3.87	0.78	66.6

Student comments on engagement in the content (Mapped to Mayer's (2001) Signaling, Personalization, Spatial & Temporal Contiguity Principles)
1. *[I like] the interactive conversation*
2. *I can explore more knowledge on my own when class is unavailable*
3. *It is very convenient if I was referring to a certain information for a certain topic, no need to find the notes and take extra time to search for it.*
4. *It helps me a lot providing answers as I am trying to find informations I needed*
5. *It is interesting and suitable for learning extra knowledge.*
6. *Faster to let me understand in my learning*
7. *I think putting photos into the explanations does help a lot to understand it, as well as the voice audio. Hence , the learning process is more immersive.*
8. *Very immersive on the topic*
9. *I like how with the accessibility of a VLA students are incentivise to study/learn/revise outside of their class time. This is very significant in the academic learning process*
10. *It provides not just images and text but also voice explanations.*
11. *I liked how it was in the form of an interactive chat bot. It emulates the feeling of interactivity and is an engaging concept.*

In addition, these results were positively supported by student comments and feedback. As can be seen in Table 3 above, students commented about their level of engagement with the topic through MERLIN, and the level of immersion with the content. These comments also show evidence of Mayer's (2001) Signaling, Personalization, Spatial Contiguity and Temporal Contiguity Principles in the chatbot, as MERLIN was developed with complementing and appropriately placed text and images, and with human audio instead of computer audio. Research by Doyumgac, Tanhan, and Kiymaz (2021) has shown that learning online requires that some form of guidance needs to be provided to help students manage their learning process and their engagement levels. Findings show that students were able to better engage with the content when interacting with MERLIN and supported that research. Here, students had commented that MERLIN's features were, "*Very immersive on the topic*", that their *"...learning process is more immersive"*, and that they liked *"...the interactive conversation",* showing evidence that they were very responsive and receptive to the using an AI chatbot to learn from when their lecturer is not around. Students were also better able to self-regulate their engagement, and with the content, by interacting with MERLIN on queries relevant to them. This is in line with the research by Wang, Hall and Wang (2018) and Doyumgac, Tanhan, and Kiymaz (2021) who suggested that some form of guidance be provided to help students manage themselves online, and addresses the issue of lack of interactions in online education by Keshavarz (2020).

Intention to Use (IU)

And lastly, Table 4 presents the 4 items in the questionnaire under the category Intention to Use (IU). 87% of the students reported that they found virtual learning assistants very suitable for online learning environments (Item #4, X = 4.27), making it the highest mean score in this category. This is followed by 84.3% of the students who also reported that they would like to use more chatbots in their other subjects (Item #1, X = 4.25). In addition, 82.2% of the student believed that learning with chatbots provides extra knowledge and in-depth understanding of the topic outside of class (Item #3, X = 4.12). And overall, 68.7% of students reported that they would like to use chatbots more often in their coursework (Item #2, X = 4.06).

Table 4. The Merlin Chatbot Questionnaire Results for Intention to Use

Intention to Use (IU)				
1.	I would like to learn more with such virtual assistants for my other subjects.	4.25	0.81	84.3
2.	I would like to use virtual learning assistants more often for my coursework.	4.06	0.93	68.7
3.	I believe it is a good idea to use virtual learning assistants for extra knowledge and in depth understanding outside of the class.	4.12	0.75	82.2
4.	I found these assistant learning tools very suitable for online learning environments	4.27	0.75	87.3
Student comments scaffolding and support (Mapped to Mayer's (2001) Pre-Training & Personalization Principles)				
1.	*It's so much more helpful, and you wouldn't have to wait for an answer, if your teacher were to be busy*			
2.	*If I am ever stuck at anything the virtual assistant merlin would be there fast*			
3.	*I feel like this will really help students, especially the shy ones, because sometimes it is scary to go up to a lecturer and ask a question, so a chatbot like Merlin would really help us in studying.*			
4.	*It helps answering question when the lecturer is not free*			
5.	*It helps me a lot providing answers as I am trying to find informations I needed*			
6.	*I got to learn new things that I don't know.*			
7.	*This chatbot will be helpful if I need to study for a quiz and there's no one to ask.*			
8.	*It helps me with things that I don't understand*			
9.	*I can explore more knowledge on my own when class is unavailable*			
10.	*The information given was straight to the point and it helps me clear out all the questions I had about certain topics.*			
11.	*I overall am very keen on the idea of having a virtual assistant such as merlin in the future*			

The survey results in Table 4 above were also well-supported by students' comments. In particular, students commented on the role of the chatbot as an effective learning and scaffolding structure that supports them during the period when they are learning online without the presence of the lecturer, as highlighted in Table 2 below. These comments also show the presence of Mayer's (2001) Pre-Training and Personalization Principles. This meant that students were already familiar with the topic prior to interacting with MERLIN but needed to learn more about it. However, the content that was returned to them was personalised to them as content that was returned to them depending upon the questions posed. Research by Sandu and Gide (2019) has posited that chatbots can be used to provide tutoring assistance to students, which can increase the efficiency of the instruction. As presented in Table 4, student comments showed interesting evidence that chatbots can provide effective scaffolding and learning support to students when learning online without the presence of the lecturer. This result provides good support for the use of chatbots as educational scaffolds, supporting research by Sandu and Gide (2019), and Gaglo, Degboe, Kossingou and Ouya (2021). In addition, by providing the asynchronous support to the students, the chatbot also becomes an important tool to narrow the gap between what students already know and what they need to learn with assistance, supporting Vygotsky's (1978) theory of the Zone of Proximal Development, where learning is enhanced through the help of more experienced tutors. Comments from students such as, "*It's so much more helpful, and you wouldn't have to wait for an answer, if your teacher were to be busy",* and "*This chatbot will be helpful if I need to study for a quiz and there's no one to ask"* show that students are in need of academic support during their asynchronous learning times, and by using a chatbot such as MERLIN was able to provide them with relevant information to their queries. This consequently reduced their search time and any confusion that arose and supported the research by Armstrong (2017) and Belland, Walker, Kim and Lefler (2017).

Overall, based on the results of the TAM questionnaire and supported by student comments, the findings showed that students' readiness to use an AI chatbot in their learning process was positive and well-received. The MERLIN AI chatbot, which was developed on Mayer's (2001) 12 Principles of Multimedia, was successful in creating a positive learning experience for the students in the study. Specifically, the chatbot's Perceived Usefulness construct showed that it was well-received by students as both enjoyable and motivating, and improved their engagement with the course content. The high overall satisfaction reported

by students after using MERLIN indicates that the chatbot was successful in improving learning and student satisfaction and is in line with research by Winkler and Sollner (2018), who posited that chatbots will have a significant positive impact in education. Students also reported positively on the chatbot's Perceived Ease-of-Use (PEOU) construct, showing that the students found the MERLIN AI chatbot to be easy to use and navigate, and well-organised with informative links and visual aids. This is also supportive of Yang and Evan's (2019) research of the incorporation of Natural Language Processing (NLP) features in MERLIN that help simulate conversations between humans, making it more relatable and useful to the learner. By being able to converse easily with MERLIN, students were more amenable to exploring the topic and delving deeper into the content, and is consistent with research by Gaglo, Degboe, Kossingou, and Ouya (2021).

In addition, student feedback and comments were also solicited in the questionnaire to gauge their attitudes towards using MERLIN. Findings from the questionnaire provide very strong evidence that using a chatbot as an instructional tool is conducive to the students' online learning experience. Specifically, results show that the use of chatbots can be useful in several areas: 1) as a scaffold and support to asynchronous online learning, 2) in empowering the student learning process by improving their understanding of the topic and being user-friendly, 3) as an innovative and fun instructional tool, that allowed students to have fun while using a new tool to learn, and 4) in improving the students' engagement in the content. In addition to these categories, these comments also provide evidence of effective mapping of Mayer's (2001) 12 Principles of Multimedia Learning to the design of the chatbot. Combining the data culled from the questionnaire and the open-ended questions show strong and positive support for the use of the MERLIN AI chatbot in their learning process, and for the use of chatbots in general as an effective instructional tool.

Using MERLIN as an Instructional Tool

Overall, the TAM findings in this study showed a high readiness to adapt and use an AI chatbot in the students' online learning process. The positive results of the chatbot's Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) consequently impacted favourably on students' Intention to Use (IU) the chatbot, which were confirmed and supported by their comments and feedback. Students reported positively on the benefits of using a chatbot in online learning, and a desire to use more chatbots in their other subjects, specifically as a scaffold and support to improve their learning and engagement, as well as being innovative and fun to learn with. This is consistent with research by Tsidylo, Samborskiy, Mazur and Zamoroz (2020), who found that students were ready to use chatbots in their courses. These results are also consistent with Georgescu (2018), who stated that chatbots are playing a more active role in delivering pedagogical content and using media-rich assets and text-to-speech features, and with research by Nurshatayeva, White and Gehlbach (2020) who posited that chatbots are effective and useful within student-centred learning environments.

Generally, the findings from the TAM questionnaire and the students' comments supported works in research on using chatbots as an effective instructional tool in the student learning process. It also successfully addressed the issue posed by Kebritchi, Lipschuetz and Santiague (2017) and Li and Lalani (2020) on the challenges in transitioning from conventional learning and physical face-to-face classrooms to the online learning environments. Using the MERLIN AI chatbot in this online learning setting was very positively viewed as a learning tutor beyond the class times, and is consistent with research conducted by Perez, Daradoumis, and Puig (2020). Figure 3 illustrates the learning framework of using the MERLIN AI chatbot as an instructional tool for asynchronous online learning.

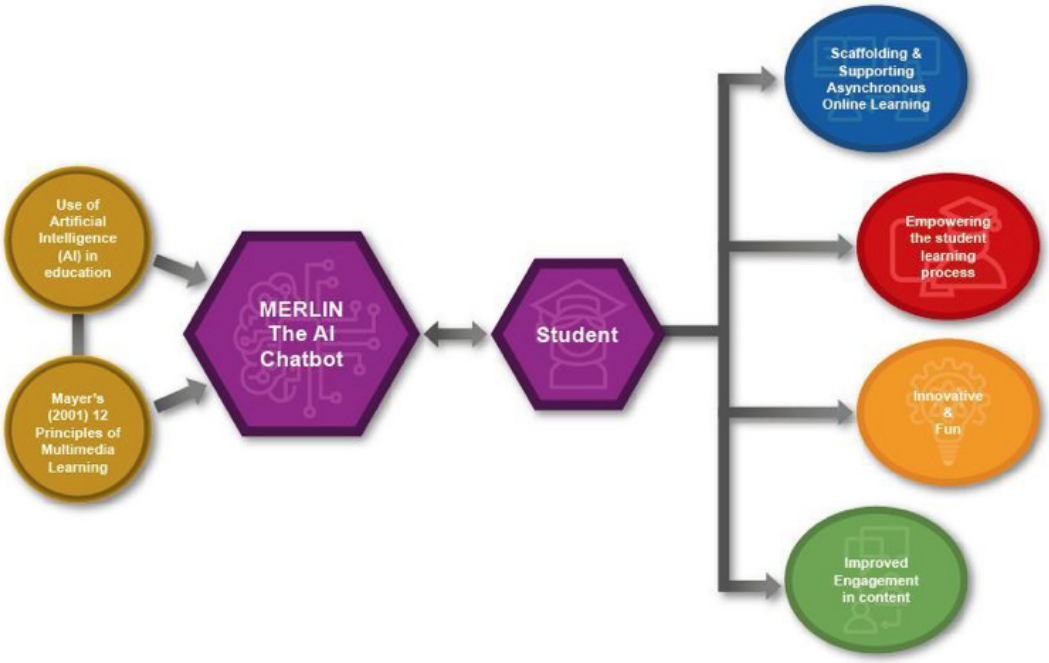

Figure 3. A learning framework of the role of the MERLIN AI Chatbot in the student learning process

As shown in Figure 3, developing the chatbot that was underpinned by Mayer's (2001) 12 Principles of Multimedia Learning and imbued with Artificial Intelligence Natural Language Processing (NLP) features enabled the chatbot to become an effective instructional tool to students. Supported by results of the study, interacting with MERLIN provided 1) Asynchronous online scaffolding and support, 2) Improved student online learning and understanding, was 3) Innovative and Fun for them to learn from, and 4) Increased their level of engagement with the course content. Using AI chatbots in an online learning setting was thus very positively viewed as a learning tutor beyond the class times.

CONCLUSION AND RECOMMENDATIONS

The advent of the COVID 19 pandemic resulted in changing to online learning. Research has shown that online learning is challenging and has limitations in the interactions it provides to students by the teacher. In addition, there was a need to provide some support for students to manage their asynchronous online learning. There is growing evidence that chatbots are playing an important role in education and can provide the pedagogical support needed for asynchronous online learning. As Malaysia was still new to the use of chatbots in the education sector, it was important to study how ready students were towards using AI chatbots as their virtual learning assistant. This project was thus undertaken to address those issues by investigating students' perceptions towards using an AI chatbot as an instructional tool in their learning process, specifically to assess their readiness to accept using an AI chatbot when learning online, and its impact in their learning process. An AI chatbot named MERLIN was designed with Natural Language Processing (NLP) features, to simulate human-like conversations, to return content that was media-rich and instructionally sound.

A questionnaire, adapted from Davis' (1983) Technology Acceptance Model (TAM), was administered to students to investigate their readiness to use chatbots, and to gauge their perceptions of using it when learning online. Findings from the study showed that Mayer's (2001) 12 Multimedia Learning Principles was an effective theoretical framework to underpin the development of the chatbot. The overall findings of positive Perceived Usefulness (PU), Perceived Ease-of-Use and Intention to Use (IU) show strong encouragement that chatbots can be an attractive yet instructionally sound learning tool to support and scaffold students asynchronous online learning. Chatbots can also be an important tool for teachers to utilize and incorporate into their teaching strategies to increase engagement and interactions with students online.

Feedback and comments from students strongly supported the results of the TAM questionnaire. Specifically, MERLIN was effective in 4 areas of the student learning process: 1) It was able to complement the teacher by being a scaffolding tool to the students when they are asynchronously learning online. This helps keep the learning process ongoing as students are not delayed in getting information or feedback, 2) It enabled students to become more active in their learning and the interactions led to a deeper understanding of the course content, 3) It made the learning fun and interesting, and was an innovative way for students to ask questions and obtain feedback immediately, especially when the teacher is not present, 4) It increased the level of engagement and participation, and made the learning experience more immersive. A learning framework was developed to provide educators with some guidance to using chatbots in the classroom to support asynchronous online learning.

There were also practical implications to using chatbots such as MERLIN and some recommendations for its use. In this study, the learning environment created was out of necessity as institutions of higher learning had to transition almost immediately from the conventional physical classroom teaching to fully online, due to the COVID 19 pandemic. However, as global education moves forward post-pandemic, there are more opportunities to continue the online learning process as the new normal, and especially with the support of technology. Based on the results of this study, it is recommended that online learning environments continue to be developed to meet the current needs of student learning, which are that these learning environments be flexible and accessible. In this new normal, more online hybrid learning environments can be created to bridge the gap between face-to-face teaching and full online learning in the following years. Hybrid and flex learning encourages these learning outcomes to be achieved as new technologies are bringing forth more adaptive, versatile and holistic learning affordances within the learning spaces, as forecasted by the Horizon Reports 2019 (Alexander, Ashford-Rowe, Barajas-Murph, Dobbin, Knott, McCormack, Pomerantz, Seilhamer and Weber, 2019), and 2020 (Brown, McCormack, Reeves, Brook, Grajek, Alexander, Bali, Bulger, Dark, Engelbert and Gannon, 2020).

It is also recommended that at the organization level, top management in universities need to provide the appropriate institutional support for the redesigning of learning spaces, imbued with technological infrastructures that support the use of blended and mixed reality technologies. By harnessing the potential of mixed reality technologies that bring more immersion into the learning experience, the study showed that chatbots can provide educators a means to better transition to the online learning environment as the interactions, engagement and understanding of the content is assisted and managed by the chatbot. This can be especially significant when students are not online with the lecturer and provides an alternative solution to the issue posed by Kebritchi, Lipschuetz and Santiague (2017) and Li and Lalani (2020). As such, institutions should begin to prepare campus infrastructures that support the use of emerging technologies such as Artificial Intelligence, Augmented Reality and Virtual Reality, for example, to assist online learning, and build more immersive and experiential learning environments that are more congruous with 21st century learning. This can be in the form of collaborative classrooms where the chatbots can facilitate group discussion and enquiries, or makerspace labs, where students create learning artefacts aided by chatbot tutors.

The study was also successful in creating a new learning system that is innovative, and a new model for online and hybrid learning. Educational institutions who are in the midst of transitioning to hybrid and flex learning can focus their new normal modes of learning towards this direction and build a more learner focused learning environment that is holistic and supportive during non-class times. The 24-hour access to the AI chatbot will allow students continual access to information and feedback, enabling them to focus on and complete their assignments with minimum challenges, and place lesser demands on the teacher to be present online after class times. There is also potential to adapt this learning framework to the learning and development centers of organizations who are looking into pedagogically sound chatbots that provide instructionally sound and media-rich content.

At the faculty level, it is recommended that lecturers prepare to upskill and redesign their learning content and teaching strategies to cope with the challenges and opportunities of teaching online. Moving assertively towards blended learning methods, at the very least, will prepare them for teaching in technology-enhanced online and hybrid learning environments, and be adaptable to any possible situation such as that brought forth by the pandemic. Training and upskilling support should be provided to these educators to afford them the necessary proficiencies and competencies to teach in mixed reality environments, and, as in this study, to

redesign their learning content to be suitable for the AI chatbot environments. In addition, students should also be provided with awareness training programs to prepare them for the newly designed content and delivery in their learning environments. While they may adapt to the use of these technologies faster, as was shown in the study's TAM questionnaire results, some form of orientation should be conducted to acquaint all levels of students with this new model for learning.

In conclusion, there is still much to be researched with regards to the efficiency and effectiveness of AI chatbots in education. But results such as in this study provide very encouraging support towards using chatbots in the classrooms as effective instructional tools in the new normal.

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